13th International Workshop on RF Superconductivity

SRF 2007

Peking University, Beijing, China

October 14 – 19, 2007

ABSTRACTS

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Program Overview (Oct. 14 – 19, 2007)

	Sunday Oct. 14	Monday Oct. 15	Tuesday Oct.16	Wednesday Oct. 17	Thursday Oct. 18	Friday Oct. 19
08:00-08:30		Registration (08:00-08:50)				
08:30-09:00			Basic SRF Topics (08:30-10:30)	Student and Young Researchers Session I (08:30-9:20)	Advances in SRF technology III (08:30-09:30)	Future projects and new ideas I (08:30-10:30)
09:00-09:30		Opening address (09:00-09:30)				
09:30-10:30		Progress Reports I (9:30-10:40)		Student and Young Researchers Session II (9:20-10:20)	Hot Topic I (09:30-10:30)	
10:30-11:00		Coffee Break	Coffee Break			
11:00-12:00		Progress Reports II (11:00-13:00)	Advances in SRF Technology I (11:00-13:00)	Advances in SRF technology II (11:00-13:00)	Hot Topic II (11:00-12:00)	Future projects and new ideas II (11:00-11:45)
12:00-13:00	Registration (09:00- 23:00)				Industrialization on SRF Accelerators (12:00-13:00)	Awards/Closing Ceremony (11:45-13:00)
13:00-14:00		Lunch				
14:00-16:00		Progress Reports III (14:00-15:55)	Poster and Industry Exhibition (14:00-16:00)	Poster and Industry Exhibition (14:00-16:00)		
16:00-16:30		Coffee Break				
16:30-18:30		Progress Reports IV (16:30-18:25)	Poster and Industry Exhibition (16:30-17:00)	Poster and Industry Exhibition (16:30-18:30)	Excursion and Banquet (14:30-20:00)	Lab Tours (14:15-)
18:30-21:00	Welcome reception		Entertainment (17:00-21:30)	IPC Meeting (18:30-21:30)		
21:00-21:30						

Summary of Workshop Program

Oct. 14 (Sunday)

Registration

18:30-21:00 Welcome Reception (*Juhe Restaurant, Friendship Palace of Friendship Hotel*)

Oct. 15 (Monday)

09:00-09:30 Opening Ceremony (*Sunny Hall, Yingjie Exchange Center*)
Chairman: D. Proch (DESY).

Session MO1: Progress Reports I (*Sunny Hall, Yingjie Exchange Center*)
Chairman: H. Padamsee (Cornell University). Each presentation includes 5 minutes for discussion.

09:30-10:00 *The Growth of SRF in China*, Jia-er Chen (IHIP, School of Physics, Peking University)
10:00-10:40 *XFEL: Plans for 100 Cryomodules*, Lutz Lilje (DESY)

10:40-11:00 Coffee Break

Session MO2: Progress Reports II (*Sunny Hall, Yingjie Exchange Center*)
Chairman: C. Pagani (INFN). Each presentation includes 5 minutes for discussion.

11:00-11:30 *SNS Commissioning and Upgrade Plans*, Isidoro Campisi (ORNL/SNS)
11:30-12:00 *Status of the Cornell ERL Injector Cryomodule*, Matthias Liepe (Cornell University)
12:00-12:30 *ERLP and 4GLS at Daresbury,* Peter McIntosh (STFC Daresbury Laboratory)
12:30-13:00 *FLASH Progress Report,* Elmar Vogel (DESY)

13:00-14:00 Lunch

Session MO3: Progress Reports III (*Sunny Hall, Yingjie Exchange Center*)
Chairman: M. Kelley (ANL). Each presentation includes 5 minutes for discussion.

14:00-14:30 *Review of SRF Linac-based FELs*, Jens Knobloch (BESSY)
14:30-15:00 *Superconducting RF in Storage-Ring-Based Light Sources*, Sergey Belomestnykh (Cornell University)
15:00-15:25 *SRF ACTIVITES AT IUAC, NEW DELHI AND OTHER LABORATORIES IN INDIA*, Amit Roy (Inter-University Accelerator Centre)
15:25-15:55 *MSU Re-accelerator - the Reacceleration of Low Energy RIBs at the NSCL*, Xiaoyu Wu (MSU/NSCL)

16:00-16:30 Coffee Break

Session MO4: Progress Reports IV (*Sunny Hall, Yingjie Exchange Center*)

Chairman: C. Antoine (Saclay). Each presentation includes 5 minutes for discussion.

16:30-16:55 *The Spiral 2 Project: Construction Progress and Recent Developments on the SC Linac Driver,* Tomas Junquera (GANIL (CEA-CNRS))

16:55-17:15 *Recent Progress in the Superconducting RF Program at TRIUMF/ISAC*, Robert Laxdal (TRIUMF)

17:15-17:35 *Development of the superconducting CH-cavity and application to proton and ion acceleration*, Holger Podlech (IAP, Frankfurt University)

17:35-18:05 *ALPI QWR and Superconducting RFQ Operating Experience,* Giovanni Bisoffi (INFN – LABORATORI NAZIONALI DI LEGNARO)

18:05-18:25 *Construction and Commissioning of KEKB Superconducting Crab Cavities,* Kenji Hosoyama (KEK High Energy Accelerator Research Organization)

Oct. 16 (Tuesday)

Session TU1: Basic SRF Topics (*Sunny Hall, Yingjie Exchange Center*)

Chairman: P. Kneisel (JLab). Each presentation includes 5 minutes for discussion.

08:30-09:00 *Outstanding Issues in RF Superconductivity: What can Theory Tell Us?* James Sethna (Cornell University)

09:00-09:30 *Review of high field Q slope, cavity measurements*, Gianluigi Ciovati (Jefferson Lab)

09:30-10:00 *Review of high field Q-slope, surface measurement,* Alexander Romanenko (Cornell University)

10:00-10:30 *Dynamics of vortex penetration, jumpwise instabilities, dissipation and nonlinear surface resistance in strong rf fields*, Alex Gurevich (NHMFL, Florida State Univeristy)

10:30-11:00 Coffee Break

Session TU2: Advances in SRF Technology I (*Sunny Hall, Yingjie Exchange Center*)

Chairman: S. Noguchi (KEK). Each presentation includes 5 minutes for discussion.

11:00-11:30 *Advances in Electropolishing / Rinsing and Assembly Techniques to Reduce Field Emission,* John Mammosser (ORNL/SNS) Cancelled

11:30-12:00 *Gradient Yield Improvement Efforts for Single and Multi-Cells AND Progress for very high gradient cavities,* Kenji Saito (KEK)

12:00-12:30 *Prospects for higher Tc superconductors for SRF application,* Xiaoxing Xi (Peking University and Pennsylvania State University)

12:30-13:00 *Review of SRF materials workshop,* Genfa Wu (Fermilab)

13:00-14:00 Lunch

Poster I (***Corridor* and *Press Hall, Yingjie Exchange Center***)

14:00-16:00 Poster and Industry Exhibition

16:00-16:30 Coffee Break

16:30-17:00 Poster and Industry Exhibition

17:00-21:30 Entertainment

Oct. 17 (Wednesday)

Session WE1: Student and Young Researchers Session I - Basic SRF & Thin films

(***Sunny Hall, Yingjie Exchange Center***)

Chairman: V. Palmieri (INFN and Padua Univ). Each presentation includes 2 minutes for discussion.

08:30-08:40 *Temperature Map studies on Nearly Oxide-Free, Thin-Oxide and Standart-Oxide Cavities,* G. Eremeev (Cornell University)

08:40-08:50 *THERMAL DESIGN STUDIES OF NIOBIUM SRF CAVITIES,* Ahmad Aizaz (Michigan State University/NSCL)

08:50-09:00 *R&D on the 3+1/2 cell DC-SC photo-cathode injector,* Wencan Xu (IHIP, School of Physics, Peking University)

09:00-09:10 *Improved Characterization of the Electropolishing of Niobium with Sulfuric and Hydrofluoric Acid Mixtures,* Hui Tian (Virginia Polytechnic Institute & State University)

09:10-09:20 *An investigation of the influence of grain boundaries on flux penetration in high purity large grain niobium for particle accelerators,* ZuHawn Sung (Applied Superconductivity Center, Florida State University)

Session WE2: Student and Young Researchers Session II - SRF Technology – Work on couplers, tuners, LLRF etc. (*Sunny Hall, Yingjie Exchange Center*)

Chairman: J. Knobloch (BESSY). Each presentation includes 2 minutes for discussion.

09:20-09:30 *Microphonics in CW TESLA cavities and their compensation with fast tuners,* Axel Neumann (BESSY GmbH)

09:30-09:40 *Different sputtering configurations for coating 1.5 GHz copper cavities,* Giulia Lanza (University of Rome, Rome, Italy)

09:40-09:50 *The progress at LNL on Nb3Sn and V3Si,* Silvia Deambrosis (INFN-LNL, Padua University)

09:50-10:00 *Application of plasma cleaning to cavity processing,* Niccolò Patron (INFN-LNL)

10:00-10:10 *Electro-Mechanical Properties of Spoke-Loaded Superconducting Cavities,* Zachary Conway (Argonne National Laboratory)

10:10-10:20 *First Test Results of Half-Reentrant Single-Cell Superconducting Cavities,* Mandi Meidlinger (Michigan State University)

10:30-11:00 Coffee Break

Session WE3: Advances in SRF technology II (***Sunny Hall, Yingjie Exchange Center***)

Chairman: T. Grimm (MSU). Each presentation includes 5 minutes for discussion.

11:00-11:20 *Progress in Seamless Cavities,* Waldemar Singer (DESY)

11:20-11:40 *Status of SC Spoke Cavity Development,* Michael Kelly (Argonne National Laboratory)

11:40-12:00 *Review of New Tuner Designs,* Shuichi Noguchi (KEK)

12:00-12:20 *Review of HOM couplers and broadband absorbers,* Nikolay Solyak (Fermi National Accelerator Lab)

12:20-12:40 *Overview of Input Power Coupler Developments, Pulsed and CW,* Sergey Belomestnykh (Cornell University)

12:40-13:00 *Superconducting RF Photoinjectors: an Overview,* Sekutowicz Jacek (DESY)

13:00-14:00 Lunch

Poster II (***Corridor* and *Press Hall, Yingjie Exchange Center***)

14:00-16:00 Poster and Industry Exhibition

16:00-16:30 Coffee Break

16:30-18:30 Poster and Industry Exhibition

18:30-21:30 IPC Meeting (***Meeting Room No.4, Yingjie Exchange Center***)

Oct. 18 (Thursday)

Session TH1: Advances in SRF technology III (***Sunny Hall, Yingjie Exchange Center***)

Chairman: R. Losito (CERN). Each presentation includes 5 minutes for discussion.

08:30-09:00 *Review of the Thin Film Workshop,* Vincenzo Palmieri (INFN and University of Padua)

09:00-09:30 *Progress on Large Grain and Single Grain Niobium – Ingots and Sheet and Review of Progress on Large Grain and Single Grain Niobium Cavities,* Peter Kneisel (Jefferson Lab)

Hot Topic I (***Sunny Hall, Yingjie Exchange Center***)

09:30-10:30 *Is large grain/ single crystal Nb an alternative material to polycristallline niobium?* Hasan Padamsee (Cornell University)

10:30-11:00 Coffee Break

Hot Topic II (***Sunny Hall, Yingjie Exchange Center***)

11:00-12:00 *Is 35 MV/m still a good choice for ILC?* Dieter Proch (DESY)

Session TH2: Industrialization on SRF Accelerators (***Sunny Hall, Yingjie Exchange Center***)
Chairman: K. Saito (KEK). Each presentation includes 5 minutes for discussion

12:00-12:30 *Industrial Study of FLASH Module Production,* B.Petersen (DESY)
12:30-13:00 *Industrialization process for XFEL Power couplers and Volume manufacturing,* W.D. Moeller (DESY)

13:00-14:00 Lunch

14:30-20:00 Excursion & Banquet

Oct. 19 (Friday)

Session FR1: Future projects and new ideas I (***Sunny Hall, Yingjie Exchange Center***)
Chairman: H. Edwards (Fermilab). Each presentation includes 5 minutes for discussion.

08:30-09:00 *BNL - electron cooling and electron-ion colliders,* Ilan Ben-Zvi (Brookhaven National Laboratory)
09:00-09:30 *High average power ERL FEL,* George Neil (Center for Advanced Studies of Accelerators, Jefferson Laboratory)
09:30-10:00 *Future High Intensity Proton Accelerators,* Frank Gerigk (CERN)
10:00-10:30 *CEBAF energy upgrade program including re-work of CEBAF cavities,* Joseph Preble (Jefferson Lab)

10:30-11:00 Coffee Break

Session FR2: Future projects and new ideas II (***Sunny Hall, Yingjie Exchange Center***)
Chairman: I. Ben-zvi (BNL). Each presentation includes 5 minutes for discussion.

11:00-11:45 *ILC: Goals and Progress of SRF R&D,* Hitoshi Hayano (KEK)

11:45-13:00 Awards / Closing Ceremony (***Sunny Hall, Yingjie Exchange Center***)
Chairman: J. Chen (PKU).

13:00-14:00 Lunch

14:15- Lab Tours (Peking University, IHEP)

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the XFEL production

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TUP30: Update on Cavity Preparation for High Gradient Super Conducting multi cell Cavities at DESY

TUP31: Update on EP experiences at DESY and Industrialization of the Electro Polishing Process at DESY

TUP32: Update on Quality Control for the DESY Cavity Preparation

TUP33: Update on the JARI 1 Project Results of Electro-polishing of Multicell Super Conducting Resonators

TUP34: Wake Fields in TESLA Accelerating Structures: Spectral Element Discontinuous Galerkin Simulations

TUP35: Waveguide Damping Study of LOM and HOM on a SC Deflecting Cavity

2. Advance of new technology of SRF

TUP36: A new electropolishing system at ANL for superconducting quarter-wave resonators

TUP37: Cancelled

TUP38: A novel sputtered medium beta cavity for ALPI

TUP39: Basic Research on the 1.3 GHz Superconducting Cavity for the ERL Main Linacs

TUP40: CW Operation of superconducting TESLA cavities

TUP41: Damping of Higher Order Modes in High Gradient SRF Structures

TUP42: DESIGN and ANALYSIS of a MEGAWATT CLASS SUPERCONDUCTING PHOTOINJECTOR CAVITY

TUP43: DESIGN and FABRICATION of a MEGAWATT CLASS SUPERCONDUCTING PHOTOINJECTOR

TUP44: Development and RF Test Results of a new HF and H2SO4 free Electro Polishing Method for Superconducting Niobium Cavities

TUP45: Development of a Digital Self-Excited Loop for Field Control in High-Q Superconducting Cavities

TUP46: Development of Low Beta Superconducting Twin Quarter Wave Resonator

TUP47: Diagnostic Instrumentation for the Fermilab Vertical Cavity Test Facility

TUP48: DRY-ICE CLEANING: THE MOST EFFECTIVE CLEANING PROCESS FOR SRF CAVITIES?

TUP49: ECR plasma for niobium surface processing

TUP50: Effect of 400 C "In-situ" Baking and Subsequent Air Exposures on 1500 MHz Single Cell Superconducting Radiofrequency Cavities

TUP51: Electropolishing of 1-cell and multi-cells Niobium Cavities: COMSOL Modelling

TUP52: FABRICATION OF 1.3 GHZ 9-CELL CAVITY BY HYDROFORMING

TUP53: FABRICATION OF SINGLE CRYSTAL NIOBIUM CAVITIES

TUP54: FIELD TUNING OF THE 9-CELL ICHIRO COPPER CAVITY MODEL

TUP55: Fine Grain and Large Grain Niobium Cavity Prototyping for a Proton Linac

TUP56: First Experiments with a NbZr - based Superconducting Joint

TUP57: First Fermilab Results of SRF Cavity Lorentz Force Detuning Compensation Using a Piezo Tuner

TUP58: First results with the ladder resonator at 4.2 K

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WEP17: Considerations on the third harmonic rf of the European XFEL
WEP18: Cryogenic system for acceptance tests of SRF cavities of BEPCII
WEP19: Cryogenic System for BEPCII Superconducting Cavity
WEP20: Design And Simulation Of Power Couplers For Multiple Power Levels, 325 Mhz Spokes Cavities
WEP21: Electrical axes of TESLA cavities
WEP22: Electron activity detection by inner conductor of XFEL input couplers
WEP23: Fabrication and Test of the 500MHz SC Modules for the BEPCII
WEP24: Field emission from single crystal and large grain Nb cathodes
WEP25: Final Tests and Commissioning of the 400MHz LHC Superconducting Cavities
WEP26: High Power Tests of Input Couplers for Cornell ERL Injector
WEP27: Horizontal Tests for Crab Cavities in KEKB
WEP28: Latest results of ILC 9-cell cavities electropolished and vertical tested at JLAB
WEP29: Status and plans for an ILC accelerator test facility at Fermilab
WEP30: New HOM coupler design for ERL injector at KEK
WEP31: Optimization of the SRF Cavity Design for the CEBAF 12 GeV Upgrade
WEP32: Performance of the CEBAF Prototype Cryomodule Renascence
WEP33: REALISATION OF A PROTOTYPE SUPERCONDUCTING CW CAVITY AND CRYOMODULE FOR ENERGY RECOVERY
WEP34: Research and development of 1.3 GHz low loss cavities made of China large grain at IHEP
WEP35: RF Superconductivity Activities of PEFP
WEP36: Single Crystal Nb, High Current, Large Aperture, Low HOM, 2.85-GHz SRF Cavity
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WEP38: SSRF Superconducting RF System
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WEP42: Status of the ILC Crab Cavity Development
WEP43: Status of the Superconducting RF Photo-Injector Development
WEP44: The commissioning of BEPCII RF system
WEP45: The first processing of capacitive-coupling coupler at room temperature in a cryomodule at STF
WEP46: The manufacture of the SSRF higher harmonic cavity

3. Industrialization of SRF technology

WEP47: BCP SYSTEM FOR THE ANL-FNAL SCSPF
WEP48: DESIGN AND FABRICATION OF SUPERCONDUCTING CAVITIES FOR INDUSTRIALIZATION
WEP49: Flexible Application of the JLab Pansophy Information System for Project Reports, Process Monitoring, and R&D Sample Tracking
WEP50: Input Couplers for KEKB Crab Cavities

WEP51: Some fabrication issues on the spare high power input coupler for BEPCII SCC
WEP52: SRF activities at ACCEL Instruments GmbH

4. Others:

WEP53: 300 MA STORED BEAM IN SOLEIL
WEP54: A Tuner for a Superconducting CH prototype cavity
WEP55: Beam-induced RF modes and RF power in the crab cavity for KEKB
WEP56: Cavity and Linac RF and detuning control simulations
WEP57: Commissioning and Beam Operation of KEKB Crab-RF System
WEP58: Comparison of different tuning systems for TESLA cavties with respect to cw operation
WEP59: Conceptual design considerations of a 5-cell dual-axis SRF cavity for ERL
WEP60: Construction and Processing of the Variable RF Power Couplers for the LHC Superconducting Cavities
WEP61: Design of the magnetic shield for TRASCO low beta elliptical cavities
WEP62: Diagnosis, Analysis, and Resolution of Thermal Stability Issues with HOM Couplers on Prototype CEBAF SRF Cavities
WEP63: Cancelled
WEP64: EFFICIENT FAN-OUT RF POWER DISTRIBUTION ALGORITHM WITH COMPLETE RF VECTOR CONTROL FOR SRF ACCELERATORS
WEP65: Study on the buffered electropolishing Jacquet layers on niobium cavity
WEP66: HIGH PRESSURE RINSING SYSTEM STUDIES
WEP67: Low-Level RF Control of Superconducting Microphonics in Spoke-Loaded Cavities
WEP68: Measurement of transfer function by dynamic Lorentz force detuning
WEP69: MgB2 Thin Films on Nb Cavity by Pulse Laser Deposition
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WEP71: Numerical Simulation of the Electropolishing process
WEP72: Operation Status of the KEKB Superconducting Accelerating Cavity
WEP73: OPERATIONAL EXPERIENCE OF THE DIAMOND SCRF SYSTEM
WEP74: Particle free pump down and venting of UHV vacuum systems
WEP75: Development of a gate valve for operation at temperatures below 10 K
WEP76: Performance of rf amplifiers for ISAC-II medium beta linac operation
WEP77: Reconstruction Of The Field Distribution By Measuring The Fundamental Passband Frequencies Of The Rossendorf SRF-Gun Cavity
WEP78: Research Activities of SRF Cryomodule in IHEP
WEP79: SCATTERING MATRIX CALCULATION OF HIGHER ORDER MODES AND SENSITIVITY TO CAVITY FABRICATION ERRORS FOR ILC SUPERCONDUCTING CAVITIES
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WEP81: Tests Of Air Cooled 1.3 GHz Waveguide Windows Using A RF-Coupler Test Bench Based On A Resonant Ring
WEP82: The Measurements of Static Heat Loss and Unloaded Q0 on the BEPCII SRF Cavities
WEP83: The prototype cryomodule for the EUROTRANS program

Monday, Oct 15, 2007

Monday Morning: Oral Session

Session MO1: Progress Reports I

MO101: The Growth of SRF in China (09:30-10:00)

Jia-er Chen, Kui Zhao (IHIP, School of Phusics, Peking Univesity)

The RF Superconductivity was first explored by Dr. Ding Yu of IHEP in early 1970's on an X-band cavity. Unfortunately the research was stopped for about 10 years after Dr. Ding passed away, until the first SRF laboratory was founded at Peking University by the end of 1980's. The early efforts of PKU SRF group on the design and fabrication of L-band high beta cavities using China-made niobium sheets as well as on developing Nb-Cu sputtering technology to construct SRF QWR as a post accelerator after Tandem are described. The "SRF accelerator based FEL light source" project, which was proposed by PKU SRF group and joined by IHEP & SIAP, was formally approved by MOST in 2003 as a national key project of basic research. A series of work around the project carried out at PKU, including the construction and feasibility test of the DC-SC photo-injector, the development of single and multi-cell cavities of large grain Nb are presented. Progresses of IHEP SRF group in developing SRF infrastructures and two 500Hz single-cell cavities on the ring of BEPCII as well as studies on 1.3 GHz & 700 MHz single cell cavities for proton acceleration are reported. Efforts made at CIAE on fabricating 150 MHz low beta Nb-Cu SRF QWR for post acceleration and R&D activities for developing SRF technology at SIAP are also presented. A growing phase of SRF in China is emerging.

MO102: XFEL: Plans for 100 Cryomodules (10:00-10:40)

Lutz Lilje (DESY)

The XFEL project will use 100 accelerator modules in its electron linac. A review of the design is being given as well as the most recent test results at the module test stand and at the FLASH accelerator. The fabrication and preparation of the superconducting cavities will be done in industry. The current plans for the acceptance testing of the cavities and the final test of the completed modules will be discussed.

Session MO2: Progress Reports II

MO201: SNS Commissioning and Upgrade Plans* (11:00-11:30)

Isidoro Campisi (ORNL/SNS)

At the last SRF Workshop it was reported that the superconducting linac at the Spallation Neutron Source had been recently installed and the 10 Hz, 4.5 K testing of the superconducting cavities was being completed. Since then, great progress has been achieved in commissioning the first fully functional pulsed superconducting linac: in August 2005 beam was first accelerated through the linac, up to 950 MeV. During the ensuing two years a great deal of experience has been gathered on the strength and weaknesses of components and systems, while operating the linac at both 4.5 and 2.1 K; at repetition rates from 10 Hz to full design 60 Hz; at energies up to 1.012 GeV and recently at a beam power level of 185 kW. Details of the operating parameters, conditions and of the lessons learned will be given, together with the status of the facilities being readied and the SRF module improvements being executed. The SNS Power Upgrade Project is under planning: the initial phases of the Project will include the beam energy upgrade to 1.3 GeV, to be reached with the addition of nine high beta (.81) SRF modules at the end of the present linac. These plans will allow better usage of the beam for increased beam power and will provide operational flexibility as the power will be ramped up to values higher than the present design level of 1.4 MW.

* SNS is managed by UT-Battelle, LLC, under contract DE-AC05-00OR22725 for the U.S. Department of Energy

MO202: Status of the Cornell ERL Injector Cryomodule* (11:30-12:00)

Matthias Liepe, Sergey Belomestnykh, Eric Chojnacki, Valeri Medjidzade, Hasan Padamsee, Peter Quigley, James Sears, Valery Shemelin, Vadim Veshcherevich (Cornell University)

Cornell University is developing and fabricating a SRF injector cryomodule for the acceleration of the high current (100 mA) beam in the Cornell ERL prototype and ERL light source. Major challenges include emittance preservation of the low energy, ultra low emittance beam, cw cavity operation, and strong HOM damping with efficient HOM power extraction. Axial symmetry of HOM absorbers, together with two symmetrically placed input couplers per cavity, avoid transverse on-axis fields, which would cause emittance growth. Fabrication of five 2-cell niobium cavities and coaxial blade tuners, ten twin high power input couplers, and six beam line HOM absorbers has finished. The injector cryomodule is presently under assembly at Cornell University with beam test planned for early 2008. In this paper we report on the cryomodule fabrication and assembly status.

* Work supported by NSF.

MO203: ERLP and 4GLS at Daresbury (12:00-12:30)

Peter McIntosh (STFC Daresbury Laboratory)

As part of the UK R&D programme to develop an advanced energy recovery linac (ERL) based light source (4GLS), a 35 MeV technology demonstrator called the Energy Recovery Linac Prototype (ERLP) has been constructed at Daresbury Laboratory. It is based on a combination of a DC photocathode electron gun, a Superconducting RF (SRF) injector linac and main linac operating in energy recovery mode, driving an IR-FEL. The priorities for this machine are to gain experience of operating a photoinjector gun and SRF linacs; to produce and maintain high-brightness electron beams; to achieve energy recovery from an FEL-disrupted beam and to study challenging synchronisation issues. The experience gained from this demonstrator will facilitate the more expansive 4GLS facility which will combine ERL and free electron laser (FEL) technologies to deliver a suite of naturally synchronised state-of-the-art sources of synchrotron radiation and FEL radiation covering the terahertz (THz) to soft X-ray regimes. CW-mode operation at high acceleration gradients will be needed for the various 4GLS accelerator systems and here is where SRF cavities excel. This review details the ERLP facility and highlights its present status, whilst also outlining the principal RF features and requirements of the 4GLS accelerator design; including the R&D currently being performed to develop a cryomodule that would facilitate ERL operation on 4GLS.

MO204: FLASH Progress Report (12:30-13:00)

Elmar Vogel (DESY)

The free electron laser in Hamburg (FLASH) is a user facility providing high brilliant laser light for experiments in the VUV and EUV wavelengths range. It is based on TESLA type superconducting accelerating structures and therefore a unique facility for testing superconducting accelerator technology for the European XFEL and for supporting the international linear collider (ILC) R&D effort. The presentation will review the progress on superconducting rf technology in view of cavity and accelerating module performance and report about the operational experience gained with FLASH operated as a user facility.

Monday Afternoon: Oral Session

Session MO3: Progress Reports III

MO301: Review of SRF Linac-based FELs (14:00-14:30)

Jens Knobloch (BESSY)

In the last two decades the reliability of superconducting RF has been amply demonstrated in many machines. Initially this was primarily in the domain of particle, nuclear and ion physics (KEK, HERA, LEP, CEBAF, ALPI etc).However the expansion into the light-source regime is now fully underway,including 3rd generation storage rings such as Diamond, Soleil and the Taiwan Light Source. Not surprising, more recent 4th generation linac-based light sources (FELs) are also turning to SRF for the driver linac. Existing machines include the JLab FEL, ELBE, and the JAEA-FEL with many new ones being planned (e.g., BESSY FEL, Wisconsin FEL, 4GLS, Arc-en-Ciel). This report provides an overview of a few of these superconducting FELs and discusses some of the challenges and resulting solutions for the linac technology.

MO302: Superconducting RF in Storage-Ring-Based Light Sources (14:30-15:00)

Sergey Belomestnykh (Laboratory for Elementary-Particle Physics, Cornell University, Ithaca, NY 14853)

Third generation synchrotron light sources are small storage rings operating in the energy range of 1.5 to 3.5 GeV. These machines require relatively low total accelerating voltage and high RF power to compensate particle beam energy losses to X-rays. Strong damping of Higher-Order Modes (HOMs) is also necessary for stable operation of a high-current multi-bunch beam. Superconducting HOM-damped single-cell cavities are ideal for such applications. Their ability to transfer almost all RF power to the beam and to operate at high accelerating gap voltages reduces the number of installed cavities thus improving overall efficiency of the RF systems. In the past many laboratories were reluctant to use superconducting RF (SRF) technology as it was considered more complex than conventional copper accelerating structures. Proliferation of superconducting insertion devices made having a cryogenic plant the necessity for every contemporary light source thus providing infrastructure for SRF as well. With the successful and reliable operation of HOM-damped cavities at CESR and KEKB, technological developments at CERN and other laboratories and the technology transfer to industry, SRF has become the readily available technology of choice for new and small labs with no prior experience in the field. In this paper we will describe the use of superconducting cavities in fundamental RF systems and as passive structures for bunch lengthening. Operating experience and recent achievements from light sources around the world will be discussed.

MO303: SRF ACTIVITES AT IUAC, NEW DELHI AND OTHER LABORATORIES IN INDIA (15:00-15:25)

Amit Roy (Inter-University Accelerator Centre)

Superconducting RF activities in India has been connected with the heavy ion booster linac projects at IUAC, New Delhi and TIFR, Mumbai. The accelerating structure for IUAC linac is a Nb QWR cavity operating at 97 MHz and optimised for beta = 0.08, whereas that for TIFR it is a Pb plated Cu QWR operating at 150 MHz, optimised for beta = 0.1. At IUAC, one module with eight cavities have been operated for beam acceleration and several problems faced with the drive coupler, slow tuner have been sorted out. A very novel method was found to reduce the microphonic noise in the cavity, which reduced the power required to amplitude and phase lock the cavities. Fields of the resonators obtained in the linac cryostat are in the range of 3 –5 MV/m at 6 watts of dissipated power at critically coupled condition of the power coupler. Fabrication of 15 more resonators for the next two modules is progressing according to schedule in the in-house resonator fabrication facility. In addition to the resonator production, several ANL built resonators have been repaired. It is also planned to design, develop and prototype a suitable low beta resonator around beta= 0.045 for the high current injector. IUAC has also agreed to build two beta= 0.22, 325 MHz Single Spoke Resonators for the proton driver linac project of Fermi National Lab (FNL), USA. The resonators will be built at IUAC, although the final processing and testing will be carried out at FNL. At TIFR, recently there was a successful run of the linac with 23 out of 28 cavities tuned to the required frequency for acceleration of ion beams from the Pelletron. The status of these projects and other SRF related activities in India will be reported.

MO304: MSU Re-accelerator - the Reacceleration of Low Energy RIBs at the NSCL (15:25-15:55)

Xiaoyu Wu, Georg Bollen, Marc Doleans, Terry Grimm, Felix Marti, Stefan Schwarz, Richard York, Qiang Zhao (MSU/NSCL)

The Coupled Cyclotron Facility (CCF) at the National Superconducting Cyclotron Laboratory (NSCL) has been used to produce the Rare Isotope Beams (RIBs) by the in-flight particle fragmentation method for nuclear physics research since 2001. To provide new opportunities for an experimental program ranging from low-energy Coulomb excitation to transfer reaction studies of astrophysical reactions, a novel system is proposed at the NSCL to first stop the high energy RIBs in a helium filled gas system followed by a Electron Beam Ion Trap (EBIT) charge breeder on a high voltage platform to increase its charge state, and finally reaccelerated to about 3 MeV/u by an accelerator system consisting of an external multi-harmonic buncher and a radio frequency quadrupole (RFQ) followed by a superconducting linac. The superconducting linac will use quarter-wave resonators with bopt of 0.041 and 0.085 for acceleration and superconducting solenoid magnets for transverse focusing. A possible upgrade option to achieve a beam energy up ~12 MeV/u with additional accelerating cryomodules is also evaluated. The paper will discuss the accelerator system design and beam dynamics simulations for the MSU Re-accelerator project.

Session MO4: Progress Reports IV

MO401: The Spiral 2 Project: Construction Progress and Recent Developments on the SC Linac Driver (16:30-16:55)

Tomas Junquera (GANIL (CEA-CNRS))

The construction of the new Spiral 2 facility has started in Caen (France) at the National Heavy Ions Accelerator Center (GANIL). The SPIRAL 2 project is based on a multi-beam Superconducting Linac Driver delivering 5 mA deuterons up to 40 MeV and 1 mA heavy ions up to 14.5 MeV/u. Different Radioactive Ion Beams (RIB) production methods are foreseen: 1) by fission process (up to 1014fissions/s, induced in an UCx target by fast neutrons from a C converter bombarded by deuterons), 2) by fusion-evaporation residues or transfer products, using p, D, 3,4He and heavy ions beams in different targets. The high intensity beams delivered by the Superconducting LINAC Driver, will also open new perspectives for super-heavy and very-heavy nuclei synthesis and spectroscopy. In addition to fundamental research in nuclear physics, the SPIRAL 2 facility will be also a high performance multidisciplinary tool for many other areas of science and technology: nuclear energy, material sciences, atomic physics and biology. After a detailed design study phase (2003-2004), the Spiral 2 project at GANIL was officially approved in May 2005. The project group for the construction was launched in July 2005, with the participation of French laboratories (CEA, CNRS) and international partners. The status of the construction of Spiral 2 will be presented covering the SC Linac Driver, the RIB production systems, buildings and safety aspects, with a special mention to the recent developments on QWR and cryomodules systems.

MO402: Recent Progress in the Superconducting RF Program at TRIUMF/ISAC (16:55-17:15)

Robert Laxdal, Ken Fong, Michael Laverty, Amiya Mitra, Qiwen Zheng, Vladimir Zvyagintsev (TRIUMF)

The first phase of the ISAC-II superconducting accelerator has recently been commissioned. The heavy ion linac adds 20MV to the 1.5MeV/u beam injected from the ISAC post accelerator. The linac is composed of five cryomodules; each cryomodule housing four 106 MHz quarter wave resonators (Beta0=0.057, 0.071) and one 9T superconducting solenoid all operating at 4K. On-line performance has confirmed cw cavity operation at a peak surface field in excess of 35MV/m. Performance after one year of operation and a full thermal cycle during the annual shutdown shows very little degradation in performance. The second phase of the program will see the installation of a further 20MV of 141MHz quarter wave cavities with Beta0=0.11. Two prototypes of the cavities are now in production. The mechanical drive for the coupling loop of the Phase I cavities is now being modified to improve the motion as part of the Phase II hardware development. TRIUMF is proposing to build a 50MeV electron driver as part of the next five year plan. Consequently plans are now underway to upgrade the SRF lab to support development at 1.3GHz. The report will summarize all aspects of the program.

MO403: Development of the superconducting CH-cavity and application to proton and ion acceleration (17:15-17:35)

Holger Podlech, Alexander Bechtold, Horst Klein, Ulrich Ratzinger, Holger Liebermann (IAP, Frankfurt University)

The CH-structure is a new drift tube structure operated in the H21-mode. The superconducting CH-structure is the first multi-cell cavity in the low and medium energy regime for the acceleration of protons and ions. A superconducting CH-prototype cavity for a beta of 0.1 and with 19 gaps has been developed and tested successfully. The development and the latest test results are presented. This cavity is an interesting candidate for proton and ion driver accelerators with high duty cycles. Several projects which consider the superconducting CH-structure will be presented.

MO404: ALPI QWR and Superconducting RFQ Operating Experience (17:35-18:05)

Giovanni Bisoffi (INFN – LABORATORI NAZIONALI DI LEGNARO)

In 2006 the new positive injector PIAVE, based on superconducting RFQs, became operational and made several new ion species available to ALPI, the LNL heavy ion superconducting linac which was previously injected only by a 15 MV XTU Tandem. The two Superconducting SRFQ cavities of PIAVE were working smoothly, even though their conditioning procedure requires particular attention. At the same time the commissioning of the ALPI cryogenic lines, which was performed to allow the refrigeration of the low beta ALPI section, was completed. For the first time the 12 lower beta resonators (full Nb, 80 MHz frequency) could be operated at the design average field of 3 MV/m, while the remaining ALPI Nb/Cu resonators could be operated at the design refrigerator power of 7 W. ALPI is hence providing, at present, an equivalent voltage of further 45 MV to ion species delivered by either PIAVE or XTU-Tandem injector. Concerning Nb/Cu sputtered QWRs, most of which are obtained by recovered Pb/Cu substrates, their average operational acceleration field is 4.5 MV/m and limited by the available cryogenic power per resonator (7 W). A higher average field can be obtained by replacing a few substrates and resputtering of some others. The operational performance of ALPI full Nb resonators is instead limited by microphonic noise which make it difficult to keep them steadily locked at an average accelerating filed exceeding 3MV/m. The acquisition of new more powerful amplifiers and the upgrading of the cryostat rf feeding lines is expected to raise the operational field beyond 5.5 MV/m. Similar full Nb resonators can presently operate in PIAVE, the cryogenic system of which is more stable, at a higher field (up to 4 MV/m).

MO405: Construction and Commissioning of KEKB Superconducting Crab Cavities (18:05-18:25)

Kenji Hosoyama, Kazufumi Hara, Teruya Honma, Atsushi Kabe, Yuuji Kojima, Yoshiyuki Morita, Hirotaka Nakai, Kota Nakanishi, Kazunori Akai, Kiyokazu Ebihara, Takaaki Furuya, Shinji Mitsunobu, Masaaki Ono, Yasuchika Yamamoto (KEK High Energy Accelerator Research Organization), Katsuya Sennyu, Hiroshi Hara, Takeshi Yanagisawa, Koichi Okubo (MHI Kobe), Takayuki Kanekiyo (HITACHI Co. LTD)

The electron positron collider KEKB is now under operation at KEK in the highest luminosity in the world. In the KEKB ring electron and positron beam bunches cross at an angle of 1.3 degrees. In this crossing scheme non-overlapping of the beam bunches at collision point causes beam instability and limit the luminosity. By using the strong time-depending electromagnetic RF field in the superconducting crab cavity, head and tail of bunches is kicked opposite directions with no kick at the center and the bunches wiggle around in the ring. Complete overlapping of the electron and positron bunches at colliding point can be attained by installation of the two superconducting RF crab cavities, one in electron ring the other in positron ring. In KEKB crab cavity design, the magnetic field of the TM110 mode with the resonance frequency of 509MHz is used to kick the beam bunch horizontally. We have adopted non-axially symmetric crab cavity so called squashed-cell shape cavity which has racetrack shape cross section to push up the resonance frequency of the unwanted degenerate TM110 mode. Mechanical designing and fabrication of the crab cavity are difficult due to large in size and non-axially symmetric in shape. And the structure of the cryostat is complicated by a coaxial coupler which must be inserted to the cavity cell part to take the unwanted TM010 acceleration mode and higher TE modes outside the cavity. Design study of the crab cavity and fabrication of a prototype model were made by K. Akai under collaboration between the KEK and Cornell laboratories around 1992. R&D study of crab cavity has been started in 1995 at KEK. After 1/3 scale 1.5 GHz model cavities, two full size 500 MHz cavities were fabricated and cold tested. The surface peak electric field Esp of these cavities could exceeded the design value of Esp = 21 MV/m and reached to 38 MV/m with Q0 values is higher than 109. Installation of the two crab cavities into KEKB was decided in 2004 and then the fabrication started. In parallel with it designing and fabrication of the horizontal cryostats were started. After assembling of the crab cavities into the horizontal cryostats, the high power test were carried out at test stand in the end of 2006. The crab cavities were installed into KEKB in January 2007. Commissioning of the crab cavities started in February 2007 and continued until the end of June. Effective head-on collision of electron and positron has been achieved successfully for the first time during spring operation period of the KEKB. A luminosity of above 1034/cm2/sec could be obtained at high beam currents operation (1300mA in the low energy positron and 700mA high energy electron). The results of the first commissioning of the crab cavities show the potential of the crab cavities. The crab cavities will be used for high luminosity machines including with a crossing angle, Super KEKB, International Linear Collider ILC, upgrading of the Large Hadron Collider LHC as well as synchrotron light source for short pulse.

Tuesday, Oct 16, 2007

Tuesday Morning: Oral Session

Session TU1: Basic SRF Topics

TU101: Outstanding Issues in RF Superconductivity: What can Theory Tell Us? (08:30-09:00)

James Sethna (Cornell University)

We are embarking upon a theoretical investigation of the predicted behavior of ideal, clean superconducting surfaces exposed to large, slowly varying magnetic fields – e.g. the niobium surface of a superconducting RF cavity. The peak operating fields of these cavities already exceed Hc1, and yet vortex penetration is not observed; theoretically we must study the metastable state between Hc1 and the instability threshold Hsh at which spontaneous nucleation of vortices at the surface becomes energetically favorable. The operating temperatures are not near Tc, and hence Ginzburg-Landau theory is not a controlled approximation; to get quantitative understanding of the superheating field, we must apply Gorkov theory or perhaps the Eilenberger equations. ('Line nucleation' formulas Hsh = Hc/kappa, which have discouraged the exploration of high kappa materials, have no theoretical basis.) We will report here on initial investigations using Ginzburg-Landau theory to test and validate numerical schemes for extracting the instability threshold for superconducting layers near Tc, and then sketch plans for applying these techniques to the full Eilenberger equations. We will conclude with speculations about the effects of microscopic and mesoscopic disorder.

TU102: Review of high field Q slope, cavity measurements (09:00-09:30)

Gianluigi Ciovati (Jefferson Lab)

One of the most interesting phenomenon occurring in superconducting radio-frequency (SRF) cavities made of bulk niobium is represented by a sharp decrease of the quality factor above peak surface magnetic field of about 90 mT and is referred to as "high field Q-slope" or "Q-drop". This phenomenon was observed first in 1997 and since then some effort was devoted to the understanding of the causes behind it. Still, no clear physical interpretation of the Q-drop has emerged, despite several attempts. In this contribution, I will review the experimental results for various cavities measured in many laboratories and I will try to identify common features and differences related to the Q-drop.

TU103: Review of high field Q-slope, surface measurement (09:30-10:00)

Alexander Romanenko (Cornell University)

High field Q-slope remains one the main physics problems in the field of niobium RF superconductivity, which needs to be addressed. Mild temperature baking at 100-120C was empirically found to improve or completely remove the high field Q-slope in niobium cavities. One of the approaches to the problem is to utilize surface analytical techniques such as XPS, SIMS, 3DAP etc. in order to look for mechanisms underlying baking improvement and clues for the high field Q-slope cause. In this talk current results of surface studies will be reviewed and their implications will be discussed.

TU104: Dynamics of vortex penetration, jumpwise instabilities, dissipation and nonlinear surface resistance in strong rf fields (10:00-10:30)

Alex Gurevich (NHMFL, Florida State Univeristy), Gianluigi Ciovati (JLab)

Penetration and exit of a vortex in a superconductor under strong rf magnetic field B(t), the field and frequency dependences of the dissipated power, and the transient time scales of vortex dynamics are discussed. Vortices breaking through the oscillating surface barrier are driven by extremely high Meissner currents of the order of the depairing current density. As a result, the vortex penetrates a superconductor at supersonic velocities v = 1-10 km/s, then it turns around and annihilates with an incoming antivortex. The decrease of the vortex viscous drag coefficient g(v) at higher velocities v(t) results in a jump-wise vortex penetration and a significant increase of the dissipated power. The effect of dissipation on nonlinear vortex viscosity g(v) and the rf vortex dynamics is quite significant, resulting in jump-wise instabilities, and thermal localization of penetrating vortex channels. We calculate the temperature distribution around a penetrating vortex taking into account retardation of temperature field around rapidly accelerating vortex, and its long-range interaction with the surface. We also address the effect of pinning on the nonlinear rf vortex dynamics and the effect of trapped magnetic flux on the surface resistance Rs which is calculated as a function or rf frequency and field. It is shown that trapped flux can result in a temperature-independent residual resistance Ri at low T, and its hysteretic low-field dependence, so that the residual resistance can decrease as B is increased, reaching a minimum at B much smaller than the thermodynamic critical field. Trapped vortices result in hotspots, which can ignite the global thermal breakdown of the cavity. We propose that slow cycling of rf field can reduce the residual resistance due to rf annealing of magnetic flux, which is pumped out of the cavity by rf field.

Session TU2: Advances in SRF Technology I

TU201: Advances in Electropolishing / Rinsing and Assembly Techniques to Reduce Field Emission (11:00-11:30) Cancelled

John Mammosser (ORNL/SNS)

The International Linear Collider (ILC) has chosen electropolishing as its baseline niobium cavity processing method. There is now clear evidence that applying electropolishing to the niobium cavities has produced the highest Superconducting RF cavity gradients world wide. The remaining problem with electropolish is that applying it has produced a wider spread in accelerating gradient performance with low reproducibility. This increase in performance spread is mainly due to surface contamination which leads to field emission during operation. At Jefferson Laboratory, additional steps were taken to address the sources of surface contamination after electropolishing and have produced exceptional results. The methodology used and the results from implementing these steps will be presented and discussed along with various monitoring techniques.

TU202: Gradient Yield Improvement Efforts for Single and Multi-Cells AND Progress for very high gradient cavities (11:30-12:00)

Kenji Saito (KEK)

(Abstract not submitted)

TU203: Prospects for higher Tc superconductors for SRF application (12:00-12:30)

Xiaoxing Xi (Peking University and Pennsylvania State University)

As the Nb cavity performance has reached close to its theoretical limit, higher Tc superconductors have been investigated for achieving SRF performance beyond Nb. In this talk, I will discuss the prospects of various materials for SRF applications, including Nb compounds, A15 compounds, high Tc superconductors, and MgB2. The high Tc and low resistivity of MgB2 make it particularly attractive as an SRF material, promising low BCS surface resistance and high critical field. Deposition technology is also available for coating the cavities. There are reasons to be optimistic about the prospect of MgB2 for SRF cavities.

TU204: Review of SRF materials workshop (12:30-13:00)

Genfa Wu (Fermilab)

The performance of niobium cavities has approached the theoretical hard limit. Yet the consistent achievement of high performing cavities remains the greatest challenge. To further understand the basic materials science, a workshop was held at Fermilab in May 2007 to present and discuss the fundamental and experimental limitations, and propose new ideas. In this paper, we will review the results and ideas presented to the workshop and advocate a nationally coordinated and comprehensive materials studies to push the current state of art of SRF material science.

Tuesday Afternoon: Poster Session (14:00-17:00)

1. Fundamental topics for RF superconductivity

TUP01: A coaxial TE011 cavity and a system to measure DC and RF properties of superconductors

Gianluigi Ciovati, Peter Kneisel, Michael Morrone, Bill Clemens, Larry Turlington, Richard Bundy, Gary Slack, Ganapati Rao Myneni (Jefferson Lab), Jayanta Mondal (BARC)

A coaxial niobium cavity has been designed and built where the center conductor consists of a removable sample. In addition, a system to measure properties such as magnetization, penetration depth, critical temperature and thermal conductivity on the same cylindrical sample has been designed and built. The purpose of this effort is to investigate possible correlations between DC and RF properties of superconductors. In this contribution, the design of the various components is discussed and the test results on a niobium sample obtained so far are presented.

TUP02: A Database for Superconducting Cavities

Paul-Dieter Gall, Andre Goessel, Vladimir Gubarev, Jens Iversen (DESY)

We look back on more than 10 years experience using a database for superconducting cavities. Originally the database was developed for a cavity R&D program in order to optimize the cavity preparation techniques to get high and reproducible accelerating gradients at high quality factors. Presently the database takes over more and more an effective part of the quality control system for the whole cavity production and preparation process for FLASH and XFEL on a very detailed level. Currently we try to find out the most effective and safe way to get the production data from the different companies to the database and to control the quality of the cavity production from the Niobium sheets to the complete modules in the linac.

TUP03: Comparative surface studies between the regions of strong and weak Q-slope in BCP and EP cavities

Alexander Romanenko (Cornell University)

High field Q-slope in niobium superconducting cavities remains one of the major physics questions in RF superconductivity. Previous studies on niobium samples prepared in the same way as cavities did not give any clear tips on what is the cause of the effect and on the positive response of the high field Q-slope to baking at 100-120C for 48 hours. In this contribution we report first surface studies results on samples dissected from the strong and weak Q-slope regions of BCP niobium cavity, which were identified using the temperature mapping system during the cavity test. Similar studies on EP cavities are now in progress and results should be available for the workshop.

TUP04: Cryogenic System for the KEKB Crab Cavities

Hirotaka Nakai, Kazufumi Hara, Teruya Honma, Kenji Hosoyama, Atsushi Kabe, Yuuji Kojima, Yoshiyuki Morita, Kota Nakanishi (KEK), Takayuki Kanekiyo (HITACHI Co. LTD), Takeshi Yanagisawa (MHI Kobe)

The crab cavities are successfully installed in the KEKB and operated with the stable operation of the large helium refrigerator for the KEKB. The cryogenic system and the cryostats for the KEKB crab cavities are introduced, especially emphasizing the unique structure of the cryostat for the crab cavities. Calorimetric measurements on the Q-factors of the crab cavities and static loss measurements of the crab cavity cryostats are also described and their results are discussed in this presentation.

TUP05: Crystal orientation effects during fabrication of single or multi-crystal Nb SRF cavities

Christopher Compton, Derek Baars, Tom Bieler, Terry Grimm (Michigan State University)

Manufacturing superconducting radio frequency (SRF) cavities from single crystal niobium is being investigated as an alternative to polycrystalline niobium for several reasons: 1) single crystal sheets may be cut directly from the purified ingot, eliminating the cost of rolling into polycrystalline sheet, 2) polycrystalline sheet texture varies among manufactures and even between batches, leading to variability in forming and surface finish, 3) a single crystal cavity has already been tested and matches the capability of polycrystalline cavities. However, knowledge about the effects of different crystal orientations on dislocation density, surface quality, and recrystallization after plastic deformation and e-beam welding are needed. These issues are evaluated at conditions similar to those anticipated for typical cavity assembly, such as plastic forming operations, chemical etches, and welding.

TUP06: CW SRF Cavity Requirements and Challenges for Light Source ERLs

Alireza Nassiri (Argonne National Laboratory)

Superconducting rf (SRF) is the technology of choice for future energy-recovery linac (ERL)-based light source facilities. ERL-based light sources are required to run in a continuous wave (cw) mode as compared to the ILC, which requires a moderate repetition rate. The difference in the two operating modes (low duty factor and CW) will necessitate a fresher look at the SRF parameter space specifically suited for light source ERLs. There are still open questions regarding the choice of rf frequencies, cryomodule design, cavity cells design and number of cells, Q factor, accelerating gradient, and higher-order-mode damping. In addition, the cryoplant for such facilities will need to be designed to handle on the order of tens of kW of cooling at 2°K. The existing cryoplants cannot provide a level of efficiency to make it cost effective to operate such facilities. Therefore, consolidated R&D efforts are needed to find a more robust solution to improve the overall refrigeration efficiency. An overview of the ERL-specific rf parameters and a review of CW cryomodule designs will be presented.

TUP07: Frequency Test and Length Adjusting of Dumb-Bell Used to Fabricate PEFP Low β Cavity

Changyi Gao (Korea University of Science & Technology)

This paper describes a way to test frequency and adjust length of a dumb-bell used to fabricate PEFP low β cavity. Frequency of dumb-bell is tested by shorting it at its 2 end sections with 2 aluminum disks. 2 antennas respectively sited at the center of each disk are connected to a network analyzer. A small metal cylinder tip (30 mm long, 4 mm diameter) is inserted through a hole at the center of the top disk to perturb the field in the upper half cell. The frequency change from tip-perturbing of 0 mode and π mode is tested by a network analyzer. The measured frequency data are evaluated by a tuning program. The output file of the program gives the frequency of the π mode of each half cell, which indicates how symmetric the two half cells are. The half cell with a high frequency shift due to tip-perturbing has a higher π mode frequency. Next, frequencies of 0 mode and π mode of the dumb bell are tested in the same way by shorting it with one grooved upper disk (which removes a volume inside the equator of the upper half cell) and one flat surface disk. From the ratio of the π mode frequency shift with removing the volume to that without removing the volume, and the groove depth, we can obtain a coefficient that indicate the frequency sensitivity due to shortening the dumb-bell. From the frequency difference between the two half cells and length sensitivity coefficient, we can determine how long to cut at the equator of the lower frequency half cell to make the two half cells have same frequency. In order to compensate the dumbbell length due to stiffening-ring-welding shrinkage, A setup for stretching a dumb-bell was designed.

TUP08: Gradient limits and SCRF performance

Jim Norem, Mike Pellin (Argonne), Jerry Moore (Massthink)

Superconducting rf is limited by a wide range of mechanisms, among them are field emission, multipactor, Lorentz detuning, global and local heating, quench fields, Q-Slope, assembly defects, and overall power use. We describe how each of these mechanisms interacts with the cavity fields and show how significant improvements may be possible assuming improvements in control over the cavity surface. New techniques such as Atomic Layer Deposition (ALD), the use of layered composites, Gas Cluster Ion Beam (GCIB) smoothing and Dry Ice Cleaning (DIC) have been proposed as ways to control the surface.

TUP9: High Power conditioning of the Input Coupler for BEPCII Superconductor Cavity

Huang Tongming (IHEP)

High power conditioning and RF processing of the input coupler for BEPCII superconductor cavity (SCC) has been performed. Gas desorption is very important for a new input coupler, high power conditioning and electron bombardment is quite effective to outgas. For this reason, the DC bias voltage is applied to the conductors of coupler in the room temperature conditioning. RF power with full reflection of 150kW has been arrived under±2000V DC bias voltage during the room temperature. A series of methods have also been studied to improve the performance of input coupler during the beam operation. Up to now, the input coupler can work well when the beam current is 250mA and beam energy is 2.5Gev, which means the input coupler can feed 100kW RF power in continuous wave mode under beam operation. The details about the high power conditioning and RF processing of the input coupler will be given in the paper.

TUP10: HIGH RELIABLE SURFACE TREATMENT RECIPE OF HIGH GRADIENT SINGLE CELL SUPERCONDUCTING CAVITIES AT KEK

Fumio Furuta (KEK)

We have continued the series tests of single cell superconducting cavities at KEK. These tests are aimed at establishing a high yield prescription for a surface treatment that would reliably allow cavities to reach gradients in excess of 45 MV/m in vertical tests. The cavity profiles were all of the KEK Low Loss design. Early results from this series test demonstrated that reaching gradients as high as 50 MV/m was feasible. However, the initial yield was of order 50%. In order to increase the yield we have modified our surface preparation followed an established KEK procedure of centrifugal barrel polishing, high temperature annealing, light chemical polishing, electropolishing, and final a high-pressure water rinse. We have succeeded to reach the 100% yield with gradient of >40MV/m.

TUP11: Lorentz-Force-Induced Deformation and Motion of High Gradient SRF Structures

Yuichi Morozumi (KEK)

Lorentz force deformation gives a considerable frequency detuning particularly to high gradient SRF accelerating structures such as the ones KEK is developing for the International Linear Collider. Mechanical deformation and vibration as well as associated RF detuning were simulated for KEK's 45 MV/m accelerating structure and TESLA structure. Results will be compared and discussed.

TUP12: MAGNETIC PROPERTIES OF SINGLE CRYSTAL NIOBIUM FOR RF CAVITIES

A. Polyanskii, P. J. Lee, D. C. Larbalestier (National High Magnetic Field Lab, Florida State University, USA), X. Singer, W. Singer (DESY, Hamburg, Germany)

Magneto-optical (MO) imaging was used to observe the flux penetration in of disc-shaped single crystal samples with crystallographic planes (100), (110) and (111) parallel to the disc surface. Magnetic flux penetrates faster for the (110) orientation and even faster for the (111) plane compared to (100).

TUP13: Measurement of RF losses due to trapped flux in a large-grain niobium cavity*

Gianluigi Ciovati (Jefferson Lab), Alex Gurevich (ASC_NHMFL, FSU)

Trapped magnetic field in superconducting niobium is a well known cause of radio-frequency (RF) residual losses. In this contribution, we present the results of rf tests on a single-cell cavity made of high-purity large grain niobium before and after allowing a fraction of the Earth's magnetic field to be trapped in the cavity during the cooldown below the critical temperature. This experiment has been done on the cavity before and after a low temperature baking. Temperature mapping allowed us to determine the location of hot spots with high losses and to measure their field dependence. The results show not only an increase of the low-field residual resistance, but also a larger increase of the surface resistance for intermediate RF field (higher "medium field Q-slope"), which depends on the amount of the trapped flux. These additional field-dependent losses can be described as losses of pinned vortices oscillating under the applied RF magnetic field.

TUP14: Measurement of the high-field Q-drop in a large-grain niobium cavity for different oxidation processes

Gianluigi Ciovati, Peter Kneisel (Jefferson Lab), Alex Gurevich (ASC_NHMFL, FSU)

In this contribution, we present the results from a series of rf tests at 1.7 K and 2.0 K on a single-cell cavity made of high-purity large (with area of the order of few cm2) grain niobium which underwent various oxidation processes, after initial buffered chemical polishing, such as anodization, baking in pure oxygen atmosphere and baking in air up to 180 °C, with the objective of clearly identifying the role of oxygen and the oxide layer on the Q-drop. During each rf test a temperature mapping system allows measuring the local temperature rise of the cavity outer surface due to rf losses, which gives information about the losses location, their field dependence and space distribution. The results confirmed that the depth affected by baking is about 20 – 30 nm from the surface and showed that the Q-drop did not re-appear in a previously baked cavity by further baking at 120 °C in pure oxygen atmosphere or in air up to 180 °C. A statistic of the position of the "hot-spots" on the cavity surface showed that grain-boundaries are not the preferred location. An interesting correlation was found between the Q-drop onset, the quench field and the low-field energy gap, which supports the hypothesis of thermo-magnetic instability governing the Q-drop and the baking effect.

TUP15: Multipacting Study of Ichiro Cavity

Ilmoon Hwang (Kyoungpook national university,republic of Korea)

High gradient superconducting RF cavity named Ichiro type in KEK is developing as the Alternatives Configuration Document for the international linear collider. Multipacting is one of the most serious limitations to achieve high gradient. Several simulation research found out that multipacting at the tapered beam pipe is too strong. We investigated multipacting effects in various type of beam tube and compared with experiments.

TUP16: ON THE DEPENDENCE OF THE Q-VALUE ON THE ACCELERATING GRADIENT FOR SUPERCONDUCTING CAVITIES

Wolfgang Weingarten (CERN)

The performance of niobium superconducting cavities for accelerator applications has improved considerably over the last decade. Individual cavities reach accelerating gradients close to the theoretical limit (about 50 MV/m), however sometimes at the expense of a re-treatment (baking, electro-polishing, rinsing) needed to eliminate an undesired decrease of the Q-value with the field gradient (Q-slope, Q-drop). Cures have been developed, but a generally accepted physical explanation is still missing. Furthermore, for successful research work on materials other than niobium, it is of utmost importance to understand better the limitations in gradient and Q-value of superconducting cavities. The paper presents an alternative explanation for the Q-slope and confronts it with experimental results for 352 and 1500 MHz cavities.

TUP17: Preliminary results on "polarized" buffered chemical polishing of a large-grain niobium cavity

Gianluigi Ciovati (Jefferson Lab), Sean Corcoran (Virginia Polytechnic Institute & State University), Juergen Halbritter (fzk-imf)

In order to further understand the relation between the high-field Q-drop and the native oxide layer on the surface of SRF niobium cavities, we tried to alter the oxidation of niobium by applying a small voltage between a large-grain niobium cavity and a niobium rod inserted in the center, during buffered chemical polishing (BCP). The cavity RF test results at 1.7 K and 2.0 K did not show any major difference in the Q-drop behavior, compared to a standard BCP treatment. In one case, dark gray regions were visible inside the cavity and were responsible for additional losses, as seen with temperature maps. In order to better understand the electrochemical process occurring during the "polarized" BCP treatment, measurements of the polarization curve have been made on a cylindrical niobium sample, with a cylindrical niobium rod in the center.

TUP18: Recent XPS Studies of the Effect of Processing on Nb SRF Surfaces*

Charles Reece (Jefferson Lab), Hui Tian, Michael J. Kelley (JLab & College of William and Mary), Louis Piper, Kevin Smith (Boston University)

XPS studies have consistently shown that Nb surfaces for SRF chiefly comprise a few nm of Nb2O5 on top of Nb metal, with minor amounts of Nb suboxides. We report results from conventional and variable photon energy XPS; the latter affords non-invasive depth profiles. We examined polycrystalline and single crystal materials after EP or BCP, with or without post-baking. Despite the confounding influence of surface roughness, certain outcomes are clear. Lower-valent Nb species are always and only associated with the metal/oxide interface, but evidence for an explicit layer structure or discrete phases is lacking. Post-baking without air exposure shows decreased oxide layer thickness and increased contribution from lower valent species, but spectra obtained after subsequent air exposure cannot be distinguished from those obtained prior to baking, though the SRF performance improvement remains.

* Presenter: Hui Tian.

TUP19: Results from a 850 C Heat Treatment and Operational Findings from the 3 GHz SRF Cavities at the S-DALINAC

Ralf Eichhorn (TU-Darmstadt S-DALINAC)

Reaching the design quality factors and lowering the residual losses of the cavities at the superconducting electron linac in Darmstadt (S-DALINAC) is still an ongoing activity. After installation of an UHV furnace in Darmstadt two years ago, six cavities have now been heat treated at 850 C to remove residual hydrogen from the niobium cavity surface. A residual gas analysis during the heat treatment procedure showed that the cavity where rather strongly contaminated, which might explain the low Q. We will report about the furnace, the heat treatment procedure and the results of subsequent surface resistance measurements. Prior to the heat treatment, the field flatness of the 20 cell elliptical cavities was measured leading to unexpected results: After almost 10 years of operation, the field flatness of some cavities was heavily distorted. This might be an indication that the frequency tuning of the cavity, which is done by compressing the cavity longitudinally does not act uniformly on each cell even though the cavity is only supported at the end cells.

TUP20: Review of high field Q-slope, surface measurements

Alexander Romanenko (Cornell University)

High field Q-slope remains one the main physics problems in the field of niobium RF superconductivity, which needs to be addressed. Mild temperature baking at 100-120C was empirically found to improve or completely remove the high field Q-slope in niobium cavities. One of the approaches to the problem is to utilize surface analytical techniques such as XPS, SIMS, 3DAP etc. in order to look for mechanisms underlying baking improvement and clues for the high field Q-slope cause. In this talk current results of surface studies will be reviewed and their implications will be discussed.

TUP21: RF Cavity Performance for the ISAC-II Superconducting Linac

Robert Laxdal, Ken Fong, Michael Laverty, Amiya Mitra, Qiwen Zheng, Vladimir Zvyagintsev (TRIUMF)

The ISAC-II superconducting linac with twenty 106 MHz quarter wave cavities is now operational since April 2006. The cryomodule design is such that the cavity rf surfaces share the vacuum space with the thermal isolation volume. Because of this we are interested in logging the performance of the cavities over time to estimate degradation due to contamination during operation or maintenance. Early commissioning demonstrated on-line cw performance at a peak surface field in excess of 35MV/m. Performance after one year of operation and a full thermal cycle during the annual shutdown shows very little degradation in performance. The paper will summarize the rf performance with a particular look at maintenance and operation issues.

TUP22: RF cavity results confronting Gurevich's non-linear BCS resistance fomulation

Rong-Li Geng (Jefferson Lab)

Our experiment data of a very high gradient cavity are rigrously compared with Gurevich's non-linear BCS resistance formulation. Good agreement is found for the lower field regim. Theoretical results quickly departure from experimental data for the higher field regim, suggesting necessity of further theoretical work.

TUP23: Status of KEK Superconducting Cavities B

Shinji Mitsunobu (KEK High Energy Accelerator)

KEKB HER (high energy ring) is operating stably by using 8 superconducting cavities. The Max. current is 1.4A, so the HOM power of each cavity is as high as 16 kW, and the beam power is 400kW for each cavity. The beam current will increase to 2 A, HOM dampers of 3mm thick ferrite have been constructed to test higher power absorbing of more than 40 kW. The construction of input coupler for 500 kW operation power is also starting with new industry TiN coating.

TUP24: Studies of the high field anomalous losses in small and large grain niobium cavities

Alexander Romanenko (Cornell University)

High field Q-slope presence in niobium superconducting cavities is observed for all niobium grain sizes. In order to study differences in the Q-slope manifestation small and large grain BCP niobium cavities have been tested with the thermometry attached. Subsequent dissection of the cavities and cutting samples from the stronger and weaker Q-slope regions allowed direct correlation of the RF behavior with surface peculiarities. In this work general behavior of small grain and large grain strong and weak Q-slope regions is compared, and possible causes of that are examined via application of a number of surface analytical techniques (i.e. XPS, Auger, EBSD, SIMS and profilometry).

TUP25: Study on Multipacting in High Gradient SRF Structures

Yuichi Morozumi (KEK)

Fundamentally accelerating gradient is limited by thermal breakdown at a critical surface magnetic field. Practically, however, it is often limited by multipacting as well as field emission on account of surface imperfection. Single-cell cavities comparatively readily reach the theoretical ultimate limit of gradient since their surfaces are almost perfectly polished and cleansed with ease. Multi-cell structures are not easily polished and cleansed to perfection. Multipacting is still one of the major problems which prevent multi-cell structures from achieving high gradients. Results from simulation and experiment will be discussed.

TUP26: Study on the thermal behaviors of SRF cavity

Z.G. Zong (IHEP)

In the dc case, supercurrents flow around defects. But at rf frequencies, the reactive part of the impedance causes the rf current to flow through the defect, producing Joule heating. If the field is raised further the heat can lead to an increase of the temperature in the surrounding niobium material above its critical temperature. In this paper, 3D structure, varying material properties and non-linearity of material properties are employed to build a model based on which thermal behaviors in the niobium material and the interface layer between niobium and HeII are analyzed. Some noticeable features in terms of external thermal loads, sizes of material defects and field levels are also presented.

TUP27: Systematic Computations for the Medium Field Q-Slope

Yi Xie, Hasan Padamsee, Justin Vines (Cornell University)

The medium field Q-slope for Nb cavities has been studied in the past as a thermal feedback mechanism combined with the BCS nonlinear surface resistance Rs(H) due to current-induced RF pair-breaking. We are systematically exploring the behavior of the medium field Q-slope with various cavity parameters such as wall thickness, residual resistance, bath temperature, kapitza resistance (or nucleate boiling for He-I), rf frequency, RRR, and phonon mean free path. The linear BCS surface resistance is obtained from SRIMP [1] (Halbritter's program for RBCS) and combined with the nonlinear BCS resistance in the clean limit from Gurevich [2]. The systematic comparison suggests specific experiments to determine the role of the non-linear contribution.

[1] J. Halbritter, Z.Physik, 238:466-476 (1970)

[2] A. Gurevich, Physica C, 441:38-43 (2006)

TUP28: Tank welding procedures and investigation to optimize the tank welding procedure for the XFEL production

A. Schmidt, A. Matheisen, H. Kaiser, G. Weichert, R. Bandelmann, G. Kreps, W. Menck (DESY Hamburg)

The actual superconducting (s.c.) resonators are cooled by bath cooling in liquid helium. For application in accelerator modules, each cavity is equipped with an individual tank. For the FLASH accelerator and the XFEL Project at DESY these tanks are made from Titanium while the cavity interconnection to the tanks is made from Niobium or Niobium Titanium alloy. Electron beam welding (EB) and tungsten inert gas (TIG) welding technique are in us for adaptation of the helium tank to the s.c. cavity. Investigation in infrastructure and the process are made to adapt this part of the cavity production to the need of large scale production and high gradient resonator performance. EB welding technique is a cost driving and time consuming factor within the tank welding process. To substitute EB welding of connecting rings by TIG welding, this welding technique is under investigation at DESY. We report on established welding procedures, welding parameters and test results on resonators after tank welding and on the new developments in welding procedures.

TUP29: THERMAL DESIGN STUDIES OF NIOBIUM SRF CAVITIES

Ahmad Aizaz (Michigan State University/NSCL)

The thermal response of niobium cavities remains an active area of research in order to increase the accelerating gradients of future accelerators. The effects of plastic deformation on thermal conductivity of niobium in the phonon transmission regime, as well as on its Kapitza conductance, have been studied. The study reveals absence of the phonon peak after deformation beyond the elastic limit of niobium, with an almost 80% reduction in the thermal conductivity of niobium at 2 K. Deformation also reduced the Kapitza conductance. Low temperature annealing did not recover the phonon peak that was measured before plastic deformation. Annealing at the higher temperatures used during the titanification process, similar to that carried out on the SRF cavities, recovered the lost phonon peak, as well as increasing the Kapitza conductance by 125%. Thermal conductivity measurements of single and bi-crystal niobium samples are also reported in this ongoing research.

TUP30: Update on Cavity Preparation for High Gradient Super Conducting multi cell Cavities at DESY

Axel Matheisen, B. v. d. Horst, A. Matheisen, B. Petersen, P. Schilling, S. Saegebarth, N. Krupka (DESY Hamburg)

For the XFEL Project at DESY about 850 superconducting resonators will accelerate the electron beam up to 20 GeV. The resonators have to provide average acceleration gradient of 23,3 MV/m. In order reach reproducible results in a medium scale production with reasonable costs, several preparation methods and surface treatments are under study at DESY. Beside the standard fine grain niobium material in use up to now, nine cell resonators made from large grain niobium are under investigation since 2006. We present the different approaches in surface preparation procedures for fine and large grain niobium and the related cavity test results obtained with the preparation methods applied.

TUP31: Update on EP experiences at DESY and Industrialization of the Electro Polishing Process at DESY

M. Schmökel, A. Matheisen, N. Steinhau-Kühl, H. Weitkämper, R. Vogt, B. Petersen (DESY Hamburg)

Since several years electro-polishing (EP) of superconducting resonators is one of the major preparation techniques in use for high gradient superconducting resonators. At DESY the EP facility is operational since mid of 2003. About 150 resonators have been polished in this infrastructure since. Typical process data, a maintenance plan and reliability of components installed in the DESY apparatus as well as actual RF test results of resonators will be presented. For the XFEL project the industrialization of the electro polishing processes is started. A status report of the industrialization will be given.

TUP32: Update on Quality Control for the DESY Cavity Preparation

Axel Matheisen, Nicolay Krupka (DESY Hamburg)

At DESY in Hamburg the preparation for the XFEL Project is ongoing. For this Project about 850 superconducting resonators will be fabricated in industry. The surface preparation for vertical test, the installation of cavities into their individual helium containers and the assembly of cavity stings inside a clean room will be done by industry as well. To obtain reproducible results and to point out problems during the industrial processes at an early state a well defined quality control system is needed. Beside the control of process consumables (air; gases and water), the quality of the processes need to be defined, online controlled and optimized. Investigation on industrialization and outsource of cleaning processes for equipment like blots and nuts are done. Studies on efficiency of cleaning procedures for accessories assembled to the cavity by surface quality control equipment are on going. We report on the actual status of quality control for superconducting cavities and equipment at DESY

TUP33: Update on the JARI 1 Project Results of Electro-polishing of Multicell Super Conducting Resonators

Steinhau Kühl, A. Matheisen, E.Palmirie*, V. Rampazzzo*, H. Morales Zimmermann (DESY Hamburg Germany, * INFN Leganaro Italy)

Under the contract RII3-CT-2003-506395 of the European Union improvement on the electro-polishing (EP) of multi cell resonators are made. Several methods to improve resonator performances are studied. Improvement of electrode shape, simulated by numerical computer codes and test set ups are presented. With respect to reproducible cavity performances and industrialization of the EP process, a study for quality control by acid management is started. An automated EP system is developed at INFN Legnaro / Italy and within the collaboration of Legnaro and DESY this automated steering will be integrated into the DESY EP facility. We will report on the status of the WP 5.2.2.and the progress of the transfer of the automated EP.

TUP34: Wake Fields in TESLA Accelerating Structures: Spectral Element Discontinuous Galerkin Simulations

Misun Min (Argonne National Laboratory)

Using our recently developed high-order accurate Maxwell solver, NEKCEM, we extend its application to longitudinal and transverse wakefields calculations for short bunches passing through TESLA cavity structures. NEKCEM employs domain decomposition approach based on spectral element discretizations on Gauss-Lobatto-Legendre grids for body-conforming hexagonal meshes. The numerical scheme is designed to ensure high-order spectral accuracy, using a discontinuous Galerkin form with boundary conditions weakly enforced through a flux term between elements. Concerns related to implementation on wake potential calculations will be discussed, and computational results will be demonstrated in comparison with the results by a finite difference time-domain code, GdfidL.

TUP35: Waveguide Damping Study of LOM and HOM on a SC Deflecting Cavity

JIARU SHI (Tsinghua University)

Superconducting RF deflecting cavity is proposed in ALS at LBNL for the ultra-fast light source while the impedance should be damped to an aceptable level. Waveguide added on the beam pipe of the 2-cell structure could damp the LOM, HOM and the unwanted digenerate mode. MAFIA T3 module is used in the damping simulation and detailed study is presented.

2. Advances of new technology of SRF

TUP36: A new electropolishing system at ANL for superconducting quarter-wave resonators

Scott Gerbick (Argonne National Laboratory)

A new electropolishing (EP) system at Argonne National Laboratory has been used with six quarter wave resonators to be installed in the ATLAS superconducting ion linac. This energy upgrade (6 QWR's, 1 HWR) will increase the output energy of the ATLAS 68 cavity array by ~30%. These cavities are the first to be processed in the new Superconducting Cavity Surface Processing Facility (SCSPF) built jointly by Argonne National Laboratory and Fermi National Accelerator Laboratory. This EP system reduces costs by electropolishing each cavity as only two major subassemblies prior to the final electron-beam closure weld. The uniformity of the polishing is improved through the use of a custom rotating cathode that also stirs the acid over the entire length of the cavity, minimizing temperature gradients in the electrolyte. Initial test results are presented.

TUP37: Cancelled

TUP38: A novel sputtered medium beta cavity for ALPI

Anna Maria Porcellato, Sergey Stark, Antonio Palmieri, Enzo Bissiato, Fabrizio Stivanello, Francesca Chiurlotto (INFN-LABORATORI NAZIONALI DI LEGNARO)

The installed medium beta ALPI cavities were produced by Nb sputtering on old copper substrates originally lead plated. The cavity renew could practically double the previous average operational accelerating field but the performance obtained in high beta resonators, whose copper bases were designed to be sputtered, could not be reached. To overcome this performance gap, we designed and built a novel medium beta cavity, which have the shorting plate rounded as in high beta cavity, and in which the beam ports are obtained by plastic deformation of the outer conductor instead to be brazed to the resonator body as in the previous medium beta cavities. The paper describes cavity design, substrate construction technology, surface treatments and first results of the resonator cold test.

TUP39: Basic Research on the 1.3 GHz Superconducting Cavity for the ERL Main Linacs

Takaaki Furuya, Shogo Sakanaka, Tsuyoshi Suwada, Takeshi Takahashi, Kensei Umemori (KEK), Hiroshi Sakai, Kenji. Shinoe (ISSP), Masaru. Sawamura (JAEA)

Feasibility study of the superconducting cavity for 1.3 GHz ERL main linacs has started under the collaboration of KEK, JAEA and Tokyo Univ. The development effort was concentrated to optimize the cavity shape to sufficiently suppress the beam instabilities for the desired accelerating beam of 100 mA with the recovery beam of 100 mA. Our final shape has a 9-cell structure with beam pipes of a large diameter on both sides. BBU simulation on dipole modes showed the BBU current limit of more than 600 mA without any randomize of HOM frequencies. HOM power absorbed by the dampers is estimated as 100 W for monopole modes. For the damping of quadrupole modes a new idea of mode conversion using an eccentric fluted beam pipe (EFB) is proposed and simulated. This simple way can take out the quadrupoles to the beam pipe easily. For the establishment of a manufacturing process and the performance of the cavity shape, two single cavities one of which has the EFB have been fabricated and measured. Shape optimizing study, fabrication and some measurement results will be presented.

TUP40: CW Operation of superconducting TESLA cavities*

Jens Knobloch, Wolfgang Anders, Sascha Klauke, Oliver Kugeler, Michael Schuster (BESSY)

TESLA technology was originally developed for pulsed operation of high energy linacs. However, recently, several projects such as the Cornell ERL, BESSY FEL and 4 GLS have been proposed with beam energies below 10 GeV. From a cryogenic point of view, CW operation thus is feasible, and for a number of other reasons, highly desirable. Since TESLA technology has been demonstrated to be mature and reliable, these new projects propose to use this technology in a modified form. At the BESSY HoBiCaT facility, cavity units have been tested under cryogenic conditions to determine what changes must be made to enable full CW operation. These studies include the optimization of the bath temperature (Q-factor versus temperature and field), testing of new feedthroughs for the HOM couplers, the thermal load on the coupler, and the limits of stable helium distribution. A summary of the results and the required changes for CW operation are provided.

* Work partially supported by the EU Commission in the sixth framework program, contract no 011935 EURO-FEL-DS5, the BMBF and the Land Berlin.

TUP41: Damping of Higher Order Modes in High Gradient SRF Structures

Yuichi Morozumi (KEK)

KEK has been proposing and developing high gradient accelerating structures for the International Linear Collider. Dampers have been designed to mount on the structures to suppress higher order resonant modes for beam stability. Features of the design as well as characteristics and performances of the dampers will be presented.

TUP42: DESIGN and ANALYSIS of a MEGAWATT CLASS SUPERCONDUCTING PHOTOINJECTOR CAVITY*

Douglas Holmes, Michael Falletta, Michael Cole, Ed Peterson, John Rathke, Tom Schultheiss, Alan Todd, Robert Wong (Advanced Energy Systems Inc.), Ilan Ben-Zvi, Andrew Burill, Rama Calaga, Xiangyun Chang, Harald Hahn, Dmitry Kayran, Vladimir Litvinenko (Brookhaven National Laboratory)

Advanced Energy Systems, Inc. is currently under contract to design and fabricate a superconducting photoinjector which will be integrated and tested at Brookhaven National Laboratory. The photoinjector is a ½ cell 703.75 MHz superconducting cavity designed to accelerate a 0.5 ampere electron beam to an energy of 2 MeV. The cavity incorporates a double quarter wave RF choke allowing the integration of a removable, normal conducting cathode system. Two power coupler ports are closely located to the cavity for high RF coupling. This paper will review the thermal and structural analysis performed during design optimization and will present the results of this analysis for the cavity configuration.

* References: Ilan Ben-Zvi et al., SUPERCONDUCTING PHOTOINJECTOR FOR HIGH-POWER FREE ELECTRON LASERS, FEL 2007 Novosibirsk.

TUP43: DESIGN and FABRICATION of a MEGAWATT CLASS SUPERCONDUCTING PHOTOINJECTOR*

Michael Cole, Bruce Abel, Tony Ambrosio, Michael Falletta, Ed Peterson, John Rathke, Tom Schultheiss, Alan Todd, Robert Wong, Doug Holmes(Advanced Energy Systems Inc.), Ilan Ben-Zvi, Xiangyun Chang, Vladimir Litvinenko, Harald Hahn, Rama Calaga, Ranjan Grover, Ramesh Gupta, Dmitry Kayran, Gary McIntyre, Stephen Plate, Triveni Rao, Robert Todd, Yatming Than, Dan Weiss, Andrew Burrill (Brookhaven National Laboratory)

Advanced Energy Systems, Inc. is currently under contract to design and fabricate a superconducting photoinjector which will be integrated and tested at Brookhaven National Laboratory. The initial design and development of this gun has been a collaborative effort over the past two years by Advanced Energy Systems, Inc., Brookhaven National Laboratory, and a variety of other partners. The photoinjector is a ½ cell superconducting electron gun designed to operate at a current of 0.5 amperes and beam energy of 2 MeV. Its two principle design points are a removable cathode assembly to be held in place by a clamp system and very high coupling achieved with two 500 kW power couplers located very close to the SRF cavity. A high temperature superconducting solenoid magnet designed by the Superconducting Magnet Division at Brookhaven National Laboratory is integrated into the cavity beamline string. This paper will present an overview of the gun and its anticipated performance parameters, review the design of the gun cavity, cryomodule, clamp system, fundamental power coupling, and finally review the current status of the design and fabrication effort.

* References: Ilan Ben-Zvi et al., SUPERCONDUCTING PHOTOINJECTOR FOR HIGH-POWER FREE ELECTRON LASERS, FEL 2007 Novosibirsk. R. Calaga et al., High current superconducting gun at 703.75 MHz, Physica C, Volume 439-1 (2006).

TUP44: Development and RF Test Results of a new HF and H2SO4 free Electro Polishing Method for Superconducting Niobium Cavities

Michael Pekeler, Stefan. Bauer (ACCEL), Joerg Ziegler, Detlef Reschke (DESY)

A new Electro Polishing method for superconducting cavities using an acid mixture without hydrofluoric and sulphuric acid was developed at ACCEL Instruments GmbH based on an exclusive license from Poligrat GmbH, Germany. Two 1.3 GHz single cell cavities were built and are used for qualification of the new Electro Polishing method. After the Electro Polishing at ACCEL, the cavities are transported to DESY for RF testing. At DESY no further surface removal by any means is done, but a high pressure water rinsing is carried out. Very promising test results were achieved right away. During the first RF test of the first treated cavity, Q values above 2E10 and accelerating gradients above 20 MV/m were measured at a helium bath temperature of 1.8 K, limited by a quench. No field emission was observed during the test.

TUP45: Development of a Digital Self-Excited Loop for Field Control in High-Q Superconducting Cavities

Jean Delayen, Trent Allison, Curt Hovater, John Musson, Tomasz Plawski (Thomas Jefferson National Accelerator Facility)

Several near-term (e.g. JLab 12 GeV project) or longer term (e.g. ERLs) projects will involve operation of a large number of high-Q superconducting cavities where the Lorentz detuning is much larger that the loaded bandwidth. Of particular importance in these machines is the stability with respect to ponderomotive instabilities and rapid turn-on time and recovery from a trip. Control systems based on analog self-excited loops have been successfully used for many decades in small low-velocity ion linacs that were operating in that regime. We have developed and tested a control system based on a digital self-excited loop for the 12 GeV upgrade, which could also be used in other superconducting accelerators projects such as the Facility for Rare Isotope Beams.

TUP46: Development of Low Beta Superconducting Twin Quarter Wave Resonator

Hiroshi Kabumoto (Japan Atomic Energy Agency (JAEA))

We have started development of superconducting Twin Quarter Wave Resonator (Twin-QWR) for TRIAC project, which is a collaboration project of JAEA and KEK for acceleration of Radioactive Nuclear Beam (RNB) and Stable Nuclear Beam (SNB). Twin-QWR is designed for acceleration of low beta heavy ions. Optimum beam velocity βopt is 6%, and resonant frequency is 129.8MHz. Twin-QWR has two inner conductors made of pure niobium, and outer conductor is made of niobium-copper cladding-sheet. Top end plate and outer conductor are connected by superconducting gasket made of niobium. We have fabricated a prototype Twin-QWR in FY2005, and have carried out performance test in FY2006.

TUP47: Diagnostic Instrumentation for the Fermilab Vertical Cavity Test Facility

Camille Ginsburg (Fermilab)

The Fermilab vertical cavity test facility (VCTF), for CW RF vertical testing of bare ILC 1.3 GHz 9-cell SRF cavities, was completed in July 2007. The primary purpose of the test facility is to assess the performance of cavities, both as a study of their production and processing and as an acceptance test prior to insertion in a cryomodule. We describe the design and initial test results of the VCTF diagnostic instrumentation which is used to understand cavity performance, including thermometry to detect hot spots caused by quenches or field-emission, and a variable RF input coupler to facilitate the TM010 passband mode measurements used to isolate poorly performing cells or pairs of cells.

TUP48: DRY-ICE CLEANING: THE MOST EFFECTIVE CLEANING PROCESS FOR SRF CAVITIES?*

Detlef Reschke, Arne Brinkmann, Klaus Floettmann, Daniel Klinke, Joerg Ziegler (DESY), Dieter Werner, Ralf Grimme, Christof Zorn (Fraunhofer IPA)

The dry-ice sublimation-impulse cleaning (DIC) technique using a two component ring jet has been proven as a highly efficient cleaning process for niobium and copper surfaces. The liquid carbon dioxide flows through a ring-type nozzle assembled in a purpose-built cleaning head, expands to form a dry-ice / gas mixture and is accelerated by the surrounding nitrogen. A setup for the HORIZONTAL cleaning of single-cell niobium cavities has been successfully commissioned during the last years. A preliminary parameter set for effective final cleaning is established. Several cavities have been cleaned and tested without any detectable field emission up to 36 MV/m. As application of the DIC technique might result in additional cleaning potential for accelerator structures, an extension of the set-up and testing of nine-cell cavities is planned until mid of 2008. Furthermore recently DIC was applied to the copper injector "gun" cavity for TTF/FLASH. In order to reduce the dark current of the gun cavity a vertical cleaning setup was developed and tested.

* We acknowledge the support of the European Community Research Infrastructure Activity under FP6 “Structuring the European Research Area” program (CARE, contract number RII-CT-2003-506395).

TUP49: ECR plasma for niobium surface processing

G. Wu, W-D. Moeller, C. Antoine, I. Pechenezhskiy, T. Khabiboulline, E. Harms, Y. Terechkine, H. Edwards, D. Mitchell, A. Rowe, C. Boffo, C. Cooper, T. Koeth, W. Muranyi (Fermilab)

An Electron Cyclotron Resonance can be excited inside a RF cavity in the absence of insert. Such a process has potential to be applied to a dressed cavity after final assembly, thus giving us the in-situ or post processing opportunities. We will describe the current effort and progress with plasma in a 3.9GHz cavity.

TUP50: Effect of 400 C "In-situ" Baking and Subsequent Air Exposures on 1500 MHz Single Cell Superconducting Radiofrequency Cavities

Grigory Eremeev (Cornell University)

To study effect of the oxide and the oxide-metal interface on the superconducting properties of niobium cavities in high RF fields, we carried out a number of tests aimed on destroying and growing of the oxide layer on the niobium surface under clean conditions. To destroy the niobium oxide we baked the cavity "in-situ" at 400 C for 2 hours. To regrow an oxide on the cavity surface, the cavity was exposed to different pressures of dry air for a different amounts of time. The baking and exposures were repeated several times to establish the trend. In this article we present RF and thermometry results of these experiments.

TUP51: Electropolishing of 1-cell and multi-cells Niobium Cavities: COMSOL Modelling*

Bernard Visentin, Melanie Bruchon, Fabien Eozenou (CEA Saclay)

In the framework of cavity electropolishing improvement, modelling permits to evaluate some parameters not easily accessible by experiments and can also help us to guide them. Different laboratories (DESY, Fermilab) work on electro or chemical polishing modelling with different approaches and softwares. At CEA Saclay, COMSOL software is used to model electropolishing of cavity in two dimensions. An improvement of our setup by modifying the arrival of the acid has been studied. The influence of a protuberant cathode has been evaluated and compared for different shapes of single cell cavities: TESLA, ILC Low Loss (LLILC), ILC Reentrant (REILC) and the optional profile half Re-entrant. This work has been extended to nine-cell CHIRO cavities in collaboration with KEK to understand if electropolishing process is related to their poor RF performances. Then, horizontal nine-cell TESLA cavities have been also studied to improve current electropolishing. Vertical TESLA cavities have been also investigated to be compared with horizontal electropolishing.

* We acknowledge the support of the European Community-Research Infrastructure Activity under the FP6 “Structuring the European Research Area” programme (CARE, contract number RII3-CT-2003-506395) and the support of the "Région Ile-de-France"

TUP52: FABRICATION OF 1.3 GHZ 9-CELL CAVITY BY HYDROFORMING*

Waldemar Singer, Igor Jelezov, Xenia Singer, Gabriele Weichert, Guennadi Kreps, Gerhard Meyer (DESY), Alexey Ermakov (Institut of Metal Physisc, Ekaterinburg, Russia)

The hydroforming technology follows the idea to fabricate the actual cavity from seamless tube by a method that avoids critical welds. The principal advantages relative to standard technology are costs reduction and performance improvement. Fabrication of a 9-cell superconducting cavity of TESLA shape was done starting on bulk seamless Nb tube of intermediate diameter between cavity equator and iris, and is based on diameter reduction in the iris area and diameter expansion in the equator area. Inside tube diameter 150 mm and wall thickness of 2.5 mm were used. Reduction of the tube diameter at the iris area and at the tube ends is done with a special profile ring. Combination of radial and axial movements of the ring allows ensure circumferentially a uniform wall thickness without remarkable it’s decreasing. The hydroforming takes place by expanding the tube with internal water pressure while simultaneously swaging it axially. The expansion is done in two stages (using intermediate constraint) in order to achieve the correct shape, rather uniform wall thickness of the complete cavity and to suppress the instabilities. Special mechanism synchronizes the moulds movement and allows forming of many cells simultaneously. Three of 3-cell cell units have been fabricated. The completing of the cavity is done at the company E.ZANON. Completing included fabrication of the end groups connected with three cell units, preparation and welding of three cell units together in a 9 cell cavity (two iris welds done from outside), weld on of the stiffening rings. The cavity is successfully completed and is currently in the preparation for the vertical RF test at DESY.

* Supported in part by European CARE program

TUP53: FABRICATION OF SINGLE CRYSTAL NIOBIUM CAVITIES*

Waldemar Singer, Xenia Singer, Detlef Reschke, Arne Brinkmann (DESY), Peter Kneisel (JLab), Michael Pekeler, Johannes Schwellenbach (ACCEL Instruments), Bernd Spaniol, Friedhold Schoelz, Egbert Stiedl (W. C. Heraeus), Robert Grill (Plansee SE)

A fabrication method for an ILC like single crystal SC niobium cavity has been proposed and verified at DESY, taking the following aspects from developments on samples into consideration : A) Definite enlargement of the single crystal disc diameter by rolling or spinning is possible without destroying the single crystal structure. B) The single crystals maintain the crystallographic structure and after forming of the cavity half cell from a disc by deep drawing the orientation perpendicular to the surface remains. C) Appropriate heat treatment will not destroy the deformed single crystal. D) Two single crystals will grow together by electron beam welding, if the orientation of the crystals is matched. Based on these investigations two prototype single crystal cavities of the TESLA shape with plane crystal orientation (111) and (100) were produced at ACCEL Instruments. The half cells of the first cavity were spun. The cups of the second cavity have been produced by rolling and deep drawing. For the removal of the damage layer the spun cavity was etched 140µm, afterwards annealed at 750°C and finally 30µm etched. It reached an accelearting gradient of only 21 MV/m. Further etching of 90µm and grinding gave no improvement. After add. 120µm electropolishing combined with in situ baking the performance improved to 41 MV/m. Surface treatments and a series of RF tests after successive material removal by BCP on deep drawn cavity were done at JLab. A best accelerating gradient of Eacc =39 MV/m was reached after BCP, annealing at 600°C and in situ baking. Analysis of single crystal growing mechanism and of optimal crystallographic orientation for cavity performance is in progress. A new niobium ingot with a large central crystal of orientation (110) is being produced by W.C.HERAEUS. Optimization of the single crystal rolling procedure is carried out at PLANSEE SE. The developed method of single crystal single cell cavity fabrication will be extended to the fabrication of multi cell cavities. The fabrication of a 9-cell single crystal niobium cavity is in progress at DESY.

* Supported in part by European CARE program

TUP54: FIELD TUNING OF THE 9-CELL ICHIRO COPPER CAVITY MODEL

Q. Z. Xing (Tsinghua University)

Field flatness measurement system is established for the 9-cell superconducting ICHIRO copper cavity model provided by KEK. The field flatness 97.2% of the TM010_PI mode is obtained after a few iterations by introducing perturbation objects into the cells. Different methods are compared for measuring the field flatness. Microwave parameters of higher order modes(HOMs) are obtained before and after tuning.

TUP55: Fine Grain and Large Grain Niobium Cavity Prototyping for a Proton Linac

Walter Hartung, John Bierwagen, Steve Bricker, Chris Compton, Terry Grimm, Matthew Johnson, David Meidlinger, John Popielarski, Laura Saxton, Richard York (Michigan State University), G. W. Foster, I. Gonin, T. Khabiboulline, N. Solyak, R. Wagner, V. Yarba (Fermilab), P. Kneisel (Jefferson National Lab, Newport News, VA 23606)

A superconducting cavity has been designed and prototyped for acceleration of particles travelling at 81% the speed of light (beta = 0.81). The application of interest is an 8 GeV proton linac proposed as an upgrade to the Fermilab accelerator complex, although the cavity would also be suitable for other proton or ion accelerators. The cell shape is similar to the 805 MHz high-beta cavity developed for the Spallation Neutron Source Linac, but the resonant frequency is 1.3 GHz and the beam tube diameter matches that of the 1.3 GHz cavity for the TeSLA Test Facility. Four single-cell prototypes have been fabricated and tested before and after post-purification. Two of the cavities were formed from standard high purity fine grain niobium sheet; the other two were fabricated from large grain niobium, following up on the work at Jefferson Lab to investigate the potential of large grain material for cost savings and/or improved RF performance. Two 7-cell cavity prototypes (one fine grain, one large grain) have also been fabricated. The single-cell results will be presented, and the status of the prototyping effort will be reported.

TUP56: First Experiments with a NbZr –based Superconducting Joint*

Peter Kneisel, Gianluigi Ciovati, Larry Turlington (Jefferson Lab), Jacek Sekutowicz (DESY)

In a previous paper [1] we have reported about our efforts to identify an appropriate superconducting material for a superconducting joint, which can withstand magnetic field levels of > 30 mT needed for a super-structure configuration for a cavity string, e.g. applicable to ILC. We have fabricated a “double” single cell cavity, where an enlarged iris opening on both cells is equipped with a NbZr conflat-type flange very close to the iris, which will be joined together with a niobium gasket. In the cavity design the magnetic peak field ratio between cavity and joint is app. 3, therefore the joint field of > 30 mT will be reached with 90 mT peak surface field in the cavities. In this contribution, we will report about our early experiences with this cavity system.

[1] P. Kneisel et al.; PAC 7007, paper WEPMS062.

TUP57: First Fermilab Results of SRF Cavity Lorentz Force Detuning Compensation Using a Piezo Tuner

Ruben Carcagno, Julien Branlard, Brian Chase, Helen Edwards, Andrzej Makulski, Darryl Orris, Yuriy Pischalnikov, John Reid, Warren Schappert (Fermilab)

Lorentz force detuning compensation of TESLA type cavities using commercially available piezo electric actuators was first demonstrated at DESY. Compensating for Lorentz force detuning to avoid excessive RF power requirements is critical for high gradient cavities such as the ones proposed for the ILC. Fermilab has started working on issues related to range, reliability, and automation of SRF cavity fast tuners. Results of Lorentz Force detuning compensation using a single piezo tuner at Capture Cavity II (CCII) are presented. To increase the piezo tuner range, a mechanical resonance excitation method was used. To evaluate long-term reliability of the design, a strain-gauge based sensor was developed to monitor piezo tuner preload continuously. A feed forward Lorentz force detuning compensation algorithm using the forward power signal; the field probe signal; and the phase difference between them has been developed. This algorithm is being implemented in a hybrid PC/FPGA based control system providing automated signal acquisition, system identification, and waveform playback. In parallel, an FPGA based real-time cavity simulator has been developed to validate the performance of the system prior to its deployment and to provide a test-bed for further detuning and microphonics algorithm development. The control system will be used to compensate for cavity detuning in the first cryomodule installed in the ILC Test Area at Fermilab. In tests of the algorithm using CCII at a gradient of 26 MV/m, compensation with a fast piezo tuner reduced the Lorentz Force detuning from 275 Hz to 20 Hz. This compensation resulted in a corresponding decrease of the peak klystron power requirement from 130% to 102% of the nominal power on resonance.

TUP58: First results with the ladder resonator at 4.2 K

Giovanni BISOFFI (INFN – LABORATORI NAZIONALI DI LEGNARO)

In this paper we report about the first 4.2 K measurements on a novel kind of superconducting 4-gap resonator for the energy range 5–20 MeV of an ISCL (independently phased superconducting cavity linac). This resonator, called Ladder structure, is proposed for a 5 mA proton driver for the production of exotic nuclear species, in the framework of the EURISOL design study (funded by the European Commission) for a next generation ISOL 0 = 0,12 and f0 = 352,2βfacility in Europe. The design of the resonator, with a MHz, was presented in Ref.1. The construction, tuning and assembly procedure is given in Ref.2. This paper presents the first results at 4,2 K: the 4,2 K frequency value, very close to the target value of 352,2 MHz, shows that the rough tuning procedure during construction was very successful; multipacting is not a critical issue; Q0 value and the Q vs. Ea curve suffer from the yet imperfect joint between the resonator and its large opening ports. Ways on how to improve this situation are discussed.

Ref.1 V. Andreev et al, Phys. Rev. Special Topics – Accelerator and beams, Vol.6, 040101 (2003)
Ref.2 A. Palmieri et al., Proc. of EPAC 2006, Edinburgh, Scotland, 451

TUP59: FROM MULTISTUB RESONATORS TO INTERMODULATION MEASUREMENTS: SRF ACTIVITIES AT ANU IN 2005-2007

Nikolai R. Lobanov, David C. Weisser (Nuclear Physics Department, Research School of Physical Sciences and Engineering, Australian National University, Canberra ACT 0200, Australia)

The design of a 150 MHz l/4, 3- and 4- gap structures with two and three loading elements, for the velocity range b = 0.015 - 0.12 has been accomplished. Rotary and displacement tuners are developed for multi-stub superconducting RF resonators. The effectiveness of these tuners is made possible because the resonators have low currents between their outer conductors and tuner elements. Computer simulations and experimental data show that the devices provide a tuning range up to 100 kHz with a frequency resolution of about 1 Hz. The manufacturing of the 150 MHz 2-QWR with rotary tuner has been completed. A credible design of 2-QWR and its rotary tuner have been developed and tested at room temperature. The PbSn plating, exercised on the existing split loop resonators, will be extended to the 2-QWR as a straightforward step to quickly explore the superconducting performance of the new geometry. The commissioning of the plating equipment has been started. In the longer term, the Nb sputter coating will be researched because, in principle, it can produce films competitive to the much more expensive solid niobium option and performs at higher fields than plated lead. The twelve split loop resonators have been electroplated with 96%Pb4%Sn film to the final thickness of 1.5 micron using methyl sulfonic acid chemistry achieving average acceleration field of 3.5 MV/m off-line. Measurement of the non-linear surface impedance and intermodulation distortion (IMD) has been conducted on the full-scale split-loop resonators (SLR). IMD measurements allow more sensitive detection of non-linearity as compared to surface impedance measurements. The source of the non-linearity in the resonator structure, such as magnetic flux penetration can be located by its contribution to the non-linear IMD response above a critical RF power level.

TUP60: HIGH POWER INPUT COUPLERS FOR THE STF BASELINE CAVITY SYSTEM AT KEK

Eiji Kako, Hitoshi Hayano, Shuichi Noguchi, Toshio Shishido, Ken Watanabe, Yasuchika Yamamoto (KEK)

A high power input coupler, which is used for transferring rf power to a superconducting cavity, is designed for the STF baseline cavity system. An input coupler, which consists of a cold coupler and a warm coupler, has two Tristan-type coaxial disk rf windows. There is no tuning mechanism for varying coupling for simplicity and cost reduction. Fabrication of four input couplers was completed, and the rf measurements with low power were carried out. The input couplers were assembled with coupling waveguides and doorknob-type transitions, and they were installed in the high power rf system. The high power tests of four input couplers were carried out in the test stand with a 5 MW pulsed klystron. Rf processing up to 1.0 MW in a 1.5 msec and 5 Hz operation (1.9 MW in a short pulse) was successfully performed without any troubles. One cavity for the STF Phase-0.5 was assembled with an input coupler and a tuning system, and the cavity was installed in one of the 6m-cryomodules. RF processing of the input coupler in the cryomodule was carried out at room temperature up to 250 kW in a 1.5 msec step pulse and 5 Hz operation. First cool down and high power test of the cryomodule are scheduled in Octorber, 2007.

TUP61: Highly-oriented film growth in SRF cavities

Daniel Bowring (University of Virginia)

Anomalous Q-drop is a severe limit on the performance of sputtered Nb thin film cavities. In this paper we review the relationship between film structure and RF performance and we discuss, in parallel, the film growth modes available under two different deposition scenarios being explored at JLAB. We discuss a procedure for growing highly-oriented thin films using existing technology, and the potential of such films for increased SRF performance.

TUP62: Hydrodynamic Thermal Modeling of 9-cell ILC Cavity Electropolishing and Implications for Improving the EP Process*

Charles Reece, John Mammosser (Jefferson Lab), Jun Ortega (Blue Ridge Numerics)

Multi-cell niobium cavities often obtain the highest performance levels after having been subjected to an electropolishing process. The horizontal EP process first developed at KEK/Nomura Plating for TRISTAN cavities is being applied to TESLA-style cavities and other structures for the XFEL and ILC R&D. Jefferson Lab is presently carrying this activity in the US. Because the local electropolishing current density is highly temperature dependent, we have created using CFDesign(TM) a full-scale hydrodynamic model which simulates the various thermal conditions present during 9-cell cavity electropolishing. The results of these simulations are compared with exterior surface temperature data gathered during ILC cavity EP at JLab. Having benchmarked the simulation, we explore the affect of altered boundary conditions in order to evaluate potentially beneficial modifications to the current standard process.

TUP63: INITIAL EXPERIENCE IN OPERATING THE SRF CRYOMODULES FOR ERLP

Shrikant Pattalwar, Peter McIntosh, Robert Bate, Rachael Buckley, Peter Corlett, Andrew Goulden, Andrew Moss, James Rogers, Stephen Buckley, Joseph Orrett, Mike Dykes (STFC, Daresbury Laboratory, UK)

Energy Recovery Linac Prototype (ERLP) is being commissioned at Daresbury Laboratory (UK) to develop and demonstrate energy recovery technique to produce FEL using SRF technology. The ERLP uses two identical Linac cryomodules, one as a booster cavity accelerating the beam to 8.5 MeV, the other as a linac module in the re-circulating loop with an energy gain of 26.5 MeV. Each module consists of two nine cell cavities operating at a frequency of 1.3 GHz and at a temperature of 2 K. As there is no energy recovery in the booster it requires a peak power of 53 kW, whereas the linac module only requires 8 kW. The cryomodules are cooled to 2 K by a cryo-system consisting of a 4K liquefier, 2 K recuperator with a JT valve and external vacuum pumps. In this paper we report our initial experiences in operating the SRF Linacs particularly with cryogenics and RF system.

TUP64: Initial tests of Atomic Layer Deposition (ALD) in superconducting rf systems

Jim Norem, Mike Pellin, Jeff. Elam (Argonne), Claire Antoine (CEA Saclay), Jerry Moore (MassThink), Lance Cooley (Fermi National Accelerator Laboratory), R. A. Rimmer (JLAB), John Zasadzinski, Thomas Prolier (IIT)

Atomic Layer Deposition (ALD) is a method of synthesizing materials in single atomic layers. We are studying this technique as a method of producing highly controlled surfaces for superconducting rf systems. We have begun tests of ALD coatings of single cells that will involve rf measurements of a cell before and after coating at Argonne. In addition to the tests on complete cells, we are also beginning a program of point contact tunneling measurements to determine the properties of the superconductors at the interface between the bulk niobium and the oxide layer. We will describe the method, and tests we are beginning with single cell resonators and small samples.

TUP65: JLab CW Cryomodules for 4th Generation Light Sources

Robert Rimmer (JLab)

Fourth generation light sources hold the prospect of unprecedented brightness and optical beam quality for a wide range of scientific applications. Many of the proposed new facilities will rely on large superconducting radio frequency (SRF) based linacs to provide high energy, low emittance CW electron beams. For high average power applications there is a growing acceptance of energy recovery linac (ERL) technology as the way to support large recirculating currents with modest RF power requirements. CW SRF and high current ERLs are two core competencies at Jefferson Lab. JLab has designed and built a number of CW cryomodules of several different types starting with the original CEBAF design, with variations for higher current in the two generations of JLab's free-electron laser (FEL), through two intermediate prototypes to the final high-performance module for the 12 GeV upgrade. Each of these represent fully engineered and tested configurations with a variety of specifications that could be considered for possible use in fourth generation light sources. Furthermore JLab has been actively pursuing advanced concepts for high-current high-efficiency cryomodules for next generation ERL based FEL's. These existing and proposed designs span the range from about 1mA single-pass to over 100 mA energy recovered current capability. Specialized configurations also exist for high-current non energy recovered sections such as the injector region where very high RF power is required. We discuss the performance parameters of these existing and proposed designs and their suitability to different classes of fourth generation light sources.

TUP66: Low emittance polarized electron source based on Superconducting RF gun

Rong Xiang, A. Arnold, H. Buettig, D. Janssen, P. Michel, K. Moeller, F. Staufenbiel, J. Teichert (FZD)

Continuous effort has been paid in last decades for the better polarized electron source for the high energy physics experiments. The DC guns with GaAs type photocathodes have been successful operated in several laboratories, but the beam emittance is regretfully very poor. Although RF gun has been considered for the generation of the polarized electron beams with low emittance, the limit on vacuum is still an open question for the currently designed RF guns. Superconducting RF gun with the GaAs photocathode would eliminate this vacuum barrier because of its low working temperature. In this paper, some requirements including the cathode response time and the electron back bombardment are discussed in some detail, and the beam dynamics simulation gives positive forecast of its future realization.

TUP67: Niobium Quarter-Wave Resonator Development for a Heavy Ion Re-accelerator

Walter Hartung, John Bierwagen, Steve Bricker, Chris Compton, Terry Grimm, Matthew Johnson, Felix Marti, John Popielarski, Laura Saxton, Richard York (Michigan State University), Alberto Facco (INFN-LNL), Evgeny Zaplatin (FZ Juelich)

A superconducting linac is being designed for re-acceleration of exotic ions produced by the Coupled Cyclotron Facility at Michigan State University (MSU). The re-accelerator beam line will include a cyclotron gas stopper, a charge breeder, a normal conducting radio-frequency quadrupole, and two types of superconducting quarter-wave resonators (QWRs) for re-acceleration to energies of up to 12 MeV per nucleon. Both QWR types are based on existing cavities that are presently used at INFN-Legnaro. The second QWR (optimum beta = 0.085, 80.5 MHz) was previously designed and prototyped as a collaborative effort between Legnaro and MSU. The first QWR (optimum beta = 0.041, 80.5 MHz) will be very similar to the corresponding QWR in use at Legnaro, but with a larger beam aperture. Separation between the cavity vacuum and the cryostat insulation vacuum will also be implemented to reduce the risk of particulate contamination. Structural analysis of the QWRs is being done in collaboration with FZ Juelich. The beta = 0.041 QWR design and prototyping effort will be discussed in this paper.

TUP68: Optimisation of first 1/2 cell for the 4GLS High Average Current SRF gun

Carl Beard, Peter McIntosh (STFC Daresbury Laboratory)

A 10 MeV 100 mA average current 100% RF and beam duty factor continuous wave electron injector is required to supply electron bunches for the spontaneous radiation sources and VUV-FEL for 4GLS. At present, there is no RF gun design which is capable of delivering such high power focused beams, therefore a bespoke system is being developed. Optimisation of the first half cell of a SRF gun has been carried out to maximise the acceleration whilst providing additional focussing and emittance compensation through shaping of the cavity to meet the design specification. In this paper, the cavity design and beam dynamic simulations are presented.

TUP69: Optimization of Baking Parameters for Electropolished Niobium Cavities*

Bernard Visentin, Jean Pierre Charrier, Yves Gasser, Melanie Bruchon, Fabien Eozenou (CEA Saclay)

High gradients, on electropolished bulk niobium cavities, can only be reached after an imperative baking at low-temperature to suppress the high field Q-drop . We already showed that the standard treatment under vacuum (48 hours - 120°C) could be simplified for Nb cavities mass production in terms of duration (3 hours at 145°C) and requirement (inert gas instead of vacuum). Duration has recently been reduced down to only 1 hour (160 °C) under argon atmosphere and the process has been still improved with the open-ended treatment of cavities.

* We acknowledge the support of the "Région Ile-de-France"

TUP70: Optimization of the BCP Processing of Elliptical Nb SRF Cavities

Germano Galasso, Charlie Cooper, Allan Rowe (FNAL), Cristian Boffo (Babcock Noell GmbH)

At present, the electropolishing (EP) process is considered the key technology unleashing the capability to fabricate Nb SRF cavities performing at or above 35 MV/m. Never the less buffer chemical polishing (BCP) is still a cheaper, simpler and effective processing technique for single grain high gradient and polycrystalline lower gradient cavities. BCP will also be adopted to chemically process the third harmonic 3.9 GHz cavities being fabricated at Fermilab [1]. The dimensions and the shape of these cavities pose the problem of a strong uneven material removal between iris and equator of the cells. This paper describes the thermal-fluid finite element model adopted to simulate the process, the experimental flow visualization tests performed to verify the simulation and a novel device fabricated to solve the problem.

TUP71: Parameters Investigation for Niobium Electro-Polishing*

Fabien Eozénou, Melanie Bruchon, Julie Gantier (CEA Saclay)

Electro-polishing (EP) experiments are carried out on niobium samples at CEA Saclay in order to highlight the influence of parameters such as temperature and acids concentrations (hydrofluoric and sulfuric). First results given at the 12th SRF Workshop have been completed. The importance of the HF/H2O ratio has been precisely investigated and diluted mixtures have been tested during long time experiments: removal rates, surface states, lifetime of the bath and possible hydrogen contamination will be reported. In addition, some experiments have been carried out with dissolved niobium in fresh mixtures, giving some ideas about mechanisms involved in EP. Furthermore, dissolved salts as well as different acids have been tested as an alternative for hydrofluoric acid use.

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TUP72: Piezo-Assisted Blade Tuner: Cold Test Results

Carlo Pagani (University of Milano & INFN Milano - LASA), Angelo Bosotti, Nicola Panzeri, Rocco Paparella (INFN Milano-LASA), Rolf Lange, Lutz Lilje (DESY)

The new simplified version of the piezo-assisted Blade Tuner will be tested at DESY in the horizontal cryostat CHECHIA by the end of September. The tuner mechanism has been characterized at room temperature and one high gradient cavity of the last production has been recently tuned and equipped with a properly modified helium tank. In view of its possible adoption for the ILC, the cheaper stainless steal version of the tuner has been chosen for the September tests. In this paper the results are presented and discussed.

TUP73: Plasma treatment of bulk Nb surface in the Cl2/Ar discharge*

Marija Raskovic (Department of Physics, Old Dominion University)

Although plasma etching of Nb thin films has been used in production of Josephson tunnel junctions [1], there are no reports on actual plasma treatment of bulk Nb used for SRF cavities. In discharge plasmas, Nb interacts with chlorine and fluorine producing volatile Nb halides. Reactive species (Cl and F radicals and ions) are produced in pulsed d.c., RF, or microwave glow discharges through collision processes. They interact with Nb on the surface producing volatile compounds that are removed from surface in the flow of reactive gas. The production of reactive species and, consequently, Nb removal rate is determined by discharge parameters such as input power, pressure, temperature, electron concentration, etc. In our experiments, two different reactive gases and discharge systems were used. For proof-of-the principle, a BF3 plasma was applied to disk shaped bulk Nb samples in a repetitively pulsed d.c. diode system [2]. Surface roughness characterization of plasma treated samples showed that their roughness was smaller compare to BCP treated samples. A microwave glow discharge system was used for Cl2/Ar reactive gas mixture interaction with disk shaped bulk Nb samples [3]. The etching rate increases with an increasing amount of Cl2 in the gas mixture and it is larger than the sputtering rate obtained in pure Ar. The measured etching rates are comparable to the rates obtained with the electropolishing method. The results of XPS analysis show that no additional contaminants have been introduced in the Nb surface layer. After optimizing experimental conditions to obtain minimum surface roughness on disk shaped bulk Nb samples, the technique will be applied to single cell cavity surface modification. In a parallel effort we are developing a plasma chemical kinetic model of the Cl2/Ar plasma interaction with Nb surface combining available experimental data with calculations. The goal is to better understand the etching kinetics and Nb surface modification in order to optimize the process with respect to etching rate and surface roughness.

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[2] M. Rašković, L.Vušković, S.Popović, L.Phillips, A.-M. Valente-Feliciano, S.B. Radovanov, and L.Godet, Nuclear Instruments and Methods in Physics Research A 569, 663 (2006).

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TUP74: Progress of the Test Cavity Program for the European XFEL

Arne Brinkmann, Jens Iversen, Detlef Reschke, Waldemar Singer, Xenia Singer, Joerg Ziegler (DESY)

Two main goals of the test cavity program for the European XFEL are the qualification of alternative niobium vendors and the investigation of the capabilities of large grain niobium for large-scale nine-cell cavity production. About 25 1.3 GHz single-cell cavities of TESLA shape have been completed at Accel Instruments and DESY. Alternative vendors for high purity fine-grain niobium are ITEP Giredmet, Cabot, Ningxia and Plansee. The in-house fabricated cavities have been tested after 800C firing and final electropolishing (EP) treatment. All cavities exceed gradients of 35 MV/m at high Q-values. For the large grain cavities of high RRR Heraeus niobium gradients up to 41 MV/m have been achieved. The performance after final chemical etching (BCP) is compared to EP for several cavities.

TUP75: PROGRESS ON CAVITY FABRICATION FOR THE ATLAS ENERGY UPGRADE

J.D. Fuerst, K.W. Shepard, M.P. Kelly, S. Gerbick, Z. Conway (ANL, Argonne IL 60439, USA)

An accelerator improvement project has been underway for several years to increase the energy of the ATLAS heavy ion linac at ANL. A new cryomodule containing drift-tube-loaded superconducting cavities is nearing the end of construction, with seven new cavities complete and ready for clean assembly into the cryostat. We describe the present status of the project, focusing particularly on cavity fabrication. Several cost saving techniques suitable for multi-unit production have been used, including wire and sinker electric discharge machining (EDM) part trimming and multi-part electron beam weld (EBW) fixturing. Subsystem fabrication including couplers, slow tuners, and VCX fast tuners is also described as are the clean processing techniques used for particle-free assembly. Performance results from single cavity testing are also presented.

TUP76: PROTOTYPING OF SPOKE CAVITIES AND AUXILLIARY SYSTEMS FOR THE INTERMEDIATE ENERGY SECTION OF THE EURISOL DRIVER

Sebastien BOUSSON (IPN Orsay)

EURISOL is the next generation of Radioactive Ion Beam (RIB) facility which aims at the provision of high intensity beams of radioactive nuclei with variable energy, from a few keV to greater than 100 MeV per nucleon, at an intensity several orders of magnitude higher than those currently available. A new scheme for the driver of EURISOL gives this machine extended capabilities : protons acceleration to a final energy of 1 GeV and 5 mA current, but also deuterons at 200 MeV (total energy) and He3+ at 2 GeV. The intermediate energy part of the driver is based on superconducting (SC) spoke cavities which are under study at the IPN Orsay laboratory. In this paper are presented the experimental results on the beta 0.15 spoke cavity, as well as recent achievements on the cold tuning system and the power coupler. In order to test the fully equipped spoke cavities in an accelerator configuration, a horizontal cryostat has been designed and fabricated: the results of the first cryogenic test of a spoke cavity equipped with its cold tuner inside this cryostat is also detailed.

TUP77: Recent experience with nine-cell cavity performance at DESY

Detlef Reschke, Lutz Lilje (DESY)

The rf performance of the last nine-cell cavity production for TTF/FLASH is analysed with respect to maximum gradient, usable gradient and field limitation. 30 cavities have been manufactured at one company from high RRR niobium (RRR > 300) by two vendors. All cavities have been treated by a long (>150µm) horiziontal EP and 800C firing. The cavity performance after final short (app. 50µm) EP with or without subsequent ethanol rinse as well as a short (10µm) BCP is compared.

TUP78: RECENT RESULTS ON CAVITIES FOR THE SPIRAL 2 SUPERCONDUCTING LINAC

Guillaume Olry (IPN Orsay)

The SPIRAL 2 superconducting LINAC is composed of 2 different families of cryomodules. The first family, in the low energy section, is composed of 12 cryomodules (called cryomodules A), housing a single Quarter-Wave Resonator at beta=0.07. The second family, in the high energy section, is composed of 7 cryomodules (called cryomodules B), housing two Quarter-Wave Resonators at beta=0.12. The frequency of these resonators is 88.050 MHz, and the design goal for the accelerating field Eacc is 6.5 MV/m. A prototype of each family was successfully tested, reaching both of them more than 9 MV/m. Last year, one beta=0.07 and two beta=0.12 pre-series resonators have been ordered. This paper describes the results of these resonators.

TUP79: Results from the Cornell ERL Injector Horizontal Test Cryomodule*

Matthias Liepe, Sergey Belomestnykh, Eric Chojnacki, Valeri Medjidzade, Hasan Padamsee, Valery Shemelin, Chris Macklin, Peter Quigley, James Sears, Vadim Veshcherevich, J. Reilly, Roger Kaplan (Cornell University)

Cornell University is developing and fabricating a SRF injector cryomodule for the acceleration of the high current (100 mA) beam in the Cornell ERL prototype and ERL light source. Major challenges include emittance preservation of the low energy, ultra low emittance beam, cw cavity operation, and strong HOM damping with efficient HOM power extraction. A one-cavity horizontal test cryostat (HTC) version of the full injector cryomodule has been designed, and fabricated recently. The cryostat design has been optimized for precise cavity alignment, good magnetic shielding, and high cryogenic loads from the RF cavities, input couplers, and HOM loads. In this paper we report on results from the first full test of the one-cavity test cryostat, including cavity performance, HOM damping measurements, and cryomodule studies.

* Work supported by NSF.

TUP80: Single Cell Electro-Polishing at CEA Saclay: First Results*

Fabien Eozénou, Melanie Bruchon, Yves Gasser, Yves Boudigou, Jean Pierre Charrier, Bernard Visentin, Stephane Berry, Claire Antoine (CEA Saclay)

The goal of the Work Package 5.1 of the CARE SRF program is to study electro-polishing (EP) of niobium and thus isolate an ideal set of parameters for 1.3 GHz single cell cavity treatment that should be applied to industry. Preliminary experiments have been carried out on samples to guide the program on single-cell cavities. In that way, a set-up for horizontal EP has been installed in our laboratory. This set-up has been successfully qualified with the standard recipe since the first EP on TESLA-shaped cavity has reached a record gradient above 42 MV/m. The search for new parameters makes then sense. Different configurations have been investigated: higher temperature, lower voltage and new acids' concentrations. Different cavities have been electro-polished and results including surface considerations, RF measurements and impurities forming will be related.

* We acknowledge the support of the European Community-Research Infrastructure Activity under the FP6 "Structuring the European Research Area" program (CARE, contract number RII3-CT-2003-506395) and of the "Région Ile-de-France".

TUP81: Stiffened medium beta 704 MHz elliptical cavity for pulsed proton linac

Guillaume Devanz, Pierre Bosland, Stephane Chel, Juliette Plouin, Bernard Visentin (CEA Saclay)

The interest in using superconducting technology in high duty cycle high intensity proton linacs has led to the successful development of high beta cavities. In the framework of the European CARE/HIPPI program, we investigate different options to use the same superconducting technology even in the low energy part of the linac (from 5 MeV to 200 MeV). Different kind of superconducting structures (CH structures, spoke or elliptical cavities) are necessary to cover this whole energy range. We have designed and build a 704 MHz elliptical cavity with a geometrical beta of 0.47 which could be advantageously used in the range 80 MeV up to 200 MeV . It was optimized for minimizing the Lorentz force detuning which is the main limitation of this type of cavities when operated in pulsed mode. The RF and mechanical design of the cavity and the first measurements are presented.

TUP82: Researches on large grain SC cavities at Peking University

Jiankui Hao, Kui Zhao, Baocheng Zhang, Shengwen Quan, Lifang Wang, Jia'er Chen (Institute of Heavy Ion Physics, Peking University, Beijing 100871, China)

Researches on large grain superconducting cavities are carried out at SRF laboratory of Peking University. A 1.3 GHz TESLA type single cell cavity and a 1.3 GHz 2-cell cavity made of large grain niobium were fabricated by Peking University. With collaboration of Jlab, the measured Eacc of the single-cell cavity reached 43.5 MV/m after BCP, bake and high temperature heat treatment.

TUP83: Fabrication studies on multi-cell TESLA-type cavity

Xiangyang Lu, Kui Zhao*, Baocheng Zhang, Shengwen Quan, Lifang Wang, Jiankui Hao, Lin Lin, Feng Zhu, Senlin Huang, Limin Yang, Wencan Xu, Zhenchao Liu, Er-dong Wang, Song Jin, Tianmu Xin, Zhongyuan Yao, Feisi He, Jia-er Chen (IHIP, School of Physics, Peking University, Beijing 100871)

The fabrication studies on multi-cell TESLA-type cavity has been launched at Peking University. The studies are based on the experience accumulation of PKU in SRF and refer other information and experience which collected form other laboratories, DESY, JLab, et al.
In the studies, for the cavity could be tested at high gradient, we focused on the quality control in every step. Those efforts include that: the high pure water system is renewed, a new class 100 (local class 10) clean room is build, the RF measurement systems for cup and dumb-bell are set-up. To control the EBW quality, the series EBW experiments have been done. The device for multi-cell cavity field distribution measurement and field flatness turning has been developed. To improve cavity inner surface, the BEP is used.
For check our fabrication arts, a 9-cell copper cavity and a 5-cell niobium cavity was made.

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TUP84: Introduction of 9 cell accelerator at Peking University

Zhenchao Liu, Shengwen Quan, Feng Zhu, Xiangyang Lu, Baocheng Zhang, Jing Dai, Song Jin, Wencan Xu, Jiankui Hao, Kui Zhao, Jia-er Chen (IHIP, Peking University)

The 9-cell superconducting accelerator module of Peking University (PKU) is in the end of factory check and will be constructed very soon. It will be the first home-made 9-cell superconducting accelerator at Peking University and in China. As the main part of the PKU ERL and FEL project, it is composed of one 9-cell superconducting cavity, liquid helium tank, liquid nitrogen tank, tuning system, power coupler, suspending device, magnetic shielding, measurement and control device. This paper will give a brief description of the 9-cell accelerator module.

TUP85: Development of single cell Superconducting Elliptical Cavity (β=0.45) and SRF Test Facility in IHEP

F.C. Zhao, H. Sun, J. Gu, M.Q. Ge, H.Shi, W.L.Huang, S.C. Zhao (IHEP)

The R&D of 700MHz and scaled 1.3GHz (β=0.45) single cell superconducting cavity for high intensity proton linac has been done. We have completed an optimal design of the cavity and fabrication of three 1.3GHz cavities in China. In order to evaluate the performance of superconducting cavity, the cavity preparation and test facility have been established in IHEP. Two radiation shielded test pits have been built. The larger one, with the size of 1.1m diameter by 5m deep, is for 700MHz cavity test, and another one is for 1.3GHz cavity test. 300W solid-state RF power amplifiers, cryostats and LLRF control are all available. We have made a collaboration with Prof. K.Saito's group in KEK. The 1.3GHz cavities have been tested in IHEP and KEK respectively. The maximum surface field gradient Esp= 42.4MV/m was achieved.

Wednesday, Oct 17, 2007

Wednesday Morning: Oral Session

Session WE1: Student and Young Researchers Session I - Basic SRF & Thin films

WE101: Temperature Map studies on Nearly Oxide-Free, Thin-Oxide and Standart-Oxide Cavities (08:30-08:40)

G. Eremeev (Cornell University)

A few nanometers of niobium oxide cover niobium in niobium cavities, prepared by standard treatments. Since the RF penetration depth is a few tens of nanometers, the niobium oxide and the metal-oxide interface may play role in RF losses of superconducting niobium. In order to understand the cause of phenomena such as the high field Q-slope, medium field Q-slope, and residual resistance, it is important to distinguish the contributions of the niobium oxide and its interface to losses at medium and high fields. XPS and Auger studies have shown that it is possible to reduce significantly the thickness of the oxide layer by heating to 300 C - 400 C for a few hours in vacuum. Leaving the surface in the vacuum does not re-grow the oxide layer. Applying such treatment to a cavity one can reduce the niobium oxide and measure the superconducting RF properties of nearly oxide-free cavity. Then via controllable air exposure one can re-grow oxide and investigate the change in properties as a function of exposure. We performed these experiments and report results of nearly oxide-free, thin-oxide and standard-oxide cavities.

WE102: THERMAL DESIGN STUDIES OF NIOBIUM SRF CAVITIES (08:40-08:50)

Ahmad Aizaz (Michigan State University/NSCL)

The thermal response of niobium cavities remains an active area of research in order to increase the accelerating gradients of future accelerators. The effects of plastic deformation on thermal conductivity of niobium in the phonon transmission regime, as well as on its Kapitza conductance, have been studied. The study reveals absence of the phonon peak after deformation beyond the elastic limit of niobium, with an almost 80% reduction in the thermal conductivity of niobium at 2 K. Deformation also reduced the Kapitza conductance. Low temperature annealing did not recover the phonon peak that was measured before plastic deformation. Annealing at the higher temperatures used during the titanification process, similar to that carried out on the SRF cavities, recovered the lost phonon peak, as well as increasing the Kapitza conductance by 125%. Thermal conductivity measurements of single and bi-crystal niobium samples are also reported in this ongoing research.

WE103: R&D on the 3+1/2 cell DC-SC photo-cathode injector (08:50-09:00)

Wencan Xu, Kui Zhao (IHIP, School of Physics, Peking University)

In order to get high quality electron beam for PKU-ERL-FEL project, A 3+1/2cell DC-SC photo-cathode injector was designed and optimized. The pierce gun and 3+1/2cell superconducting Nb cavity are DC acceleration section and RF acceleration section respectively. The tuning structure for 3+1/2 cell superconducting cavity is also analyzed and designed. The beam parameters of 3+1/2 cell DC-SC photo-cathode injector is also presented in this paper. The disadvantage and problem of 1+1/2 DC-SC photo cathode injector which was for principle demonstration have been improved and overcame in the new design of 3+1/2 DC-SC photo cathode injector.

WE104: Improved Characterization of the Electropolishing of Niobium with Sulfuric and Hydrofluoric Acid Mixtures* (09:00-09:10)

Charles Reece, Hui Tian, Michael J Kelley (Jefferson Lab), Sean Corcoran (Virginia Polytechnic Institute & State University)

Niobium surfaces are commonly electropolished in an effort to obtain optimally smooth surfaces for high-field SRF cavity applications. We report the first use of standard electrochemical analysis techniques to characterize the small-sample electropolishing of niobium using a sulfuric and hydrofluoric acid mixture. Through the use of a reference electrode we are able to clearly distinguish the cathode, electrolyte, and anode polarization potentials that sum to the applied power supply voltage. We then separate the temperature and HF concentration dependence of each. We also report first use of Electrochemical Impedance Spectroscopy on this system and find the EIS data are consistent with simple acceptor-species (F- ion) diffusion-limited conditions in the plateau region, and inconsistent with the presence of a salt film barrier. Clarification of the basic processes is expected to provide an appropriate foundation with which to optimize the preparation of high-field niobium cavity surfaces.

WE105: An investigation of the influence of grain boundaries on flux penetration in high purity large grain niobium for particle accelerators (09:10-09:20)

P.J. Lee, A. Gurevich, A.A. Polyanskii, V. Griffin and D.C. Larbalestier

Presented by ZuHawn Sung (Applied Superconductivity Center, Florida State University)

Grain boundaries (GBs) in niobium cavities may be one of the important causes of extra power dissipation by reducing the field of first vortex penetration because the superconducting gap and the local depinning current density Jb on the GB are reduced. It is therefore important to measure the critical current density Jb and investigate the microstructure at grain boundaries to better understand whether or how grain boundary weakness can affect SRF cavity performance. Our experiments are currently correlating the global (by magnetometer) and local magnetization (by magneto-optical imaging), transport critical current density and atomic scale structure of Nb samples so that a DC analog of the RF surface currents can be developed for real Nb surfaces prepared using cavity optimization treatments. To measure Jb we apply transport current as a function of perpendicular magnetic field on BCP-treated bi-crystals of as-received, high-purity, large-grain niobium sheet. After measurement, we thin the very same grain boundary so that we image the microstructure of the external surface adjoining each GB by scanning transmission electron microscopy (STEM) in conjunction with EELS (Electron Energy Loss Spectroscopy). EELS has shown the presence of stoichiometric niobium oxide on the topmost layers, well within the typical superconducting niobium penetration depth (~ 50nm). 1. now at SACLAY

Session WE2: Student and Young Researchers Session II - SRF Technology - Work on couplers, tuners, LLRF etc.

WE201: Microphonics in CW TESLA cavities and their compensation with fast tuners* (09:20-09:30)

Axel Neumann, Wolfgang Anders, Jens Knobloch, Oliver Kugeler (BESSY GmbH)

Superconducting Linac cavities of single pass Free Electron Lasers or Energy Recovery Facilities have a very low or near zero beamloading and are thus operated at a high quality factor with a narrow RF resonance, respectively. Following the phase and amplitude stability of the RF field is very easily degraded by any kind of mechanical detuning. In cw operation microphonics is the main error source for cavity detuning. To achieve high field stabilities in the regime of 0.02° in phase and 1e-3 in amplitude a fast tuning system is mandatory to compensate the detuning. In this paper the microphonics detuning measured at HoBiCaT will be shown and analyzed with respect to a detuning controller application. The controller design is given by a combination of a feedback and adaptive feedforward approach based on fast piezo tuners implemented in the Saclay coarse tuner designs. It will be shown, that at 1.8 K and loaded quality factors between 3e7-1e8 a compensation of a least a factor of two is achievable.

* Work partially supported by the EU Commission in the sixth framework programme, contract no 011935 EURO-FEL-DS5, BMBF and Land Berlin.

WE202: Different sputtering configurations for coating 1.5 GHz copper cavities (09:30-09:40)

Giulia Lanza, Edoardo Bemporad, Fabio Carassiti, Marco Sebastiani (University of Rome, Rome, Italy), Hasan Padamsee (Newman Lab, Cornell University, Ithaca, USA), Vincenzo Palmieri, Niccolò Patron, Cristian Pira, Sergey Stark (LNL-INFN, University of Padua, Italy)

In the framework of the attemps to densify the sputtering discharge two different sputtering configuration are reported: - a mixed bias magnetron sputtering technique has beeen explored for depositing niobium into 1,5 GHz copper cavities. Results are presented and compared with the standard CERN technique.The superconducting and high resolution morphological and mechanical properties of niobium films sputtered onto the inner walls of electropolished cavities, have been studied as a function of the deposition technique and nature of the substrate. Even if niobium films coated with the bias technique show a higher density and Tc similar to the other films, they present damage due to the surface beneath and not higher RRR values. Preliminary RF tests are presented. - post Magnetron sputtering in thermoelectric emission regime have been investigated and is under improvement in order to increase the RRR values of sputtered Nb: superconducting and structural properties of the obtained films have been measured to check the technique capability and its possible application for coating cavities.

WE203: The progress at LNL on Nb3Sn and V3Si (09:40-09:50)

Silvia Deambrosis, Vincenzo Palmieri (INFN-LNL, Padua University), Giorgio Keppel, Niccolò Patron, Nicola Pretto, Serguey Stark, Fabrizio Stivanello, Vanessa Rampazzo (INFN-LNL), Antonio Rossi (Padua University), R. G. Sharma (INFN-LNL, Nuclear Science Center, New Delhi, India)

In the framework of the research for a valid alternative to Nb for RF applications, Nb3Sn and V3Si have been investigated at LNL. Nb3Sn - The chosen technique is based on the molten Tin diffusion method and it has been progressively modified to improve our samples superconducting properties (Tc and DTc) and to eliminate Sn traces on the Nb3Sn surface. Our “Hybrid process” seems to be the most promising (Tc = 16,5 K and DTc = 0,3 K, no residual Sn traces on the sample surface, no Sn rich phases). The present point is to test the obtained material RF properties: the best recipe used for samples has been applied to coat a 6 GHz Nb cavity and now we can show our preliminary results. At the same time, we are going to study the multilayer technique to have Nb3Sn good superconducting cavities: the first attempt gave a superconducting deposition with Tc = 17,9 K and DTc =.0,02 (four contacts measurement). V3Si - This A15 intermetallic compound has been obtained using the thermal diffusion of Silicon into Vanadium: bulk V is heat treated in a SiH4 atmosphere for several hours and then annealed in vacuum. The samples superconducting properties are encouraging (Tc = 15,5 K and DTc = 0,2 K). At the moment, we are trying to use plasma during the sylanization process to avoid the hydrogen presence into the growing films. The first V3Si coating grown has Tc = 15,7 K and DTc = 0,22 K: this result is already comparable to what we had with the “traditional” technique”. To check the material RF performances we prepared a V3Si 6 GHz cavity (sylanized for 4h at 850°C with p(SiH4) = 5x10-3 mbar): it has been measured several times after a heating treatment in vacuum progressively longer (6h at 850°C, 12h at 850°C, 32h at 850°C).

WE204: Application of plasma cleaning to cavity processing (09:50-10:00)

Niccolò Patron (INFN-LNL), Matthias Bäcker (Aachen University, Germany), Silvia Maria Deambrosis, Vincenzo Palmieri (INFN-LNL, Padua University), Larry Phillips (TJNAF)

Atmospheric-pressure plasma treatment is an emerging, very versatile and inexpensive technique used in a variety of surface processes such as dry etching, surface treatments and modification of surface wettability. An analysis of our studies on different configurations of RF, MW and DC atmospheric plasma devices will be given in order to outline which can be the more suitable and efficient device for the treatment of the cavity inner surface. We report the effect of the increased Nb surface hydrophilicity and results on increased performances of 6 GHz cavity after atmospheric plasma treatment will be shown.

WE205: Electro-Mechanical Properties of Spoke-Loaded Superconducting Cavities (10:00-10:10)

K.W. Shepard, M.P. Kelly, J.D. Fuerst, J. Delayen, and G.K. Davis

Presented by Zachary Conway (Argonne National Laboratory)

This paper presents experimental data characterizing the electro-mechanical properties of superconducting spoke-loaded cavities developed for high-intensity ion-linac applications, such as the cw ANL Advanced Exotic Beams Laboratory (AEBL) driver linac and the pulsed FNAL High Intensity Neutrino Source (HINS) proton driver linac. High-gradient cw operation at 4.2 K can produce violent boiling in the liquid helium coolant causing microphonic frequency noise. A spoke cavity designed to minimize the effects of helium pressure on RF eigenfrequency, the total microphonic induced RF frequency variations, were found to be smaller than the phase noise in the reference oscillator. To determine the pulsed cavity RF performance the Lorentz transfer function was measured and used to predict the dynamic detuning in pulsed operation. There is good agreement between the predicted fit and the measured data, demonstrating the utility of the Lorentz transfer function, which can completely characterize the dynamics of the coupling between the mechanical cavity structure and the cavity RF field due to the Lorentz force. Simulations of a pulsed spoke-loaded cavity operating with 1 ms 9.6 MV/m pulses repeating every 0.1 s (the HINS driver linac operating parameters), show that the dynamic RF frequency variations due to the Lorentz force are 50% greater than the loaded cavity bandwidth in the triple-spoke cavity studied.

WE206: First Test Results of Half-Reentrant Single-Cell Superconducting Cavities (10:10-10:20)

Mandi Meidlinger, John Bierwagen, Steve Bricker, Chris Compton, Terry Grimm, Walter Hartung, Matthew Johnson, John Popielarski, Laura Saxton, Richard York (Michigan State University), P Kneisel (JLab, Newport News, VA 23606), Evgeny Zaplatin (FZ Juelich)

Particle physicists are on the verge of reaching a new frontier of physics, the Terascale, named for the teravolts of kinetic energy per particle required to explore this region. To meet the demand for more beam energy, superconducting cavities need to achieve higher accelerating gradients. It is anticipated that niobium cavities will reach a performance limit as the peak surface magnetic field approaches the critical magnetic field. "Low loss" and "reentrant" cavity designs are being studied at CEBAF, Cornell, DESY, and KEK, with the goal of reaching higher gradients via lower surface magnetic field, at the expense of higher surface electric field. At present, cavities must undergo chemical etching and high-pressure water rinsing to achieve good performance. While these surface treatment methods have been effective for low-loss and reentrant single-cell cavity designs, it is not clear whether the same methods will be adequate for multi-cell versions. A "half-reentrant" cavity shape has been designed with RF parameters similar to the low loss and reentrant cavities, but with the advantage that the same surface preparation should be reliable for multi-cell half-reentrant cavities. Two 1.3 GHz prototype single-cell half-reentrant cavities have been fabricated and tested at Michigan State University. One of the cavities was post-purified, etched via buffered chemical polishing, and tested at Jefferson Laboratory, reaching a maximum accelerating gradient of 35 MV/m. The half-reentrant cavity concept, design, fabrication, and test results will be presented.

Session WE3: Advances in SRF technology II

WE301: Progress in Seamless Cavities (11:00-11:20)

Waldemar Singer (DESY)

In connection with the ILC activities the interest to fabrication of seamless cavities is increased. Seamless technique has potentially an advantage over the standard cavity fabrication by deep drawing and electron beam welding. Seamless technique allows avoiding the risk of performance degradation at the welding area. Last progress in development of the superconducting connection between adjacent cavities opens the way to manufacture the accelerating cavities as a rotationally symmetric cells part by seamless fabrication technology and extra an asymmetric end groups. Lower cost of fabrication especially for a large series and better statistic in RF-performance can be expected. Problems of the fabrication of seamless tubes and cavities from bulk niobium and clad NbCu are mainly solved on laboratory level. Fabrication of multi cell cavities was recently proven. First 9- cell cavities of TESLA shape are produced. For the preparation of seamless cavities the combination of the centrifugal barrel polishing CBP with electropolishing seams to be reasonable. CBP allows reaching more uniform material removal and smooth off the surface for the next treatment steps. The highest achieved accelerating gradient for bulk niobium cavities is up to now the same for both seamless and welded versions (ca. 40 MV/m). The NbCu clad cavities demonstrated an accelerating gradient up to 40 MV/m too. The still remaining draw back of NbCu cavities is the frozen-in magnetic flux, caused by introduced thermo-currents.

WE302: Status of SC Spoke Cavity Development (11:20-11:40)

Michael Kelly (Argonne National Laboratory)

Superconducting (SC) TEM-class spoke cavities are required for proposed cw and pulsed ion linac applications world-wide. Laboratories and institutions have demonstrated high field performance (Epeak>30 MV/m) in single- and multi-spoke geometries intended for use with ions over the full mass range and for velocities $0.15 < v/c < 0.8$. Recent results show spoke cavities, initially designed for 4 K operation, now operate with substantially better overall efficiency at 2 K, resulting in large part from performance gains due to clean assembly and hydrogen degassing. Total Rf losses less than 10 nanoOhm, even for high accelerating fields required in operations (Epeak~30 MV/m) have been achieved. Fast tuning, required for most operations, has been demonstrated using a piezoelectric- and magnetostrictive-based mechanical tuners. The status of recent activities and plans at several laboratories are discussed.

WE303: Review of New Tuner Designs (11:40-12:00)

Shuichi Noguchi (KEK)

(Abstract not submitted)

WE304: Review of HOM couplers and broadband absorbers (12:00-12:20)

Nikolay Solyak (Fermi National Accelerator Lab)

(Abstract not submitted)

WE305: Overview of Input Power Coupler Developments, Pulsed and CW (12:20-12:40)

Sergey Belomestnykh (Cornell University)

While many successful high power fundamental input couplers have been developed over years for superconducting cavities, projects like the International Linear Collider (ILC), Energy Recovery Linacs (ERLs), Free Electron Lasers (FELs), and Superconducting RF (SRF) guns bring new challenges. As a result, a number of new coupler designs, both for pulsed and CW operation, was proposed and developed recently. In this paper a brief discussion of design options and technical issues associated with R&D, testing and operation of the high power couplers will be given first. Then we will review existing designs with an emphasis on new developments and summarize operational experience accumulated in different laboratories around the world.

WE306: Superconducting RF Photoinjectors: an Overview (12:40-13:00)

Sekutowicz Jacek (DESY)

R&D programs based on various approaches at AES, Beijing University, BNL, FZ-Rossendorf, JLab and DESY will lead in the near future to low emittance continuous wave (cw) operating SRF-guns, which are indispensable devices for the cw operating superconducting linacs driving the FEL facilities. This contribution covers present status of these programs and progress made since the last SRF2005 Workshop at Cornell University.

Wednesday Afternoon: Poster Session (14:00-18:30)

1. Advances of new technology of SRF

WEP01: Studies of Alternative Techniques for Niobium Cavity Fabrication

Christopher Compton, Derek Baars, Tom Bieler, Steve Bricker, Terry Grimm (Michigan State University), Lance Cooley, Hairong Jiang, Bob Kephart (Fermi National Accelerator Laboratory)

Michigan State University (MSU), in collaboration with Fermi National Accelerator Laboratory (FNAL), is investigating alternative fabrication techniques for superconducting radio frequency (SRF) cavities. The main goals are to reduce cavity fabrication costs and expand possibilities for advanced cavity designs. At present, SRF cavities are fabricated via deep drawing of parts from sheet material and electron beam welding (EBW) to join the parts together. EBW produces welds of high quality, but the procedures are costly and time-consuming. Alternative technologies being explored include tungsten inert gas (TIG) welding of Nb, hydroforming of Nb, and electron beam free form fabrication (EBFFF) of Nb. If techniques can be developed which do not degrade the Nb purity, TIG welding could reduce or eliminate the need for EBW. Hydroforming could also be an alternative to deep drawing and EBW. As has been demonstrated by several other groups, complete cavities can be hydroformed from Nb tubes in one step using internal pressure and outer dies. Hydroforming of cavities in an industrial setting is presently being explored by MSU. EBFFF is a new technique for forming parts from wire stock. The technique was developed to form parts from materials that are expensive and not readily available in large sizes. Wire from a spool is melted with the electron beam in a controlled manner to produce the desired shape. Though it may not be suitable for fabrication of a complete cavity, EBFFF could be used to produce tubes for hydroforming or parts for drift tube cavities. The possibility of producing single crystal tubes using EBFFF is being explored.

WEP02: Superconducting RF Photocathode Gun for Low Emittance Polarized Electron Beams*

Douglas Holmes, Hans Bluem, Bruce Abel, Anthony Favale, Ed Peterson, John Rathke, Tom Schultheiss (Advanced Energy Systems Inc.), Jorg Kewisch, Ilan Ben-Zvi, Andrew Burill, Ranjan Grover, David Pate, Triveni Rao, Robert Todd (Brookhaven National Laboratory)

The use of an RF electron gun with a magnetized cathode in place of a DC gun for ILC may eliminate the need for emittance damping rings. So far only DC guns have been used to provide polarized electron beams because of the very high vacuum level needed for survival of the Gallium Arsenide (GaAs) cathode material used to generate polarized electrons. Maintaining adequate lifetime of GaAs cathode material requires vacuum levels in the 10e-11 torr range. While vacuum levels around the 10e-9 torr range are common in a normal conducting RF gun, the cryogenic pumping of the cavity walls of a superconducting RF gun is expected to provide vacuum levels in the range needed for GaAs cathode longevity. Advanced Energy Systems, Inc. is collaborating with Brookhaven National Laboratory to investigate the generation of polarized electron beams using a superconducting RF photocathode gun. The team is developing an experiment to study the quantum lifetime of a GaAs cathode in a superconducting RF cavity and investigate long term cavity performance while integrated with a cesiated GaAs cathode. This paper reviews the design and analysis performed to develop a method to prepare and install GaAs cathodes into a superconducting cavity in support of this experiment.

* This work is supported by The Department of Energy under SBIR Application No. 80384S06-II grant

WEP03: SUPERCONDUCTING STORAGE CAVITY AT 56 MHz FOR RHIC*

Ilan Ben-Zvi, Xiangyun Chang, Harald Hahn, Vladimir Litvinenko, Damayanti Naik (Brookhaven National Laboratory)

We will describe the motivations and plans to use a 56 MHz SRF cavity for beam storage at the Relativistic Heavy Ion Collider (RHIC). This extremely low frequency for a cavity applied to a relativistic beam will be a single 15 cm gap quarter wave resonator, with the beam traveling along the symmetry axis. The voltage provided will be approximately 2.5 MV. Special considerations must be made to accommodate the large reactive beam power due to the 0.25 ampere RHIC current and HOM damping. The resonator design, including surface field optimization and multipacting calculations will also be presented.

* Work performed under the auspices of the U.S. Department of Energy.

WEP04: Surface Roughness Characterization of Niobium Subjected to Incremental BCP and EP Processing Steps*

Charles Reece (Jefferson Lab), Hui Tian, Michael J. Kelley (JLab & College of William and Mary), Guihem Ribeill (North Carolina State University)

Niobium surfaces are typically etched by some means in order to obtain a “clean” and “smooth” surface desirable for high-field SRF cavities. We report the results of the systematic characterization of the roughness of a set of niobium samples prepared from fine-grain high-RRR-grade sheet stock as has been typical of SRF cavities. Using a Power Spectral Density (PSD) analysis technique we are able to combine data from scales accessible to stylus profilometry and atomic force microscopy to obtain a more complete characterization of the surface topology produced by various chemical polishing steps. We report the evolution of the niobium surface PSD as a function of applied etching and polishing steps. PSD offers a quantitative description of the harmonic scales of roughness and may thus be a means of distinguishing roughness that “matters” to SRF cavity performance and roughness that does not.

* Presenter: Hui Tian. This manuscript has been authored by Jefferson Science Associates, LLC under U.S. DOE Contract No. DE-AC05-06OR23177. The U.S. Government retains a non-exclusive, paid-up, irrevocable, world-wide license to publish or reproduce this manuscript for U.S. Government purposes. Ribeill was supported by the US DOE Summer Undergraduate Laboratory Internship (SULI) program.

WEP05: TESTING THE FLASH SUPERCONDUCTING ACCELERATING MODULES

D Kostin, W.-D.Moeller, A Goessel, R Lange (DESY, Notkestrasse 85, 22607 Hamburg, Germany)

The Free-electron LASer in Hamburg (FLASH), operating in the VUV wavelengths range,is not only the outstanding research facility in Europe, but also the test bench for the TESLA superconducting linac technology. Started XFEL, as well as planned ILC,both depend on the progress made here. New module test stand was recently put into operation at DESY. The FLASH linac has been upgraded to 6 superconducting modules. The accelerating modules testing experience and the results of the tests are put in the base of this paper, describing the recent developments of the TESLA technology.

WEP06: SPIRAL 2 PROTOTYPE COUPLER PREPARATION AND RF CONDITIONING

Yolanda GOMEZ MARTINEZ (LPSC / IN2P3 / CNRS), Maud Baylac, Thierry Cabanel, Jean Marie Carretta, Yolanda Gómez Martínez, Denis Marchand, Roger Micoud, Fabrice Pancher, Damien Tourres, Francis Vezzu (LPSC)

3 prototype radiofrequency couplers are been fabricated, prepared and conditioned. They will be mounted in the prototype cryomodules of the SPIRAL 2 superconducting linac. After the cryomodules are tested at full power, the SPIRAL2 coupler series will be fabricated. This paper describes the coupler preparation and the first results of their conditioning.

WEP07: The Cornell ERL Main Linac Concept*

Matthias Liepe, Sergey Belomestnykh, Eric Chojnacki, Valeri Medjidzade, Hasan Padamsee, Valery Shemelin (Cornell University)

Cornell University is in the process of developing the technology for an Energy-Recovery-Linac driven x-ray light source. Part of this accelerator will be a 5 GeV superconducting linac operated in cw mode. Among the many challenges faced by this linac are a high total beam current of 200 mA, emittance preservation of an ultra low emittance beam, and cw cavity operation at a high loaded Q above 5e7. In this paper we describe our solutions to these demands, including cavity design, HOM damping schemes, and cryomodule layout.

* Work supported by NSF.

WEP08: Upgrade of the PIAVE-ALPI linac low-beta section at LNL

Alberto Facco (INFN-LNL)

The superconducting linac PIAVE-ALPI includes a low-beta section made of 20 bulk niobium quarter wave resonators, working at 80 MHz, with beta=0.047 and 0.055. Originally designed for operation at 3 MV/m with 7 W rf power, the on-line resonators have quality factors that allow significantly higher gradients, limited at present by the existing rf system capabilities. An upgrade program has started at LNL, that includes the construction of 4 more cavities, the adoption of 1 kW rf power amplifiers and modifications of the cryostats that will allow cooling of the rf couplers. The final goal is to increase the voltage gain in the low-beta section from the present value of about 10 MeV/q to above 20 MeV/q, achieving efficient acceleration of heavy ions with mass number around 200.

WEP09: Vacuum Sealing Problem of ISE Cavity with large beam tube

Juho Hong, I. Ko (POSTECH), Kenji. Saito, F. Furuta, T. Saeki, H. Inoue, Y. Morozumi (KEK)

Now KEK is developing LL 9-cell cavity for ILC ACD. So far four Ichiro 9-cell cavities were fabricated and tested but the performance was not great. Two end single cell cavities with large beam pipe have been fabricated and to tested to understand the low performance. We have found out that one cause of these problems is power loss at the vacuum sealing gap between cavity beam flange and the end plate. We have modified the sealing configuration and solve this problem. In this paper, the results of simulation and cavity measurement results will be presented.

WEP10: VERTICAL TEST RESULTS ON THE STF BASELINE 9-CELL CAVITIES AT KEK

Eiji Kako, Hitoshi Hayano, Shuichi Noguchi, Toshio Shishido, Kensei Umemori, Yasuchika Yamamoto (KEK), Ken Watanabe (GUAS/AS(KEK)), Hiroshi Sakai, Kenji Shinoe (ISSP), Sun Ik Moon (POSTECH), Qing Jin Xu (IHEP)

The STF-Baseline superconducting cavity system, which includes four TESLA-type 9-cell cavities, input couplers and frequency tuners, has been developed for the future ILC project. A main improvement in the cavity system is a very stiff design in a He vessel and a cavity tuning system, which can relax a cavity deformation due to Lorentz force. Making clear the performance level of four 9-cell cavities, which were fabricated by “a Japanese company” and were prepared by “existent infrastructures at KEK”, is the most important purpose in the whole vertical test. Total 14 vertical tests on four 9-cell cavities were carried out repeatedly. The obtained Eacc,max in the final performance was 29.4 MV/m in the #2 cavity, and the others are 20.8, 20.5 and 20.2 MV/m, where Qo values higher than 1x1010 was achieved in all cavities. Peculiar phenomena, like increasing of Qo values with higher Eacc or very slow degradation of Qo values, were observed in the vertical tests. Summary of the vertical test results on four 9-cell cavities will be presented in this paper.

TUP11: Parameter measurement of 2cell superconducting cavity

Shen xuming, Bai wei (Institute of Applied electronics, CAEP, 621900), Sun hong, Ge mingqi (Superconducting test Lab. IHEP, Beijing, 100049)

The main parameters of a 1.3GHz, 2cell TESLA type superconducting niobium cavity, designed and developed by Peking university, are simulated using MAFIA in institue of applied electronics, CAEP. the curves of Eacc to Q0 and Rs to 1/T relations are measured under 2K temperature, after this cavity treated by CP, rinsed by high pressure de-ionized water and vacuum pumped. Results show that Eacc and Q0 of this cavity reaches 7.06MV/m and 1.2*1010 each.

Key words: 2cell superconducting cavity; Superfluid Helium; cooling by Vacuum pumped

TUP12: Design of the Compact High Average Current DC-SC Photo-injector at PKU

Feng Zhu (IHIP, School of Physics, Peking University)

A new compact high average current DC-SC photo-injector has been designed at Peking University. The main Part of the injector consists of a DC pierce gun and a 3+1/2cell superconducting cavity. The optimization of the DC gun and superconducting cavity are presented in this paper. The simulation results show that the new injector can provide high average current electron beams with bunch charge of 100pc, cw (or high repetition rate mode) operation, transversal emittance lower than 2 mm-mrad and bunch length of 4 ps.

2. New and important projects

WEP13: Cavity Diagnostic System for the vertical test of the Baseline SC Cavity in KEK-STF

Yasuchika Yamamoto, Hitoshi Hayano, Eiji Kako, Shuichi Noguchi, Toshio Shishido, Kensei Umemori (KEK), Sun Ik Moon (POSTECH), Hiroshi Sakai, Kenji Shinoe (ISSP), Ken Watanabe (GUAS/AS(KEK)), Qing Jin Xu (IHEP)

This paper reports the result obtained by the cavity diagnostic system for the vertical tests of the Baseline SC Cavity in KEK-STF. This system consists of the carbon resistors and the PIN photo diodes. They are attached around the equator of the cavity and fixed. And, a few PIN photo diodes are attached on the axis of the cavity. The data sampling time is 100 or 200msec. The heating spots around the equator were observed by the carbon resistors. Although all cavities experienced the centrifugal barrel polish twice, the heating spot around the equator remained.

WEP14: Commissioning and Early Operating Experience with the Fermilab Horizontal Test Facility*

Elvin Harms, Andy Hocker (Fermilab)

The Horizontal Test Facility at Fermilab became fully operational in July 2007. This facility allows testing of single 1.3 and 3.9 GHz cavities within two caves: CC2 and HTS which share common RF and Interlock systems. We report on commissioning and early operating experience with the new HTS area as well as updated status of Capture Cavity 2.

* Work supported by the U.S. Department of energy under contract No. DE-AC02-07CH11359

WEP15: Commissioning and Initial Results from Fermilab's Vertical Test Stand for SRF Cavities*

Joe Ozelis (Fermilab)

Fermilab has constructed a facility for vertical testing of SRF cavities, operating at a nominal temperature of 2K, to be used as part of the global International Linear Collider (ILC) effort to improve cavity processing and performance reproducibility. Following successful cryogenic commissioning, the first tests of single cell and 9-cell ILC-style cavities were performed. These first test results are presented, along with a discussion of present measurement accuracy and plans for facility optimization.

* Fermilab is operated by Universities Research Association, Inc. for the U.S. Department of Energy under contract DE-AC02-76CH03000

WEP16: Commissioning of BEPCII superconducting RF system

Yi Sun (IHEP)

There are two RF stations for the BEPCII double-ring machine. Two 499.8MHz superconducting cavities, similar as the KEKB type, had been fabricated by Mitsubishi Electric company since 2003. These two SCC had passed the vertical test at the beginning of 2005, and the horizontal test in the summer of 2006, respectively. Since Nov.2006, the two SCC had been employed in the first beam commissioning of the synchrotron radiation (SR) mode, also the e+/e- colliding mode. During the SR operation, 200mA/2.5GeV with 80KW beam power was reached under 1.3MV RF voltage from the East cavity, and the maximum injection beam current at 1.89GeV had reached 500mA. During the e+/e- colliding mode, the beam current of either e+ or e- ring had over 100mA. This paper will give a brief introduction about the commissioning of the BEPCII RF system.

WEP17: Considerations on the third harmonic rf of the European XFEL

Elmar Vogel (DESY)

Ultra short bunches with high peak current are required for the creation of high brilliance coherent light in the x-ray range in undulators. At the European x-ray free electron laser (XFEL) they will be obtained by a two stage bunch compression scheme based on off the rf field crest acceleration and transverse magnetic chicanes. The deviation of the rf field's sine shape from a straight line leads to long bunch tails and reduce peak current. This effect will be eliminated by adding a third harmonic rf system. The paper surveys the basic principle for the third harmonic rf, the most relevant design parameters, the actual status of beam physical examinations and potential concepts for the technical realization.

WEP18: Cryogenic system for acceptance tests of SRF cavities of BEPCII

Z. G. Zong (IHEP)

In the upgrade project of Beijing Electron Positron Collider (BEPCII), two superconducting RF cavities are employed in the double storage rings, one for electron and another for positron. A cryogenic test station was constructed for acceptance tests of SRF cavities of BEPCII. The preliminary commissioning of the cryogenic system was carried out. The cryogenic system showed very robust in case of quench. In this paper, the performance of the cryogenic system are presented. The strategies of the cooling down SRF cavities and protection against cavities quenches are also described.

WEP19: Cryogenic System for BEPCII Superconducting Cavity

Yaping Liu (IHEP)

In order to improve the luminosity of the Beijing electron positron collider, two KEKB type 500MHz superconducting cavities are adopted in the rebuild project which is named as BEPCII. These two cavities are installed in e+ and e- ring, respectively. They are cooled in liquid helium bath contained in a vacuum insulated vessel. Cryogenic system is designed and constructed to provide the operating circumstance for the cavities. This paper is dedicated to briefly introduce the BEPCII cryogenic system for the cavities.

WEP20: Design And Simulation Of Power Couplers For Multiple Power Levels, 325 Mhz Spokes Cavities*

QuanSheng Shu, J. Susta, G. F. Chen, I. Phipps, F. H. Lu (AMAC Inc. Newport News, VA 23606), T. Khabiboulline, N. Solyak (Fermilab Chicago, IL 60510)

Three different power levels (25kW, 100kW and 210kW) are required for the 325 MHz Fermilab Proton Driver couplers in order to increase the protons energy up to 8 GeV in a driver Linac. The particles must be accelerated through various stages and the problem identified by the project is that no High RF power coupler for these cavities has ever been designed and produced using US industrial capabilities. AMAC proposed a novel resolution by development of innovative modular, multiple power levels, 325 MHz spoke cavities power couplers, which can cost effectively meet three type cavities with one coupler design. The simulation and concept design are presented. The results of HFSS, MAFIA, ANSYS, and Multipacting are also discussed.

* The project is sponsored by the US Department of Energy (2007)

WEP21: Electrical axes of TESLA cavities

Anton Labanc (DESY)

Precise alignment of cavities to the beam is one of strong requirements in order to obtain high quality beam. A missalignment could cause unwanted interaction between the beam and electromagnetic fields in the cavity, both accelerating field and wakefields. Up to now the eccentricity of cells is measured mechanically on the outer side of cell equators. In this way measured eccentricity could be not precise in case of not uniform cavity wall thickness or in case of cavity wall deformation on other place than measured equator. Therefore an alternative method based on small perturbation field mapping was developed and applied on some cavities.

WEP22: Electron activity detection by inner conductor of XFEL input couplers

Anton Labanc (DESY)

The most successful co-axial input coupler used up to now with TESLA cavities, the TTF3 coupler, uses three small pickup (one in the cold part and two in the warm part) in order to detect multipacting, residual gas discharge or field emmision and to trigger the interlock. These pickups are expensive vacuum feedthrougs and their electronic interface must be very sensitive and therefore complicated and also expensive. The base of the inner conductor is RF grounded, but DC insulated. This proposes an alternative and cheaper interlock solution for the XFEL - to measure free electron current between inner and outer conductor of the coupler through externally connected DC path.

WEP23: Fabrication and Test of the 500MHz SC Modules for the BEPCII

Zhongquan Li, G. Wang, W. Pan, Y. Sun, Shaopeng Li, Qiang Ma (IHEP), Takaaki Furuya, Shinji Mitsunobu, Kazunori Akai, Yasuchika Yamamoto (KEK)

Two KEKB type HOM damped SC cavities constructed during past three years, those SC module are designed and employed for the BEPCII, the upgrade project of the Beijing Electron and Positron Collider, and already operated smoothly, it's a products of successful collaboration among the Mitsubishi Electric Co (MELCO), KEK and IHEP of China. The cavity module is fabricated and surface treated by MELCO with the help of KEK, the vertical test and the high power test of coupler and damper was carried out in KEK and final acceptance test was done in IHEP.

WEP24: Field emission from single crystal and large grain Nb cathodes

Arti Dangwal, Günter Müller (Berg. Universität Wuppertal), Detlef Reschke, Xenia Singer (DESY)

Appreciable suppression of field emission (FE) from metallic surfaces have been achieved by the use of improved surface cleaning techniques, and dry ice cleaning (DIC) has emerged recently as a very effective tool in this respect [1]. In order to understand the effects of surface preparation on FE, systematic measurements were performed on five single crystal and three large grain samples of high purity (RRR > 300) Nb, by means of AFM, XRD, high resolution SEM and dc field emission scanning microscope (FESM). The mμm and others for 100 μsamples were treated with BCP, half of those for 30 removal of surface damage layer, followed by a final high pressure water rinsing. The samples with longer BCP treatment showed the onset of FE at slightly higher fields. A low temperature (~ 150 °C) heat treatment in high vacuum (10-6 mbar) chamber for 14 hours, on a selected large grain Nb sample, gives the evidence for the grain boundary assisted FE at very high fields of 250 and 300 MV/m. Finally, an interesting correlation between sizes of all investigated emitters derived from SEM images with respect to their respective onset fields has been found, which might facilitate the quality control of superconducting radio-frequency cavities for linear accelerators.

[1] A. Dangwal, G. Müller, D. Reschke, K. Floettmann, and X. Singer, acc. by J.Appl. Phys. 07.

WEP25: Final Tests and Commissioning of the 400MHz LHC Superconducting Cavities

Pierre Maesen, Edmond Ciapala, Gabriel Pechaud (CERN)

The four LHC RF modules, each containing four 400 MHz single cell cavities, were successfully completed and installed in the LHC tunnel in 2006. A number of minor modifications were made to the original construction to improve reliability in operation and to obtain tighter control on the otherwise large spread in the tuning ranges of individual cavities. After fitting of the variable power couplers, careful power processing was applied to bring all cavities to 8 MV/m, i.e. 1.5 times the nominal, and to the maximum 300 kW forward power. Reaching the goal of full performance without major incident has been the result of careful clean room assembly, careful vacuum operation and ensuring proper operation of all protection systems during RF operation. Preparation for operation in the LHC is now ongoing, where the modules will operate from same cryogenics distribution line as the LHC's superconducting magnets.

WEP26: High Power Tests of Input Couplers for Cornell ERL Injector

Vadim Veshcherevich (Cornell University)

RF power couplers for the ERL injector, currently under construction at Cornell University, have been fabricated. The couplers were assembled in pairs in the liquid nitrogen cryostat, built for their tests. First two couplers were tested using an IOT transmitter and a resonant ring for additional power amplification. They were successfully tested up to the goal power level of 50 kW CW and used later for tests of the first injector cavity. However, the first pair of couplers showed excessive temperature rise in some points. Therefore, minor changes in the design have been done to improve cooling. The couplers of updated design were tested from a klystron. In situ baking was implemented for coupler installed in the cryostats.

WEP27: Horizontal Tests for Crab Cavities in KEKB

Yasuchika Yamamoto, Masaaki Ono, Kazunori Akai, Kiyokazu Ebihara, Takaaki Furuya, Kazufumi Hara, Teruya Honma, Kenji Hosoyama, Atsushi Kabe, Yuuji Kojima, Shinji Mitsunobu, Yoshiyuki Morita, Hirotaka Nakai, Kota Nakanishi (KEK), Toshiharu Nakazato (JASRI), Hiroshi Hara, Katsuya Sennyu, Takeshi Yanagisawa (MHI KOBE), Takayuki Kanekiyo (HITACHI Co. LTD)

Two Crab cabities were assembled and tested in KEK last year. This paper reports the detail of these horizontal tests. RF conditioning, tuner drive test, tuner phase measurement, loaded Q-value measurement, unloaded Q-value measurement and tuner feedback check were done in these tests. Two Crab cavities were achieved above the operational level, 1.4MV. Although the tuner performance were different between two Crab cavities, it was found that this problem was not significant after the beam commissioning.

WEP28: Latest results of ILC 9-cell cavities electropolished and vertical tested at JLAB

Rong-Li Geng (Jefferson Lab)

It has been over a year since JLAB started processing and testing ILC 9-cell cavities in the frame work of ILC cavity R&D, aiming at the goal of a 35 MV/m gradient at a Q0 of 1E10 with a yield of 90%. The necessary cavity processing steps include field flatness tuning, electropolishing (EP), hydrogen out-gassing under vacuum, high-pressure water rinsing, clean room assembly. These are followed by RF test at 2 Kelvin. Ultrasonic degreasing with Micro-90, an effective post-EP rinsing recipe discovered at JLAB, is routinely used. Six industry manufactured 9-cell TESLA-shape cavities are processed and tested repeatedly. So far, 27 EP cycles are accumulated, corresponding to more than 60 hours of active EP time. An emphasis put on RF testing is to discern cavity quench characteristics, including its nature and its location. Often times, the cavity performance is limited by thermal-magnetic quench instead of field emission. The quench field in some cavities is lower than 20 MV/m and remains unchanged despite repeated EP, implying material and/or fabrication defects. The quench field in some other cavities is high but changes unpredictably after repeated EP, suggesting processing induced defects. Based on our experience and results, several areas are identified where improvement is needed to improve cavity performance as well as yield.

WEP29: Status and plans for an ILC accelerator test facility at Fermilab*

Michael Church, Helen Edwards, Jerry Leibfritz, Sergei Nagaitsev (FNAL), Philippe Piot (FNAL/NIU)

A 750 MeV electron beam test facility at Fermilab is in the planning and early construction phase. An existing building is being converted for this facility. The photoinjector currently in use at the Fermilab NICADD Photoinjector Laboratory (FNPL) will be moved to the new facility and upgraded to serve as an injector for a beam acceleration section consisting of 3 TTF-type or ILC-type cryomodules. A low energy off-axis beam will be constructed to test ILC crab cavity designs and provide opportunities for other tests. Downstream beamlines will consist of a diagnostic section, a beam test area for additional beam experiments, and a high power beam dump. The initial program for this facility will concentrate on testing ILC-type cryomodules and RF control with full ILC beam intensity. A future building expansion will open up further possibiliities for beam physics and beam technology experiments.

Presented by Helen Edwards (FNAL).

WEP30: New HOM coupler design for ERL injector at KEK

Ken Watanabe, Hitoshi Hayano, Shuichi Noguchi, Eiji Kako, Toshio Shishido (KEK)

The development of superconducting cavities and cavity package for ILC and ERL project is under way at STF (Superconducting RF Test Facility) in KEK. The TESLA-style coaxial HOM couplers have a problem at CW operation, which it is pick-up probe heating of HOM coupler. The pick-up prove heating was observed at vertical tests. The probe heating study for CW operation (changing pick-up probe geometry and probe gap) tried at vertical tests by using KEK STF TESLA-style 1.3 GHz 9-cell superconducting cavity, and simulated by using HFSS code for estimate the relation of the limit E-field of probe heating and the probe surface current. The design of proto-type coaxial HOM couplers of CW operation for KEK ERL-injector was tried based on this information. The probe heating is generated due to the probe surface current by the RF load of accelerating mode. Therefore, as one method, it can be controlled if the RF load of accelerating mode is reduced by putting the high pass filter between the coupling loop and the notch filter. In addition, the target beam current of ERL is about 100mA, therefore, we were considered that the cooling of inner conductor of HOM coupler by liquid He is necessary to be expected the heating of inner conductor by HOM power of excited in the beam. The design was held based on these. In this report, a design of HOM coupler for KEK ERL-injector is presented.

WEP31: Optimization of the SRF Cavity Design for the CEBAF 12 GeV Upgrade*

Charles Reece, Genfa Wu, Haipeng Wang, Robby Hicks, Ed Daly, Jim Henry, Joseph Preble (Jefferson Lab)

Based on initial testing of the “HG” and “LL” 7-cell cavities in the prototype cryomodule “Renascence,” several opportunities for improved optimization were identified. The HOM damping configuration was refined so as to meet the requirements for damping key dipole modes while simultaneously dramatically reducing risk of HOM pickup probe heating and also creating beamline clearance for mounting the tuner to stainless steel helium vessel endplates (rather than NbTi/Ti transitions to a titanium helium vessel). Code modeling and bench measurements were performed. The new design maintains the 7-cell LL cells and incorporates a brazed transition between Nb and the SS helium vessel. The resulting configuration is now called the “C100” design. Cavity design details as well as vertical dewar and horizontal test bed performance will be presented.

WEP32: Performance of the CEBAF Prototype Cryomodule Renascence*

Charles Reece, Ed Daly, Robby Hicks, Michael Drury, G. Kirk Davis, Joseph Preble, Haipeng Wang (Jefferson Lab)

The prototype cryomodule Renascence was constructed as an energy building block for securing 6 GeV operation of CEBAF and to validate design elements for future CEBAF upgrade modules. These elements include the new “HG” and “LL” 7-cell cavity designs and a new tuner design.[1] Issues were identified during initial testing in 2005. The module has been reworked to address the issues with thermal stability, component breakage, and tuner motion. In addition, opportunity was taken to employ upgraded cleaning and assembly techniques for the cavity string. The HOM coupler heating issue was resolved, and seven of the eight cavities in the cryomodule have run stably at an average of 20 MV/m CW. The cryogenic, rf, and mechanical performance of the cryomodule during initial testing and after rework will be presented. Commissioning in CEBAF begins in September 2007.

[1] E.F. Daly et al., PAC05, p 1377, TPAB077.PDF.

WEP33: REALISATION OF A PROTOTYPE SUPERCONDUCTING CW CAVITY AND CRYOMODULE FOR ENERGY RECOVERY

Peter McIntosh, Carl Beard (STFC Daresbury Laboratory), Hasan Padamsee, Sergey Belomestnykh (Cornell University), John Corlett (LBNL), Andreé Buechner (FZR), Todd Smith (Stanford University)

For Energy Recovery applications, the requirement for high-Q accelerating structures, operating in CW mode, at large beam currents and high beam-loading, with precise phase & amplitude stability and modest accelerating gradients are all fundamental in achieving intense photon fluxes from the synchronised FEL insertion devices. Both Daresbury Laboratory and Cornell University are developing designs for advanced Energy Recovery Linac (ERL) facilities which require accelerating Linacs which meet such demanding criteria. The specification for the main ERL accelerator for both facilities dictates a modest accelerating gradient of 20 MV/m, at a Qo of better than 1010, with a Qext of up to 108. A collaborative R&D program has been set-up to design and fabricate a roof-of-principle cryomodule (which is well underway) that can be tested on ERLP at Daresbury and also on the Cornell ERL injector. This paper details the new cryomodule design, provides an insight to the design solutions employed and reports on present status of the project.

WEP34: Research and development of 1.3 GHz low loss cavities made of China large grain at IHEP

Z. G. Zong (IHEP)

Institute of High Energy Physics, IHEP, has studied SRF cavities since Oct. 2000. To contribute to International Linear Collider (ILC), research on 1.3 GHz low loss cavities using China large grain niobium was carried out recently at IHEP. The shape and some parameters of the cavity will be presented in this paper. The cavities were fabricated by standard procedures, such as deep drawing, trimming and welding by electron beam. To prepare the RF surface for vertically cryogenic test, centrifugal barrel polishing, barrel chemical polishing, annealing, high pressure rinsing and baking are employed. This paper introduces the features of the fabrication and surface treatments on the large grain cavity and presents the preliminary results of the research.

WEP35: RF Superconductivity Activities of PEFP*

An Sun (Korea Atomic Energy Research Institute)

The RF superconductivity activities of the Proton Engineering Frontier Project (PEFP) aim to develop a superconducting RF linac to accelerate a proton beam from 80 MeV at 700 MHz. In the past two years, the preliminary design of a low-beta cryomodule has been completed. A low-beta (beta=0.42) cavity, a higher-mode coupler and a fundamental power coupler for the PEFP cryomodules have been designed. The dies, fixtures and coining rings, as well as the dumbbell tuning sets of the low-beta cavity have been designed and fabricated. Also a warm tuner for PEFP cavities has been designed and fabricated for tuning the PEFP cavity field flatness. Two prototype copper cavities are under production and testing. An overview of the RF superconductivity activities of PEFP in the coming two years is presented.

*This work was supported by the 21C Frontier R&D program in Ministry of Science and Technology of the Korean Government.

WEP36: Single Crystal Nb, High Current, Large Aperture, Low HOM, 2.85-GHz SRF Cavity*

QuanSheng Shu, J. Susta, F. H. Lu, I. Phipps, J. L. Shi (AMAC Inc. Newport News, VA 23606), R. P. Redwine, F.H. Wang, D. Wang (MIT Cambridge, MA 02139)

The AMAC design and studies of a 2.85 GHz cavity system is for the future electron-ion collider (eRHIC) and a very brilliant, broadband, teraherz coherent synchrotron radiation source (CRS) and also to meet the increasing demand for High beam Current, high Radio-Frequency (RF) power S-band cavities in existing and new accelerator projects. To achieve this goal, the RF cavities must be upgraded to a gap voltage of 1.5 MV in a limited space available in the machine with a high gradient superconducting cavity. The other challenges are how to extracted the very high HOM power induced by the very high current of 10-100mA at the relatively small cavity. At the present time there are no cavities and accessories designed to support the high beam currents of up to 10-100 mA at such a high frequency and the same time provide a high gap voltage. The paper described the AMAC's approaches in design of such a SRF system (Cavity, high power input copler and HOM absorber device.

* The project is sponsored by the US Department of Energy (2007)

WEP37: Squid Based Nondistructive Testing Instrument Of Dished Nb Sheets For Srf Cavities*

QuanSheng Shu, J. Susta, G. F. Chen, I. Phipps (AMAC Inc. Newport News, VA 23606), R. Selim, J. Mast Christopher (Newport University, Newport News, VA 23606), P. Bauer, P. Kneisel, G. Myneni (Jefferson National Lab, Newport News, VA 23606), I. Ben-Zvi (Brookhaven National Lab, NY 11719.)

AMAC has developed a SQUID scanning system based on eddy current technique that allows the scanning of curved Nb samples. This SQUID scanning system successfully located tantalum defects about 100 μm diameter in a flat Nb sample and was able to also locate the defects in a cylindrical surface sample. Most importantly, however, the system successfully located the defects on the backside of the flat sample and curved sample, both 3-mm thick. The performance of superconducting rf cavities used in accelerators can be enhanced by detecting micro particles and inclusions which are the most serious source of performance degradation. These defects prevent the cavities from reaching the highest possible accelerating fieldsThis system can be used for the inspection and detection of such defects during SRF cavity manufacturing.

* The project is sponsored by the US Department of Energy (2007)

WEP38: SSRF Superconducting RF System

Jianfei Liu, Hongtao Hou (SSRF)

SSRF (Shanghai Synchrotron Radiation Facility) Superconducting RF system includes three RF stations, each of which is composed of one set of transmitter, one set of superconducting RF module, one set of digital LLRF control system and one set of auxiliary system, etc. Each set of the transmitter is able to output 300kW rf power to superconducting cavity to compensate the energy loss of electrons. The superconducting module is CESR type and resonant frequency is 499.654MHz, and its external Q is (1.7+/-0.3)×105. The digital LLRF control system adopts digital I/Q technology based FPGA system and is responsible for maintaining the constant amplitude and phase of accelerating field in superconducting cavity, including amplitude loop, phase loop and frequency loop. Up to now, 1st set of transmitter has passed the test of 300kW output rf power running 50 hours continuously without trip, the 2nd and 3rd set are in the process of test. The 1st set of superconducting module has been installed to the storage ring tunnel and aligned by laser tracking, the 2nd has arrived at SSRF waiting for installation. The prototype machine of digital LLRF control has been developed and tested successfully.

WEP39: Status of 9-cell cavity processing/testing at Cornell

W.J. Ashmanskas, A.C. Crawford, H.S. Padamsee (Fermi National Accelerator Lab / Cornell Universit)

As part of the coordinated U.S. effort to build up SRF infrastructure for the ILC, the Cornell SRF lab has developed tools and procedures for 9-cell 1.3 GHz cavity processing and vertical testing at Cornell. Steps performed with 9-cell cavities at Cornell include tuning for field flatness, vertical electropolishing (or BCP if desired), high-pressure rinsing in ultra-pure water, baking at 110 degrees C, and RF testing at 2K in a vertical cryostat. Since spring 2006, Cornell has performed ILC cavity processing/testing cycles at a rate of about one per month. We summarize methods, results, and possible next steps.

WEP40: Status of beta=0.12 quarter wave resonator for radioactive beams production at Spiral2 facility

G. Martinet (IPNO)

Spiral2 is a french project which aims at the construction of superconducting linac to deliver proton, deuteron (5mA, 40 MeV) and Q/A=1/3 (1mA, 14.5 MeV/u) beams. In this framework, IPN is in charge of the high beta part (beta=0.12). Dedicated Quarter Wave Resonators working at 88MHz require accelerating field of 6.5 MV/m. First prototype has been built and we present here the status of the work performed on it including Q-desease effect, microphonics and cold tuning system.

WEP41: Status of the 3.9 GHz SCRF Effort at Fermilab*

Elvin Harms (Fermilab)

Fermilab is enagaged in an effort to assemble 3.9 GHz superconducting RF cavities for a four-cavity cryomodule for use at the DESY TTF/FLASH facility as a third harmonic structure. This effort includes design, fabrication, intermediate testing, assembly, and delivery of the completed vessel. We present the latest status of this enterprise, especially cavity performance and status of assembly.

* Work supported by the U.S. Department of energy under contract No. DE-AC02-07CH11359

WEP42: Status of the ILC Crab Cavity Development

Graeme Burt, Amos Dexter (Cockcroft Institute), Peter McIntosh, Philippe Goudket, Carl Beard (STFC Daresbury Laboratory), Leo Bellantoni (FNAL), Zenghai Li, Liling Xiao (SLAC), Terry Grimm (Michigan State University)

The International Linear Collider (ILC) will require two dipole cavities to rab" the electron and positron bunches prior to their collision. It is proposed to use two 9 cell SCRF dipole cavities operating at a frequency of 3.9 GHz, with a transverse gradient of 5 MV/m in order to provide the required transverse kick. Extensive numerical modelling of this cavity and its couplers has been performed. Aluminium prototypes have been manufactured and tested to measure the RF properties of the cavity and couplers. In addition single cell niobium prototypes have been manufactured and tested in a vertical cryostat.

WEP43: Status of the Superconducting RF Photo-Injector Development

Friedrich Staufenbiel, A. Arnold, H. Buettig, D. Janssen, M. Justus, U. Lehnert, P. Michel, K. Moeller, P. Murcek, Ch. Schneider, R. Schurig, J. Teichert, R. Xiang (FZD), J. Stephan (IKS), W.-D. Lehmann (SGE), T. Kamps (BESSY), G. Klemz, I. Will, A. Matheisen (DESY), B.v.d. Horst (DESY), P.vom. Stein (ACCEL), V. Volkov (IBNP)

A status report of the superconducting RF photo electron injector development at Forschungszentrum Dresden-Rossendorf (FZD) will be given. The SRF gun project is a collaboration of BESSY, DESY, MBI and FZD and aims at the installation of a high average current CW photo injector at the ELBE superconducting electron linac. Main design parameters of the SRF gun are an electron energy of 9.5 MeV, a maximum average current of 1 mA, transverse normalized emittances (rms) of 1 mm mrad at 77 pC and 2.5 mm mrad at 1 nC bunch charge. The 1.3 GHz niobium cavity consists of three full cells with TESLA geometry, a specially designed half-cell in which the photo cathode is placed, and a choke filter in order to prevent rf losses at the cathode side of the cavity. Presently, the cryomodule assembly has been finished and the gun was installed in the ELBE accelerator hall. The vacuum and the cool down test are successfully and the HF-Tests can be performed. A short test beamline will be installed with the laser port and a beam dump. The development of the 262 nm driver laser system for the high charge mode (500 kHz, 1 nC) is finished. A diagnostic beamline, which is especially designed for the SRF gun parameter measurement, is being build up.

WEP44: The commissioning of BEPCII RF system

Guangwei Wang (IHEP)

In BEPCII RF system, there are two independent subsystems for electron and positron Ring respectively. KEK-B(IHEP) type 500MHz superconducting cavities are adopted in BEPCII . At the end of the 2006, RF system had finished the construction and begun the commissioning and operation. This paper is focus on the performance of BEPCII RF system, some problem and experience during the initial operation.

WEP45: The first processing of capacitive-coupling coupler at room temperature in a cryomodule at STF

Takayuki SAEKI, Kenji Saito, Toshiyasu Higo (KEK)

We are constructing Superconducting RF Test Facility (STF) at KEK for the R&D of ILC accelerator. In the beginning of year 2007, we installed one TESLA-like 9-cell cavity and one high-gradient Low-Loss (LL) type 9-cell cavity into cryomodules at STF. For each cavity, an input coupler and peripherals were assembled with a cavity in a clean room. The assembled cavity packages were dressed with thermal shields and installed into cryomodules. After the installation, at the room-temperature, we performed the processing of capacitive-coupling input-coupler which was assembled with high-gradient LL cavity in the cryomodule. We achieved the power of 250 kW with the pulse-width of 1.5 msec at the repetition rate of 5 pps. This presentation describes about the assembly of the capacitive-coupling coupler and 9-cell high-gradient LL cavity in a clean room and the processing of the coupler at the room temperature in cryomodule.

WEP46: The manufacture of the SSRF higher harmonic cavity

MA Guangming, MA Zhenyu, LIU Jianfei (SSRF)

The higher harmonic cavity for SSRF is a 1.5GHz superconducting cavity. The single cell cavity has been designed to have low loss and higher impedance. Niobium and copper cavities have been manufactured and are being tested. For the vertical test of the niobium cavity, a polishing room, an ultra clean room, an ultra pure water system and a cryostat have been prepared.

3. Industrialization of SRF technology

WEP47: BCP SYSTEM FOR THE ANL-FNAL SCSPF

Allan Rowe (Fermilab)

FNAL has undertaken an effort to design, develop, commission and operate a system that efficiently polishes the interior and exterior surfaces SRF cavities using buffered chemical polish. This system was designed for the Joint Superconducting Cavity Processing Facility (SCSPF) at ANL for use during the GDE S0/S1 ILC cavity testing programs. The demands of the S0/S1 programs required the development of a pre-industrial type polishing system that ensures operator safety as well as procedure reliability and repeatability. The BCP System design methodology and technical details are presented, including a discussion on the control system design and philosophy. The BCP System’s safety features, ancillary hardware, and operational scope are also described.

WEP48: DESIGN AND FABRICATION OF SUPERCONDUCTING CAVITIES FOR INDUSTRIALIZATION

Katsuya Sennyu, Hiroshi Hara (MHI KOBE), Masanori Matsuoka (MHI TOKYO)

We designed and fabricated four STF-baseline superconducting cavities with tuners, helium jackets. By fabricating four cavities, some problems to the next step are cleared. Some changes of design and fabrication procedure for next new cavity are described. And some new procedures of cavity fabrication for industrialization are proposed.

WEP49: Flexible Application of the JLab Pansophy Information System for Project Reports, Process Monitoring, and R&D Sample Tracking*

Charles Reece, Valerie Bookwalter, Bonnie Madre (Jefferson Lab)

The use and features of the JLab SRF Institute IT system "Pansophy"[1] continue to expand. In support of the cryomodule rework project for CEBAF a full set of web-based travelers has been implemented and an integrated set of live summary reports has been created. A graphical user interface within the reports enables navigation to either higher-level summaries or drill-down to the original source data and procedures. In addition to the collection of episodic data, Pansophy is now used to capture, coordinate, and display continuously logged process parameters that relate to technical water systems and cleanroom environmental conditions. This allows coordinated retrieval of process conditions coincident with particular activities. In a new expansion, Pansophy is being used to collect and track process and analytical data sets associated with SRF material samples that are part of the surface creation, processing, and characterization R&D program. The methods used within Pansophy, the resulting user interface for these functions, and illustrations of the use of these features for quality control and performance correlations discernment will be presented.

[1] http://accelconf.web.cern.ch/AccelConf/p05/PAPERS/RPPE062.PDF

WEP50: Input Couplers for KEKB Crab Cavities

Kota Nakanishi, Kazufumi Hara, Kenji Hosoyama, Yuuji Kojima, Shinji Mitsunobu, Yasuchika Yamamoto (KEK), Kazunori Okihira, Katsuya Sennyu (MHI KOBE), Tatsuji Tanaka (Broad Wireless Corporation)

RF input couplers for KEKB crab cavities were designed, fabricated and RF tested. Since bunches are kicked horizontally in KEKB, the probe type RF couplers have to be attached horizontally. The RF power is supplied from above the cryostat. Thus, the couplers must have some structure to bend perpendicularly. And sufficiently strength is required to support the horizontal part. The RF windows for superconducting accelerator cavities for KEKB are used. The doorknob translators for TRISTAN are used, too. Because the diameters of RF window and RF port of crab cavity are different, a section to reduce the diameter is required. These couplers have T-stub structure to provide sufficiently strength. The inner conductors between the RF window and the T-stub structure are separated to reduce the stress for RF window. And the diameters are changed at the connection part. The separated inner conductors are cooled by water respectively. The couplers were designed to minimize the reflection coursed by T-stub structure and reducer of diameter. According to HFSS that is RF analysis code, the reflection caused by these structures is sufficiently small (VSWR < 1.15). Easy fabrication and low field enhancement were also considered. It is assumed that 100kW of RF power will be fed from klystron in the practical operation. Aging was done before assembling to crab cavity. At first, traveling wave was applied. It was spend 8 to 16 hours to overcome multipacting and to achieve 250kW of input RF power. Subsequently, standing wave was applied. The phase of standing wave, namely length of wave-guide is changed every 20 degree (~5cm). It is confirmed that the couplers can handle 200kW of standing wave RF power using prototype coupler. It was spend 4.5 hours to achieve 200kW of RF power. After finished the aging, the phase of standing wave was changed continuously as supplying 200kW of RF power. No trip was observed at that time. To avoid the risk, the target of standing wave aging for the practical couplers was changed to 100kW. Trip was hardly observed below 100kW. In practical operation, 25kW and 75kW of RF power are applied to LER and HER crab cavities respectively. Kick voltages are 0.9MV and 1.5MV at that time. Total trip rates of crab cavities are 1.57times/day and 1.27times/day.

WEP51: Some fabrication issues on the spare high power input coupler for BEPCII SCC

Huang Tongming (IHEP)

The specification for the 500MHz BEPCII SCC input coupler is that it can feed 150kW RF power under continuous wave (CW) to meet high beam current of 910 MA in colliding operation mode. The BEPCII SCC input coupler was manufactured in Toshiba. We are trying to make two spare BEPCII SCC input couplers by ourselves now. Some fabrication issues on the spare high power input coupler for BEPCII SCC will be presented in this paper.

WEP52: SRF activities at ACCEL Instruments GmbH

Michael Pekeler, Stefan Bauer, Peter vom Stein, Hanspeter Vogel (ACCEL)

We report on activities and achievements at ACCEL in the field of SRF cavity and component production, cavity preparation techniques and SRF module design, construction and operation experience.

4. Others:

WEP53: 300 MA STORED BEAM IN SOLEIL

Catherine Madec (CEA Saclay)

In the Storage Ring (SR) of the Synchrotron SOLEIL light source, two cryomodules will provide the maximum power of 600 kW required at the nominal energy of 2.75 GeV with the full beam current of 500 mA and all the insertion devices. A first cryomodule, housing two 352 MHz superconducting (Nb/Cu) single-cell cavities, especially developed for SOLEIL, with strong damping of the Higher Order Modes, has been successfully commissioned on the SR : up to 300 mA of stable beam at 2.75 GeV is routinely stored, each cavity being powered up to 150 kW with a solid state amplifier. The main results are reported. The second cryomodule, which is presently under manufacturing, will be implemented beginning of 2008 in order to achieve the nominal performance (4 MV and 500 mA).

WEP54: A Tuner for a Superconducting CH prototype cavity

Alexander Bechtold (IAP, Frankfurt University)

The superconducting CH multi-cell prototype cavity will be equipped with a frequency tuning system. The rf-tuning during operation bases on the principle of a slight elastic deformation at both ends of the tank. The gap width of the first and the last accelerating cells are consequently changed and the accompanying variation of capacity results finally a frequency shift. The effect of deformation on rf-frequency and field distribution has been measured and can be compared with previous calculations. The tuning system implies two stages, a slow mechanical device and a fast piezo system, first parts are already manufactured. Additionally The mechanical resonances of the cavity have been investigated experimentally in the environment of an acoustical laboratory.

WEP55: Beam-induced RF modes and RF power in the crab cavity for KEKB

Yoshiyuki Morita, Kazunori Akai, Takaaki Furuya, Teruya Honma, Kenji Hosoyama, Shinji Mitsunobu, Yasuchika Yamamoto (KEK)

Two superconducting crab cavities were installed in the KEKB rings and the crab crossing operation started early in 2007. Each crab cavity has two ferrite RF absorbers (HOM dampers), which were developed for the superconducting accelerating cavities of KEKB. One is attached in a beam pipe and the other is attached in a coaxial coupler. The dampers have to damp not only the higher order modes but the lower order modes, since the crabbing mode is not the lowest mode. These parasitic modes should be sufficiently damped for the high current operation. Several antennas were set on the beam pipe to monitor beam-induced RF modes. The most dangerous mode, TM010-like mode, was detected in the RF spectrum. However, its Q-factor was below the instability criterion and consistent with the measured value at the horizontal test before installation. No dangerous modes with high Q-factor were observed in the beam-induced RF spectrum. KEKB stored the beam currents of 1.7A and 1.35 A in the low energy positron ring and the high energy electron ring, respectively. No serious beam instabilities caused by the parasitic modes were observed and the HOM dampers successfully absorbed the beam-induced RF power up to 12 kW. We will present HOM dampers used for the KEKB crab cavities, and measurement results of the beam-induced RF modes and RF power. Simulation results for the beam-induced RF power will be also discussed.

WEP56: Cavity and Linac RF and detuning control simulations*

Axel Neumann, Jens Knobloch (BESSY GmbH)

Single pass free electron lasers, such as the planned BESSY-FEL, require a very stable beam with a bunch-to-bunch time jitter of less than 50 fs and an relative energy jitter below 1e-3. Regarding the low beamloading, the 144 cavities of the superconducting Linac will be operated in CW at a high loaded quality factor of 3e7. To understand the achievable stability of the beam and the budget of the individual error sources for the cavity field stability, a single cavity simulation tool has been developed. It includes the cavity field envelope model, an LLRF feedback system model and furthermore mechanical transfer functions, tuner characteristics, the fast piezo control system, microphonics and other noise sources measured or developed at HoBiCaT. Incorporating realistic beam parameters due to the acceleration process in the photoinjector and the first booster cavity allows to model the resultant energy and time jitter of the beam at the end of the Linac. Additionally the model has been used to find optimum operation parameters for the cavity and controller.

* Work partially supported by the EU Commission in the sixth framework programme, contract no 011935 EURO-FEL-DS5, BMBF and Land Berlin.

WEP57: Commissioning and Beam Operation of KEKB Crab-RF System

Kazunori Akai, Kiyokazu Ebihara, Takaaki Furuya, Kazufumi Hara, Teruya Honma, Kenji Hosoyama, Atsushi Kabe, Yuuji Kojima, Shinji Mitsunobu, Yoshiyuki Morita, Hirotaka Nakai, Kota Nakanishi, Masaaki Ono, Yasuchika Yamamoto (KEK)

Two heavily-damped superconducting crab cavities were installed in KEKB, one for LER and the other for HER, respectively. After RF system adjustment and conditioning of the cavities, beam operation started in February 2007. During four and a half months operation until summer shut down the crab cavities have been operating very stably to conduct crab crossing experiment. They have shown excellent performance with high stored beam currents up to 1.7 A in LER and 1.35 A in HER. It was also demonstrated that the crab crossing works at a high luminosity over 10E34 /cm2s that exceeds the KEKB design luminosity. Machine tuning with crab crossing will continue for aiming at a big boost in luminosity as expected from beam-beam simulations. In this paper we present RF system for the crab cavities, commissioning process, performance of the crab cavities with high current beams as well as beam-loading-related issues on the crabbing mode.

WEP58: Comparison of different tuning systems for TESLA cavties with respect to cw operation*

Oliver Kugeler, Axel Neumann, Jens Knobloch, Wolfgang Anders (Bessy)

BESSY has planned an FEL that will be operated with TESLA type cavities at high Q-values in cw mode. These operating parameters imply a low cavity bandwidth and a high sensitivity towards ponderomotive oscillations, in particular microphonics. In the HoBiCaT facility, located at BESSY, we have characterized several tuning systems (Saclay I, Saclay II, and Meier-Weichert tuner) and analyzed their suitability for CW cavity operation. We came to the conclusion that the Saclay II tuner is best fitted for the needs at BESSY.

* Work partially supported by the EU Commission in the sixth framework programme, contract no 011935 EURO-FEL-DS5, BMBF and Land Berlin.

WEP59: Conceptual design considerations of a 5-cell dual-axis SRF cavity for ERL*

Chun-xi Wang (Argonne National Lab)

Recently dual-axis energy recovery linac has been proposed for ERL applications, in which accelerating and decelerating beams can go through separate axes but still recover energy in novel dual-axis cavities. Here we discuss a conceptual design of a 5-cell dual-axis cavity evolved from side-by-side jointed TESLA-type cavity. Instead of an optimized engineering design, we aim to explore the feasibility of such a new cavity.

* Work supported by U.S. Department of Energy, Office of Science, Office of Basic Energy Sciences, under Contract No. DE-AC02-06CH11357.

WEP60: Construction and Processing of the Variable RF Power Couplers for the LHC Superconducting Cavities

Eric Montesinos (CERN)

The Large Hadron Collider (LHC) will accelerate beams of protons with a main RF system of sixteen 400 MHz superconducting cavities. The different requirements at injection and collision together with the heavy beam loading have imposed the use of a variable power coupler with a coupling value varying by a factor 10. The power requirements are high; 250 kW cw for several hours and a peak equivalent power of 450 kW. In order to withstand these levels, copper sealing rings are used on the main ceramic instead of original kovar® design used in the LEP couplers. To avoid multipactoring occurring at high powers and beam intensities, a second ceramic is used to provide a second DC polarization of the antenna. Twenty-four couplers have already been fully conditioned using a special dedicated FM+AM conditioning process, with 16 installed in the cavities in the LHC tunnel for first powering tests.

WEP61: Design of the magnetic shield for TRASCO low beta elliptical cavities

Paolo Pierini, Serena Barbanotti, Laura Monaco, Nicola Panzeri (INFN Milano-LASA)

The TRASCO elliptical cavities (beta=0.47) for intermediate velocity protons will be tested in horizontal test modules, equipped with a coaxial cold tuner of the blade type. A magnetic shield which is internal to the helium vessel has been designed, using CRYOPERM 10 material. The magnetic shield is capable to meet the performance goals of the 700 MHz cavities and simplifies the mechanical interface to the cavity/tuner assembly. The present paper illustrates the technical design of such a shielding system.

WEP62: Diagnosis, Analysis, and Resolution of Thermal Stability Issues with HOM Couplers on Prototype CEBAF SRF Cavities*

Charles Reece, Robby Hicks, Ed Daly, Joseph Preble, Haipeng Wang, Timothy Rothgeb, G. Kirk Davis (JLab), Genfa Wu (FNAL), L. Phillips (Thomas Jefferson National Accelerator Facility)

During initial testing of the prototype cavities incorporated into the developmental cryomodule "Renascence" severe thermal stability issues were encountered during CW operation. Additional diagnostic instrumentation was added. This enabled identification of an unanticipated thermal impedance between the HOM coupler probe feedthrough assembly and the cavity beamtube. Subsequent detailed FE analysis successfully modeled the situation and indicated the need for alternate cooling path for the couplers on those cavities. HOM damping was measured to be adequate employing only two of the four HOM couplers. The two pickup probes on the couplers at the input power coupler side of each cavity were removed, the remaining HOM probe feedthroughs were heat stationed to two-phase helium supply piping, and a novel heat sink was added to station both the inner and outer conductors of the remaining HOM rf cables. The characterization measurements, analysis, modifications, and resulting performance will be presented.

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WEP63: Cancelled

WEP64: EFFICIENT FAN-OUT RF POWER DISTRIBUTION ALGORITHM WITH COMPLETE RF VECTOR CONTROL FOR SRF ACCELERATORS *

Y. W. Kang (SNS)

In fan-out RF power distribution for feeding multiple accelerating cavities with a single RF power generator, independent control of cavity RF voltage vectors is required. A new RF vector control algorithm for fan-out power distribution using reactive transmission line circuit parameters for maximum power efficiency is presented. This control with fan-out power distribution system is considered important for large scale SRF accelerator systems to save construction and operation costs significantly. Other fixed power splitting system with individual cavity voltage control at each cavity input may not deliver the power efficiency since excessive power is need to be maintained at each cavity input. In the proposed approach, the RF control parameters for specified cavity RF voltage vectors are determined for an entire fan-out system. The reactive loadings can be realized using high power RF phase shifters.

*This work was supported by SNS through UT-Battelle, LLC, under contract DE-AC05-00OR22725 for the U.S. DOE

WEP65: Study on the buffered electropolishing Jacquet layers on niobium cavity

Erdong Wang, Tianmu Xin ,Xiangyang Lu, Liming Yang, Lin Lin, Song Jin, Zhao Kui

Buffered electropolishing on niobium cavities has been developed at Peking University. Some small niobium samples have been polished very smoothly. An experiment has demonstrated that both of the liquid and solid Jacquet layers exist on the surface of anode simultaneously. The results of experiment, that more than 70% voltage is taken by the Jacquet layers, show us that the cathode shape is not a necessary condition for polishing the dumbbell. Flat cathode is available to polish the dumbbell. We have observed though the experiment that the different fluid liquid Jacquet layer movements could cause the different results on the dumbbell surface. These studies show that BEP can offer a smooth surface on niobium cavities.

WEP66: HIGH PRESSURE RINSING SYSTEM STUDIES

Daniele Sertore, Massimo Fusetti, Paolo Michelato, Carlo Pagani (INFN Milano - LASA), Toshiyasu Higo, Juho Hong, Kenji Saito (KEK), Gianluigi Ciovati, Timothy Rothgeb (JLab), Axel Matheisen (DESY)

High pressure rinsing (HPR) is a key process for the surface preparation of high field superconducting cavities. HPR water jets used in different laboratories have been characterized measuring the transferred momentum between the water jet and a load cell. The information taken during these measurements, combined with HPR process parameters, allow calculating new significant measurable variables such as the jet power, the deposited energy on the cavity surfaces and the pressure.

WEP67: Low-Level RF Control of Superconducting Microphonics in Spoke-Loaded Cavities

Zachary Conway, K. W. Shepard, J. R. Delayen, M. P. Kelly, S. I. Sharamentov, G. K. Davis, and L. R. Doolittle (Argonne National Laboratory)

This paper presents the results of cw phase stabilization experiments performed on a superconducting, 345 MHz, beta = 0.5 triple-spoke-loaded cavity operating at 4.2K at an accelerating gradient of 9.7 MV/m. Two methods of RF phase control were characterized: overcoupling with negative phase feedback, and also fast mechanical tuner feedback at a loaded Q = 1.3e7. Each method controlled the cavity RF field amplitude and phase to ±0.5% and ±50.

WEP68: Measurement of transfer function by dynamic Lorentz force detuning*

Axel Neumann, Wolfgang Anders, Jens Knobloch, Oliver Kugeler (BESSY GmbH), Guillaume Devanz, Michel Luong, Eric Jacques (CEA Saclay)

TESLA-type cavities operated in CW mode may experience time varying Lorentz forces by changes in the field amplitude due to microphonics peak detuning events. For systems driven by limited RF power a saturation of the klystron may lead to an excitation of ponderomotive oscillations, exciting mechanical eigenmodes of the cavity-tuner system. To understand the nature of this effect and to characterize the response of the cavity mechanical system the dynamic Lorentz force detuning transfer function has been measured at HoBiCaT. These data provide a basis for the mechanical simulation and modal analysis of the TESLA structure as well as for pulsed mode of operation. Furthermore, they were used to provide realistic parameters for cavity RF control simulations including a second order detuning model.

* Work partially supported by the EU Commission in the sixth framework programme, contract no 011935 EURO-FEL-DS5, BMBF and Land Berlin.

WEP69: MgB2 Thin Films on Nb Cavity by Pulse Laser Deposition

Shinji Mitsunobu (KEK High Energy Accelerator)

The large efforts have been concentrated on Nb cavities for International Linear Collider (ILC). The maximum accelerating field gradient of Nb cavities is limited about 50 MV/m due to Hcsh. MgB2 (MgB2) have higher Tc than Nb and expected to have higher Hcsh. Thin films of MgB2 on Nb is useful to increase future ILC energy upgrading. At KEK, the preliminary test of thin films on Nb by Pulse Laser Deposition(PLD) method have been started and initially the direct deposition of MgB2 film on Nb was studied. The partially shielding of RF magnetic field for Nb was observed using surface resistance measurements of Nb disks. Now, we preparing C band TM010 Nb cavity which is scaled model of ILC base line model. We will coating the inner surface with MgB2 thin films.

WEP70: Nb Coating of Copper cavities by UHV Cathodic arc

Roberto Russo (ICIB-CNR and INFN)

Niobium thin film coated copper RF cavities are an interesting alternative to niobium bulk cavities mainly because copper is cheaper, has higher thermal conductivity and better mechanical workability and stability than niobium. Unfortunately the observed degradation of the sputter-coated cavities quality factor with increasing accelerating voltage prevents their use in future accelerators specified to work at field values higher than 15MV/m. To try and overcome this limitation we have developed an alternative coating technique based on a cathodic arc system working under UHV conditions. Main advantages of this technique compared to standard sputtering are the ionized state of the evaporated material, absence of gases to sustain the discharge, high energy of atoms reaching the substrate surface and possibility to have high deposition rates. Recent results on the characterization of niobium film samples produced by UHV cathodic arc are presented, showing that the technique can produce high quality films under different angle of deposition. The system to deposit a single cell cavity have been commissioned and first results will be presented.

WEP71: Numerical Simulation of the Electropolishing process

Germano Galasso (FNAL), Cristian Boffo (Babcock Noell GmbH)

Electropolishing (EP) is the baseline surface processing technique, which will be adopted during cavity fabrication for both the European X-FEL and later for the ILC. At the moment this process allowed reaching record accelerating gradients higher than 50 MV/m in 1-cell cavities, but the performance scattering resulting form the application of the process on multi-cell cavities still does not satisfy the reliability and repeatability criteria necessary for series production. As part of the effort ongoing in the SRF community, an in depth numerical analysis and simulation is being pursued at Fermilab in collaboration with Udine University (Italy). This article describes the status of the numerical models developed to describe the thermal fluid behavior of the EP process of a 1-cell Nb cavity and the attempt to develop a full multiphysic model which in addition includes the electrochemical and diffusive properties of the system.

WEP72: Operation Status of the KEKB Superconducting Accelerating Cavity

Takaaki Furuya, Kazunori Akai, Shinji Mitsunobu, Susumu Takano, Yasuchika Yamamoto (KEK), G. Wang, W. Pan, Y. Sun, Z. Li (IHEP)

In the seven year operation since 1999, the e+e- collider, KEKB accumulated the total integral luminosity of 710 fb-1, while improving the peak luminosity to 1.71E+34cm-2s-1. Eight superconducting damped cavities of 509 MHz provided the accelerating voltage of 11 MV and RF power of 2.4 MW to accelerate the HER beam of 1.4 A. Top-up injection kept the bunch charge of 10 nC in 1389 bunches and caused the HOM load of 15 kW in CW for each cavity module. Commissioning of BEPC-II has started at IHEP in China using two 500 MHz superconducting damped cavities of KEKB type that have been developed under the international collaboration of KEK and IHEP. In both operation modes of synchrotron radiation mode and collision tuning mode for tau-charm physics, IHEP cavities have provided the required accelerating performances and the stable operation. Operation of these cavities will be reported.

WEP73: OPERATIONAL EXPERIENCE OF THE DIAMOND SCRF SYSTEM

Morten Jensen, Shivaji Pande, Alun Watkins (Diamond Light Source)

The DIAMOND storage ring presently operates with two superconducting RF cavities with the possibility of adding a third cavity in the future. The ring has been commissioned with a single cavity and has been operating in the user mode at 125 mA for many months. Recently it has been operated at currents exceeding 200 mA with two cavities delivering power to the beam. We report on investigations of the Robinson's stability limits for various operating conditions. The optimum parameters for the operation of the RF system under different conditions are described. We present the results of our simulations, cavity tests, high power conditioning and the operation of the RF system.

WEP74: Particle free pump down and venting of UHV vacuum systems

Kirsten Zapfe, Jerzy Wojtkiewicz (DESY)

Vacuum systems containing superconducting cavities to be operated at high gradients need to preserve the cleanliness of the superconducting cavity surfaces. In addition to an adequate preparation of the vacuum components special care needs to be taken during pump down and venting. Neither should be particles introduced into the vacuum system, nor should particles already present within the system be moved. In the framework of the superconducting linear accelerators for FLASH and XFEL at DESY a series of measurements have been performed to study the movement of particles in long tubes during pump down and venting using an in-situ vacuum particle counter. By reducing and varying the gas flow during these processes, it is possible to perform these actions without moving particles present inside such systems without making the procedures unacceptably time consuming. Based on these measurements a set-up using various diaphragms, flow controllers and pressure gauges has been developed to avoid introducing particles into the vacuum system as well as moving existing particles. This set-up allows automated pump-down and venting of critical vacuum systems in a reliable and reproducible way, being much faster than the procedures used so far.

WEP75: Development of a gate valve for operation at temperatures below 10 K

Kirsten Zapfe, Nils Mildner, Helmut Remde, Antonio Zubiaurre-Wagner (DESY)

The superconducting linear accelerator for the European XFEL will contain up to 100 acceleration modules in a row resulting in a length of about 1300 m of cold beam vacuum. While for standard operation such a long vacuum sector has no drawbacks, it might be useful to separate the system into much shorter units in case of a drastic failure. E.g. in the unlikely event that the beam damages the wall of a cavity it would be advantageous to isolate part of the system before starting warming up the whole section thus preventing the distribution of harmful gases and particles over the whole length of the superconducting linear accelerator. This requires a gate valve which can be operated at room temperature as well as at 2-4 K while staying leak tight during temperature cycles of the system. As such a device so far has not been available commercially a development program for an all metal gate valve including RF-shielding has been performed. Special measures had to be taken to avoid water condensation on those parts sticking out of the insulating vacuum tank. Tests of a prototype at room temperature and at 4 K will be reported. It is planned to install these newly developed gate valves at a distance of about 140 m within the string connection boxes of the XFEL.

WEP76: Performance of rf amplifiers for ISAC-II medium beta linac operation

Amiya Mitra, Ken Fong, Robert Laxdal, Joseph Lu, Richard Shanks (TRIUMF)

A heavy ion superconducting linac at TRIUMF to increase the final energy of radioactive beams from the existing room temperature ISAC accelerator is now operational. The linac consists of twenty quarter wave cavities operating at 106 MHz to produce an accelerating voltage gain of 20 MV. This paper describes the operational experience of the 106 MHz rf tube amplifiers which were installed and commissioned for the medium beta linac in October 2005. Total rf power installed is 16 kW where one quarter power is used for regular linac operation. During the initial commissioning of the amplifiers, only one power tube was found to be noisy and was replaced. The first major tube failure occurred in April 2007 after 8800 operating filament hours. Soon thereafter five more tubes showed signs of loss of gain. It was evident that most of the tubes reached their tube life by this time and all were replaced with new tubes. The extension of tube life, and prediction of tube failure are the main concerns of these tube amplifiers. Efforts are being made to incorporate reduced filament power operation in order to get longer tube life. Systematic check of the amplifier performance during scheduled maintenance and shutdown period is undertaken. Reduction of tube emission and hence gain degradation from their nominal value causes excessive drive power from the rf control system to keep the cavity voltage constant under closed loop. Hence monitoring the drive power is useful to predict early tube failure. Input drive power and gain of all the 20 amplifiers are available at the EPICS data archive which can be monitored and plotted. This will allow early warning of tube failure so that tubes can be replaced before they actually fail. The failure modes of the tubes and diagnostics to predict tube failure will be described.

WEP77: Reconstruction Of The Field Distribution By Measuring The Fundamental Passband Frequencies Of The Rossendorf SRF-Gun Cavity

André Arnold (Research Center Dresden Rossendorf), H. Buettig, D. Janssen, U. Lehnert, P. Michel, K. Moeller, P. Murcek, Ch. Schneider, R. Schurig, F. Staufenbiel, J. Teichert, R. Xiang (FZD), A. Matheisen, B.v.d. Horst (DESY), J. Stefan (IKS), W.-D. Lehmann (SGE), T. Kamps (BESSY), V. Volkov (IBNP), G. Klemz, I. Will (MBI)

In contrast to the TESLA cavities the shapes and the mechanical stiffness of the four SRF-Gun cells differ from each other. Furthermore the axis field to achieve a “flat” surface field over all cells has a profile of 60% in the first and 100% in the TESLA like cells, respectively. Due to the different mechanical properties one tuner for the half cell and one for the three TESLA cells are assembled. Both of them are equipped to manipulate the field of the cavity during the adjustment of the tuner bias and later during operation. Hence it is very important to determine the fields inside the cleaned and closed cavity. The poster presents a method that provides the field profile by measuring the passband frequencies based on the well known equivalent circuit for cell coupled cavities. At least one complete field and frequency measurement prior the last cleaning is necessary. The comparison with real measured values demonstrates the accuracy of the predicted field distribution within a range of 2%.

WEP78: Research Activities of SRF Cryomodule in IHEP

Q. J. Xu, J.Y. Zhai, C.H. Li, Y. Sun, Z.L. Hou, J. Gao (IHEP, CAS), T.X. Zhao, L.Y. Xiong, W.H. Lu, Z.G. Zong, L.Q. Liu, L. Zhang (TIPC, CAS)

A SRF Cryomodule collaboration group between IHEP(Institute of High Energy Physics) and TIPC(Technical Institute of Physics and Chemistry) was set up in last October. Technical design of a 9-cell cavity cryomodule is the first task of this group. The Cryomodule can be used for the horizontal test of a 9-cell cavity, the "china test model" for the ILC cryomodule, and also as the component of a superconducting accelerator test unit which will be built in the near future. This paper presents the detail structure, flow diagram, thermal and mechanical simulation and the cost estimation of the cryomodule. Some collaboration work with KEK STF was also presented in this paper.

WEP79: SCATTERING MATRIX CALCULATION OF HIGHER ORDER MODES AND SENSITIVITY TO CAVITY FABRICATION ERRORS FOR ILC SUPERCONDUCTING CAVITIES

Roger Jones, Ian. Shinton (University of Manchester/Cockcroft Institute)

A cascaded scattering matrix approach is used to determine the electromagnetic (e.m.) field in the main ILC cavities. This approach is used to compute higher order e.m. modes in the baseline configuration, and high gradient alternative configurations. We present results on: TESLA, Cornell University's re-entrant and, KEK's "Ichiro"design. This approach allows realistic experimental errors to be incorporated in the studies in an efficient manner and allows several cavities to be modelled. The implications of indentations in the cavity on the modal properties of the structure are presented.

WEP80: SIMULATION OF TRANSVERSE HIGHER ORDER DEFLECTING MODES IN THE MAIN LINACS OF ILC

Roger Jones, Christopher Glasman (University of Manchester/Cockcroft Institute)

We investigate the electromagnetic field (e.m.) excited by a train of multiple bunches in the main superconducting linacs of the ILC. These e.m. fields are represented as a wake-field. Detailed simulations are made for the modes which constitute the long-range wake-field in new high gradient cavities. In particular, we focus our study on the modes in new high gradient cavities: re-entrant and low-loss “Ichiro” shapes in which the central cavity has an iris radius of 30 mm in both cases. The modes in these high gradient cavities are compared with those in the TESLA design which incorporates an iris radius of 35 mm. The potential for trapped modes in these cavity shapes with a reduced iris is discussed and the implications on cavity alignment and emittance preservation is studied.

WEP81: Tests Of Air Cooled 1.3 GHz Waveguide Windows Using A RF-Coupler Test Bench Based On A Resonant Ring

Hartmut Buettig (Reserch Center Dresden-Rossendorf), Frank Gabriel, Andreé Buechner, Peter Michel, Joerg Voigtlaender, Armin Winter, Rico Schurig, Jochen Teichert, Gerald Staats, Andre Arnold (FZD)

RF power couplers for TESLA-like cavities suitable for high power CW-operation are one topic of interest of the EUROFEL programme. The power limit of the existing ELBE couplers is unknown so far. A new coupler test bench based on a resonant ring has been built to run window- as well as coupler tests with RF power up to 100 kW. The ring is driven by a 10 kW CW- klystron. In a first step waveguide windows equipped with additional air cooling have been tested. The design of the test bench and measurements on air-cooled waveguide windows are presented.

WEP82: The Measurements of Static Heat Loss and Unloaded Q0 on the BEPCII SRF Cavities

Lin Bian, Shaopeng Li, Yaping Liu (IHEP)

The Beijing electron and positron collider upgrade (BEPCII) adopted the advanced double-ring scheme. It has two 500MHz superconducting RF cavities and one in each ring. Before being installed in the tunnel, the cavities carried out their horizontal tests at the test station. The static heat loss and unloaded Q0 are most important values for both cryogenic system and RF system. The BEPCII SRF cavity operates in a liquid helium bath contained in a vacuum insulated, liquid nitrogen cooled radiation shielded vessel. During horizontal test at the test station, thermodynamic method is used to measure and calculate the static loss and Q0 of SRF cavity. This paper has briefly introduced the method and process to measure the static loss and Q0 of the SRF cavity. Results under different experimental conditions are also given. These results are also used as important data for acceptance test of the SRF cavity.

WEP83: The prototype cryomodule for the EUROTRANS program*

Paolo Pierini, Serena Barbanotti, Nicola Panzeri (INFN Milano-LASA), Jean-Luc Biarrotte (CNRS/IPNO)

EUROTRANS is a research program funded by the EURATOM (EC) in the 6th Framework Programme for the assessment of a nuclear waste transmutation system driven by a high intensity superconducting linac. The design of the high energy end of the linac (above 100 MeV) is based on low beta multicell elliptical cavities. A prototype cryomodule containing a single 5 cell cavity (built and tested successfully at INFN) is being developed jointly by INFN and IPN-Orsay. This paper describes the module layout and its implementation plan at Orsay.

* This work is supported by the EURATOM 6th Framework Program of the EC under contract FI6KW-CT-2004-516520.

WEP84: The test bench for the power amplifiers of the Spiral-2 SC linac

Marco DI GIACOMO, Bernard DUCOUDRET, Jean Claude DEROY, Patrick BARET (GANIL, Bd. H. Becquerel 14076 - CAEN cedex 5)

The high current driver accelerator of the SPIRAL 2 project uses independently phased SC resonators working at 88 MHz. Solid state power amplifiers equipped with circulators are foreseen to drive the cavities with widely ranging conditions of beam loading. These power devices will be developed by industrial companies and a test bench has been studied and manufactured to test the prototypes, to commission all the units before their installation on the accelerator and to be used to test repaired modules. Even if designed to be used at 88 MHz, the test bench can be used at higher frequencies too. The poster describes the test bench principle as well as the results on the first power devices bought for the cryomodule power tests.

WEP85: Waveguide coupler kick to beam bunch and current dependency on SRF Cavities*

G. Wu (FNAL), Haipeng Wang, C. E. Reece, R. A. Rimmer (JLAB)

JLab SRF cavities employ waveguide type fundamental power couplers (FPC). The FPC design for the 7-cell upgrade cavities was optimized to minimize the dipole field kick. For continuous wave (CW) operation, the forwarding RF power will be at different magnitude to drive the different beam current and cavity gradient. This introduces some deviation from optimized FPC field for varying beam loading. This article analyzes the beam behavior both in centroid kick and emittance growth under different beam loading conditions. This analysis is also applied to the JLab Ampere-class cavities for the energy recoverd beam when beam bunches are off-crest of electric fields.

WEP86: Niobium surface treatment by Buffered Electropolishing

Song Jin, Xiangyang Lu, Lin Lin, Limin Yang, Erdong Wang, Tianmu Xin, Kui Zhao (IHIP, School of Physics, Peking University)

A buffered electropolishing (BEP) process for Niobium is studied. The electrolyte of BEP is consisted of hydrofluoric (48%), sulfuric (98%) and lactic (85%) acids. Parameters that control the BEP process have been learned. It has been demonstrated that the polishing rate of BEP is directly proportional to current density, which is determined to be better controlled. Through inspection using a metallographic optical microscope (MOM) and an Atomic Force Microscope (AFM), it is proved that Niobium surfaces treated by BEP was much smoother than those treated by electropolishing (EP) process widely used in the superconducting radio frequency community. And all of those provide a good prepare for the next study—BEP for Nb cavity.

Thursday, Oct 18, 2007

Thursday Morning: Oral Session

Session TH1: Advances in SRF technology III

TH101: Review of the Thin Film Workshop (08:30-09:00)

Vincenzo Palmieri (INFN and University of Padua)

The present superconducting RF accelerator technology is based on solid Niobium. Thin film technology offers considerable savings in fabrication costs and what is even more important it opens the way to use alternative superconducting material with enhanced intrinsic properties such as critical temperature and critical field. Intensive and coordinated R&D effort is of decisive importance to explore the realization of this promise and to make the benefits available to the next generation of SC accelerators. The aim of this workshop is to bundle the expertise from industry, research laboratories and accelerator technology in order to launch a new initiative in thin film and innovative related technology for superconducting RF accelerator application. The immediate infusion of industrial expertise and specialists from cross-disciplinary fields, as for instance superconductivity, plasma physics, material science, nanotechnology and rf engineering, is of crucial importance.

TH102: Progress on Large Grain and Single Grain Niobium – Ingots and Sheet and Review of Progress on Large Grain and Single Grain Niobium Cavities (09:00-09:30)

Peter Kneisel (Jefferson Lab)

Progress on Large Grain and Single Grain Niobium – Ingots and Sheet and Review of Progress on Large Grain and Single Grain Niobium Cavities* Peter Kneisel Jefferson Lab, Newport News, Virginia, USA Large grain and single crystal niobium has been proposed several years ago as an alternative material to poly-crystalline niobium for superconducting cavities, exhibiting potential advantages such as “stream-lined” procedures, reduced costs and better reproducibility in performance. Several major laboratories have investigated the use of large grain and single crystal material in the past years and the niobium producing industry has responded in providing ingot material with improved grain sizes. Besides a large number of single cell and multi-cell cavities from large grain niobium, several single crystal cavities have been fabricated and tested with good performances. This contribution will review the progress since the SRF workshop in 2005 in material processing and handling and in cavity performances. * This manuscript has been authored by Jefferson Science Associates, LLC under U.S. DOE Contract No. DE-AC05-06OR23177. The U.S. Government retains a non-exclusive, paid-up, irrevocable, world-wide license to publish or reproduce this manuscript for U.S. Government purposes

Hot Topic I

Is large grain/ single crystal Nb an alternative material to polycristallline niobium? (09:30-10:30)

Chairman: Hasan Padamsee (Cornell University)

The arrival of large grain and single grain niobium more than 2 years ago has generated a great deal of excitement in the SRF community. With activities at many laboratories it is time to critically examine whether large grain/single grain Nb is a viable alternative to polycrystalline niobium.

Peter Kneisel's review talk on "Progress on Large Grain and Single Grain - Ingots, Sheets Cavities" should provide an ideal launching point for our discussion when we hope to address the following topics :

- Do the material properties for fabricating cavities out of large grain/single grain provide benefits over polycrystalline Nb?
- Are there any special material challenges that need to be addressed, such as earing, grain slippage...?
- It is hoped that large grain/single grain material can avoid the need for EP, a procedure more difficult to execute and control than BCP. Is the high field performance of large grain/single grain cavities with BCP comparable to performance of polycrystalline cavities with EP, both from the perspective of best peformance as well average performance over many cavities?
- Are there any other treatment simplifications offered by large grain/single grain material, such as reduced need for baking...?
- Does large grain material have fewer defects due to the elimination of the forging, rolling and many other steps during sheet formation? For example, does eddy current scanning of sheets or thermometry with cavities show reduced defect occurrence?
- Are there clear cost advantages to using large grain/single grain material sliced from the ingot?
- Do we have an economically viable procedure to fabricate sheets directly from the ingot by slicing?

Hot Topic II

Is 35 MV/m still a good choice for ILC? (11:00-12:00)

Chairman: Hasan Padamsee (Cornell University)

Session TH2: Industrialization on SRF Accelerators

TH201: Industrial Study of FLASH Module Production (12:00-12:30)

K.Jensch, J.Knobloch, R.Lange, A.Matheisen, B.Petersen (DESY)

The cryomodules of the FLASH linac at DESY represent the development of the cryomodule design of the TESLA Technology Collaboration. Beside of the use in the FLASH linac, the cryomodule design and construction serve as a generic approach for other projects. In particular, the industrial production of the cryomodules of the European XFEL-project will be based on the FLASH cryomodule development.
To prepare for the construction of the European XFEL and other superconducting linac based light sources like the BESSY-FEL, the existing FLASH cryomodule design and assembly procedures are reviewed by means of industrial studies. The aim is to prepare for series production, as well as to reduce the effort and costs and to increase the performance and the reliability. As a result of a European negotiated procurement procedure, two European companies were qualified to take part in the studies. The ACCEL Instruments GmbH and the Babcock Noell Nuclear GmbH (BNN) took part in the complete assembly the cryomodule production No.6 at DESY in May/June 2006. Both companies will also be involved in the assembly of cryomodule No.8 in fall 2007. The present status of the studies and first results are reported. The industrial studies are supported by the EUROFEL Design Study contract No.011935.

TH202: Industrialization process for XFEL Power couplers and Volume manufacturing (12:30-13:00)

Serge Prat (LAL, Orsay), Wolf-Dietrich Moeller (DESY, Hamburg)

The XFEL (European X-Ray Free-Electron Laser) is a new international large-scale research infrastructure to be built in the north west of Hamburg, Germany.
The TESLA power coupler TTF3, developed at DESY for TESLA was chosen to be the first choice for the XFEL. For further development, testing and conditioning of the power coupler a collaboration is working between LAL, Orsay and DESY, Hamburg since 2004. Up to 60 power couplers of the TTF3 type are fabricated, conditioned and under operation at the TESLA Test Facility.
For the industrialisation of the power coupler three contracts where placed at the Industry. The follow up of these contracts is under the supervision of LAL.
We will report about the approach of the contract and some results.

Friday, Oct 19, 2007

Friday Morning: Oral Session

Session FR1: Future projects and new ideas I

FR101: BNL - electron cooling and electron-ion colliders* (08:30-09:00)

Ilan Ben-Zvi (Brookhaven National Laboratory)

Superconducting Energy Recovery Linacs (ERL) have significant potential uses in various fields, including High Energy Physics and Nuclear Physics. BNL is pursuing some of the potential applications in this area and the technology issues that are associated with these applications. The applications that I will discuss are electron cooling of high-energy hadron beams and electron-nucleon colliders. The common issues for some of these applications are the generation of high currents of polarized or high-brightness unpolarized electrons, high-charge per bunch and high-current. One must address the associated issue of High-Order Modes generation and damping. Superconducting ERLs have great advantages for these applications as will be outlined in the text.

* Work supported by U.S. Department of Energy, Office of Nuclear Physics

FR102: High average power ERL FEL (09:00-09:30)

George Neil (Center for Advanced Studies of Accelerators, Jefferson Laboratory)

The continued development of srf accelerators has enabled a new application of the technology to become practical, the Energy Recovering Linac (ERL). In the ERL the energy of the used electrons is recycled rather than the electrons themselves. This permits the high efficiency of storage rings while allowing the high brightness achieved by fresh electrons from the injectors which only pass through the system once and do no have time to come into equilibrium. Such high brightness beams are ideal for many applications, especially light sources. This talk will discuss the application of ERLs to light sources and specifically to advanced Free Electron Lasers.

FR103: Future High Intensity Proton Accelerators (09:30-10:00)

Frank Gerigk (CERN)

This paper provides an overview of currently planned high-intensity proton accelerators. While for high energies synchrotrons are the classical tools to produce high-intensity beams, the recent years have seen an impressive development of mostly linac-based low-energy (<8 GeV) high-intensity proton sources for spallation sources, accelerator driven systems (ADS), production of radioactive beams and various neutrino applications. This paper will discuss the optimum machine type (cyclotron, RCS, FFAG, linac) according to the beam requirements of the application and then focus on a range of projects, which are likely to be realised within the coming decade.

FR104: CEBAF energy upgrade program including re-work of CEBAF cavities (10:00-10:30)

Joseph Preble (Jefferson Lab)

(Abstract not submitted)

Session FR2: Future projects and new ideas II

FR201: ILC: Goals and Progress of SRF R&D (11:00-11:45)

Hitoshi Hayano (KEK)

After completion of the reference design report (RDR) in spring 2007, ILC is changed their phase into the engineering design phase (ED). The new organization is now under construction in GDE, and new work packages are in discussion. The engineering design for the superconducting rf technology is divided to cavity and cavity package, cryomodule, cryogenics, high-level rf, and main linac integration. The detail discussion in each area are started to complete the EDR until middle of 2010 by making a lot of technology decision and downselection.

The technological and organizational issues are summarized, and a possible solution and the R&D will be proposed to achieve ILC SRF performance goals.