Status of SPIRAL2 project

HIAT2012

Chicago, 18-21 June 2012

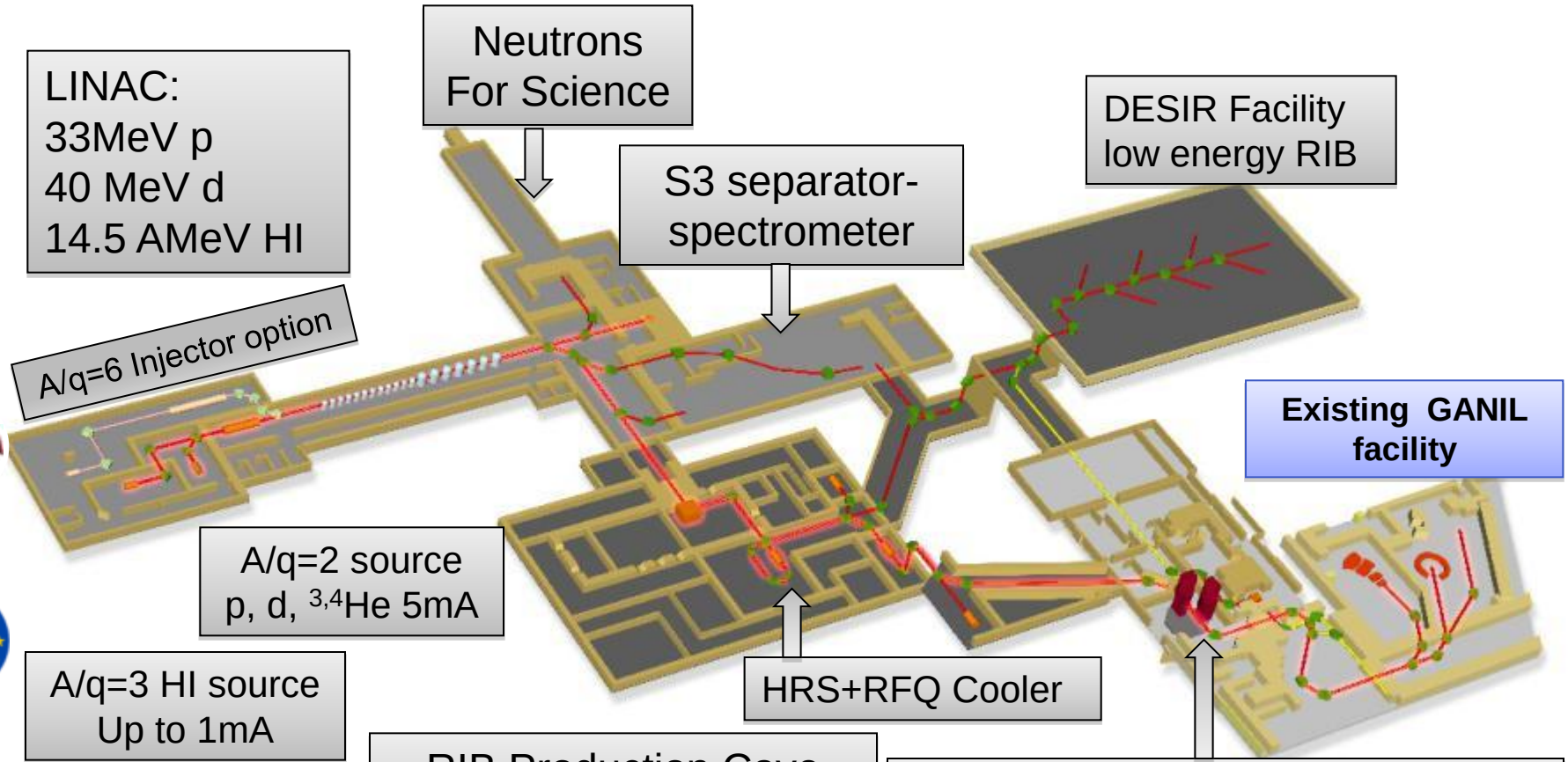
Eric Petit

Status of SPIRAL2 project:

- ✓ description of SPIRAL2 facility
- ✓ presentation of project organization
- ✓ progress of the first phase of SPIRAL2
- ✓ progress of the second phase of SPIRAL2
- ✓ conclusions

The SPIRAL2 facility

SPIRAL2 is one of the ESFRI list projects (45 most important EU research infrastructure projects)



SPIRAL2 project organization

Decision level

CEA/DSM

CNRS/IN2P3

Strategic management

Steering Committee

International steering committee

Evaluation committees TAC - SAC

Operational management

Head of project

Management team

Scientific community

Nuclear Facility

Systems

Accelerator driver

RIB

Buildings

Laboratories

Autres

Partner laboratories for construction

R§D and Construction

CEN Bordeaux-Gradignan (**CENBG**)

Centre de Spectro. Nucléaire et Spectro. de Masse Orsay (**CSNSM**)

Institut de Physique Nucléaire Orsay (**IPNO**)

Institut de Physique Nucléaire Lyon (**IPNL**)

Institut Pluridisciplinaire Hubert Curien Strasbourg (**IPHC**)

Laboratoire Accélérateur Linéaire Orsay (LAL) (**LPC**)

Laboratoire de Physique Nucléaire et de Htes Energies Paris (**LPNHE**)

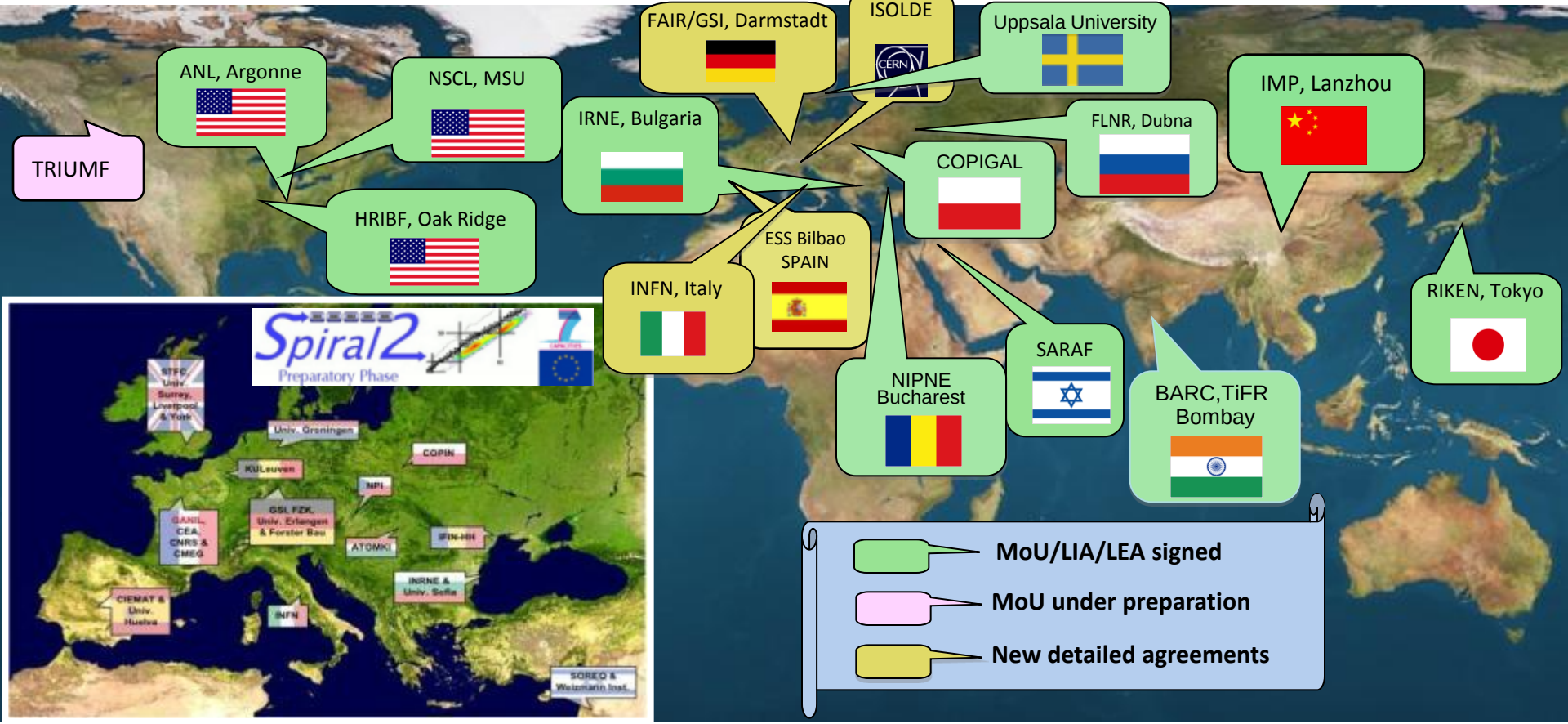
Laboratoire de Physique Subatom. et de Cosmol. Grenoble (**LPSC**)

	R§D	Construction
DSM	**IRFU/SPhN**	**IRFU/SACM**
DSM		**IRFU/SIS**
DSM		**IRFU/SENAC**
DSM – Saclay		Expertise
DAM	DPTA	**DASE et DP2I**
DEN		Expertise
DPSN		Expertise

Grand Accélérateur National d'Ions Lourds
GANIL
Laboratoire commun CEA / DSM - CNRS / IN²P³

International collaborations

International Collaborations



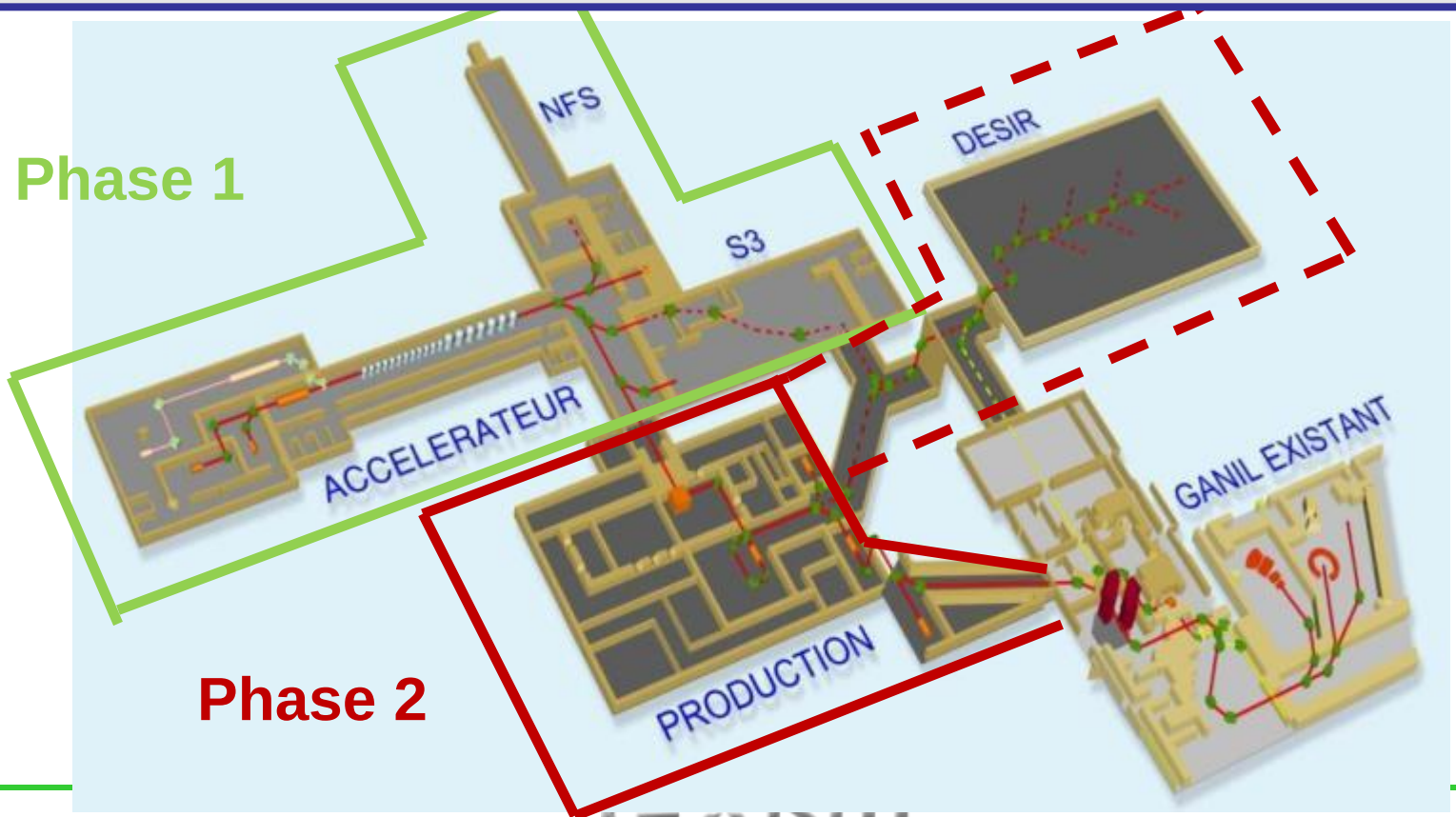
16 signed (LEA*, LIA**, MoU***) agreements
MoU with Bilbao (RIB production module,…) signed in March
2 agreements under preparation:
- MoU with GSI/FAIR (baseline project)
- LIA/MoU with TRIUMF (laser sources)

15-19/11/10 LEA Workshop with SPES
13/12/10 MoU with Sweden
5-8/01/11 LIA Symposium RIKEN
14-15/03/11 Workshop with FLNR Dubna
31/03/11 Workshop with ESS Bilbao

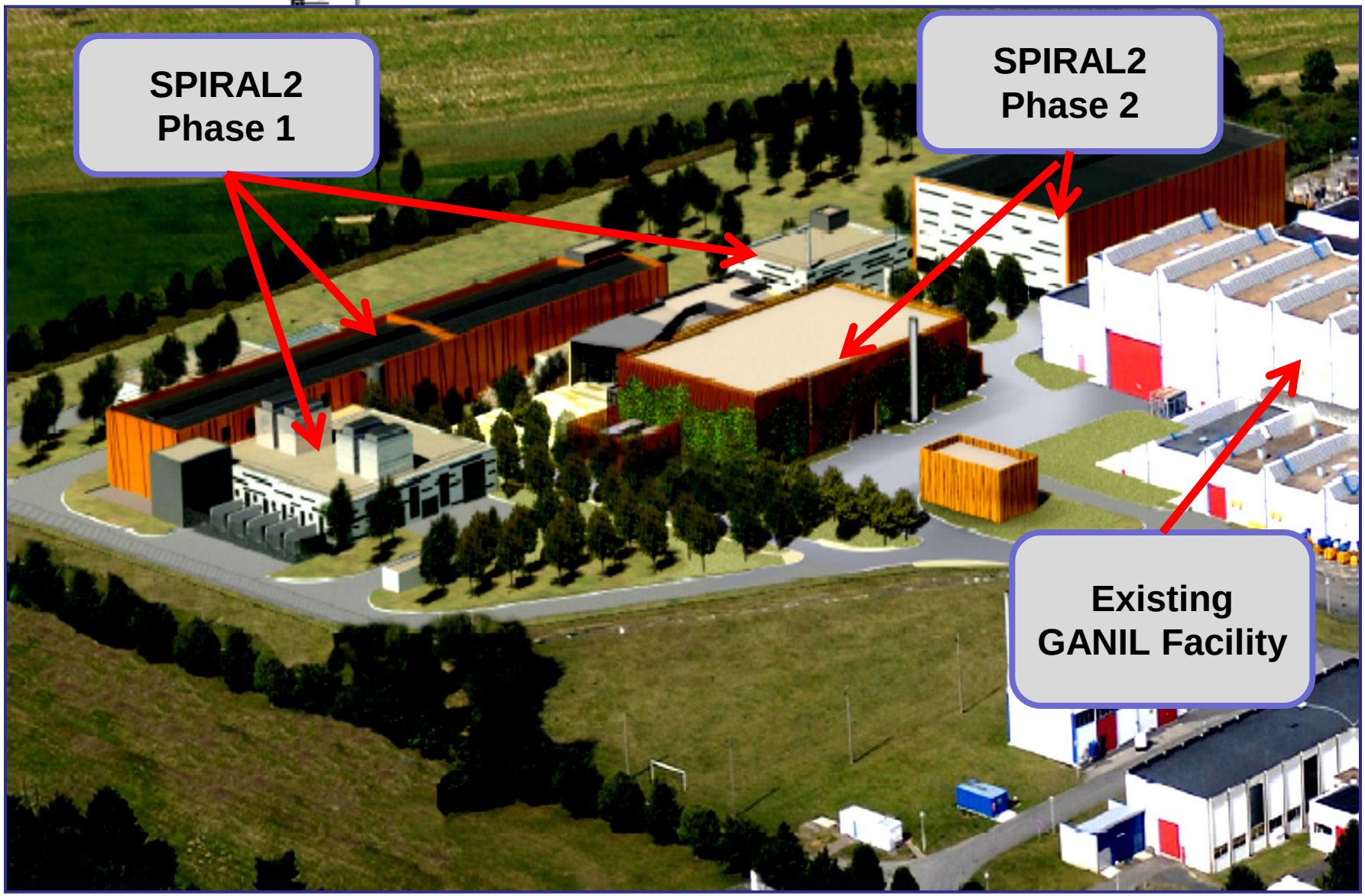
Construction of SPIRAL2 in 2 phases

Beginning of 2008: 2 phases construction strategy, with its licensing procedure and associated schedule, validated by ASN => one public enquiry, one DAM report and one decree for the two phases.

Beginning of 2012: ASN has required us a strategy with 2 public enquiries, 2 DAM reports and 2 decrees



Construction of SPIRAL2 in 2 phases



Planning for SPIRAL2 Phase 1

	2006				2007				2008				2009				2010				2011				2012				2013				2014			
	T1	T2	T3	T4	T1	T2	T3	T4	T1	T2	T3	T4	T1	T2	T3	T4	T1	T2	T3	T4	T1	T2	T3	T4	T1	T2	T3	T4	T1	T2	T3	T4	T1	T2	T3	T4
Accelerator and associated experimental area buildings																																				
Definition of buildings specifications																																				
Competition and Moe choice									★ June 2008																											
Preliminary Design of buildings ("APS+")																																				
DAM Transmission													★ April 2009																							
Submission of buildings permit														★ July 2009																						
Detailled design of buildings ("APD")																																				
Public enquiry and instruction by IRSN																																				
Permit of construction obtained																	★																			
Site preparation - Buildings construction																																				
Receipt of first underground caves																									★											
Receipt of first surface caves																													★							
Equipment installation																																				
Decree																																				
First beam tests																															★					
Tests and operation																																				

Status of buildings construction

Site before its preparation in November 2010

Status of buildings construction

Status of buildings construction

First concrete pouring in September 19th of last year

Status of buildings construction

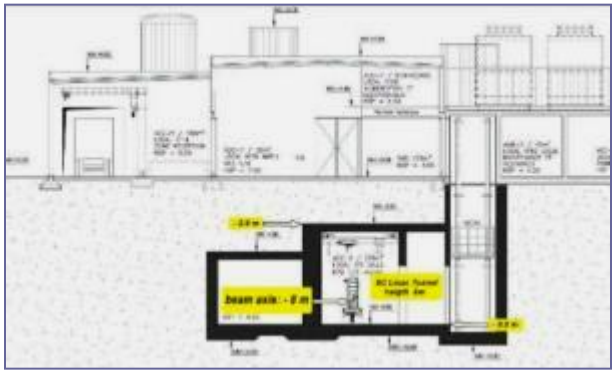
May 2012

Status of buildings construction

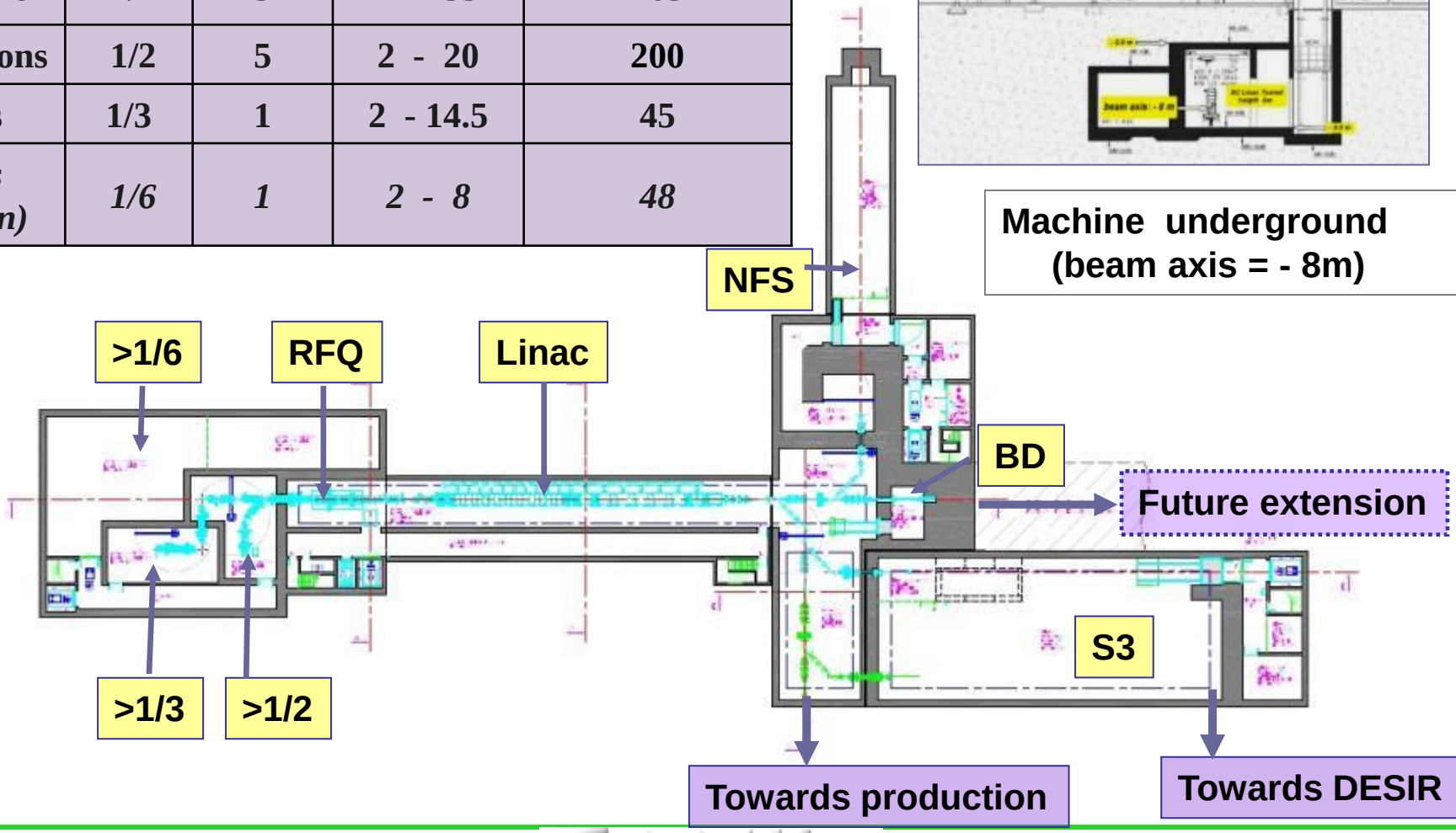
End of May 2012

SPIRAL2 Phase 1: Driver Beam Characteristics

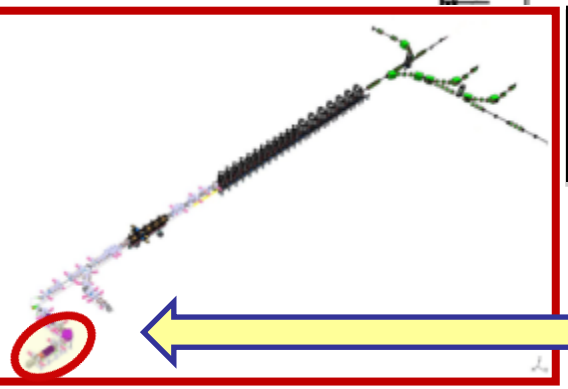
	Q/A	I (mA)	Energy (Mev/u)	CW max beam Power (KW)
Protons	1/1	5	2 - 33	165
Deuterons	1/2	5	2 - 20	**200**
Ions	1/3	1	2 - 14.5	45
Ions (option)	*1/6*	*1*	*2 - 8*	*48*



Machine underground
(beam axis = - 8m)

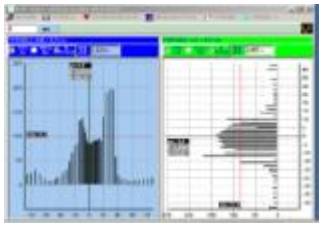


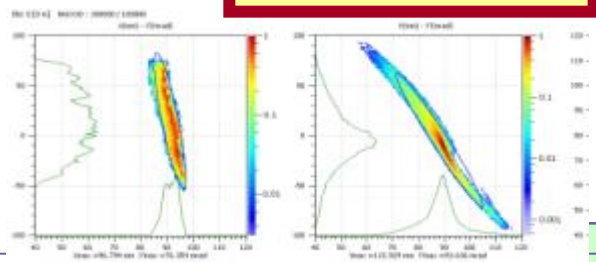
Phoenix-V2 + LEBT1 line



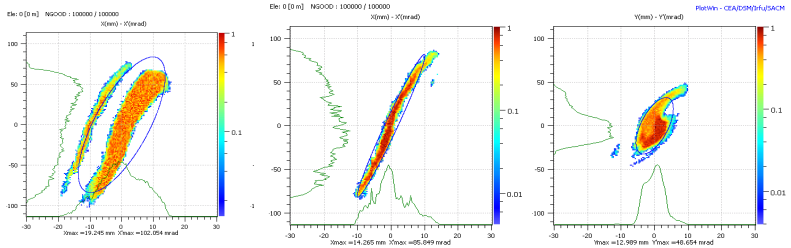
A/q=3 HI source
up to 1mA
with its associated LEBT

Irfu Saclay
LPSC Grenoble
IPHC Strasbourg
Ganil





Beam profiles and emittance 0,22 pi.mm.mrad (O16 6+, March 2010)

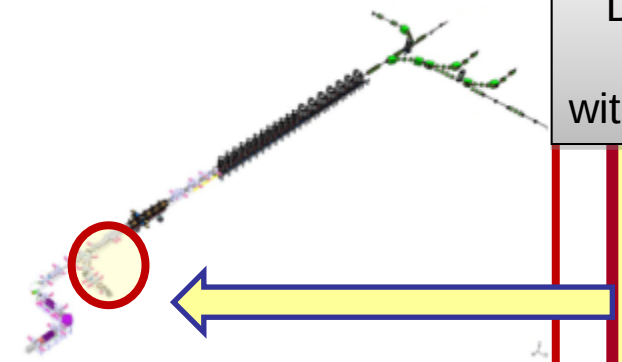


Xe132 25+
O16 3+

Xe132 25+
Separation using slits

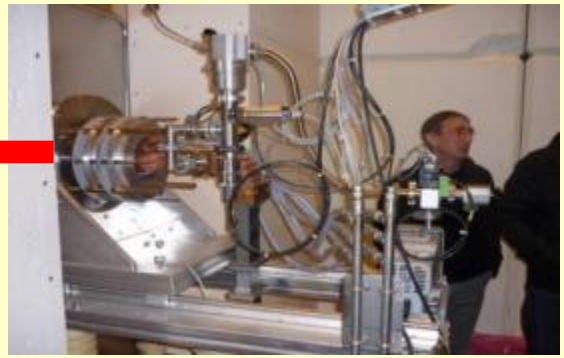
- **Technical & beam tests 2010/2011 :**
  - **PLCs, C/C (Epics) , Vacuum…**
  - **Faraday cups, profilers**
  - **Emittance-meters, slits**
- **Last beam tests (since September 2011) :**
  - ***Oxygen beam obtained at 60 kV***
  - ***Metallic beams developments:25 µA Ca40 13+ (600 Watt HF power, 35 kV) and 20µA Ni58 19+ obtained***

Deuteron/proton Source + LEBT2/LEBTC lines

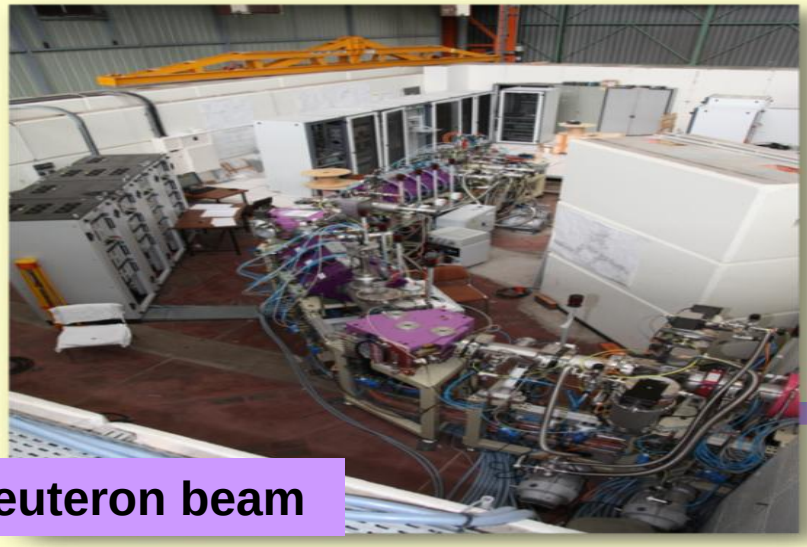


Deuteron and proton source
with its associated LEBT

Irfu Saclay
LPSC Grenoble
IPHC Strasbourg
INFN-LNS
Ganil

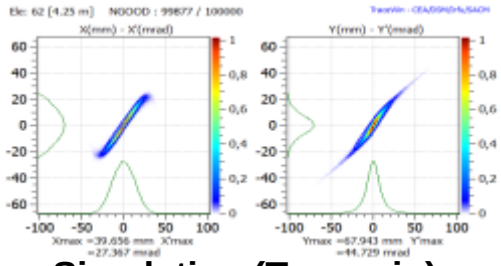


Deuteron 2.45 GHz ECR source tested successfully in March 2010 (Protons)

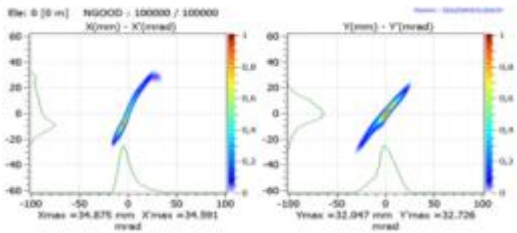


Deuteron beam

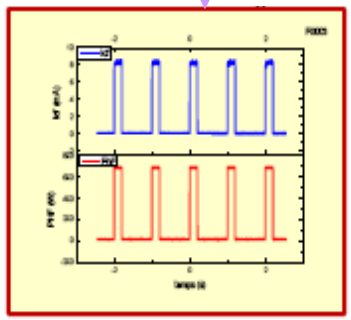
7 emA protons and deuterons beams tuned to the end of LBE line with 85% of transmission
Beam chopper and its associated scraper tested



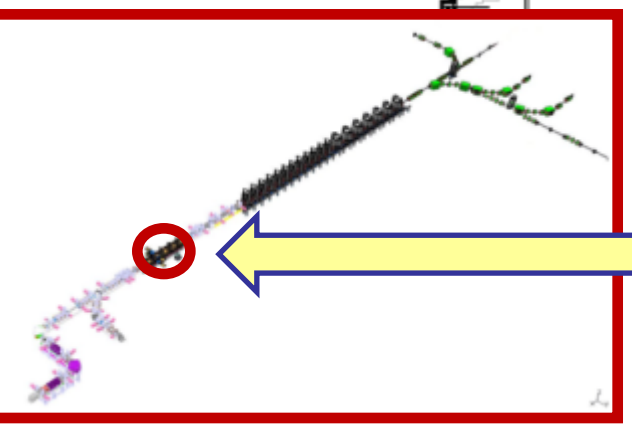
Simulation (Tracewin)



Experiment (Oct 2010)

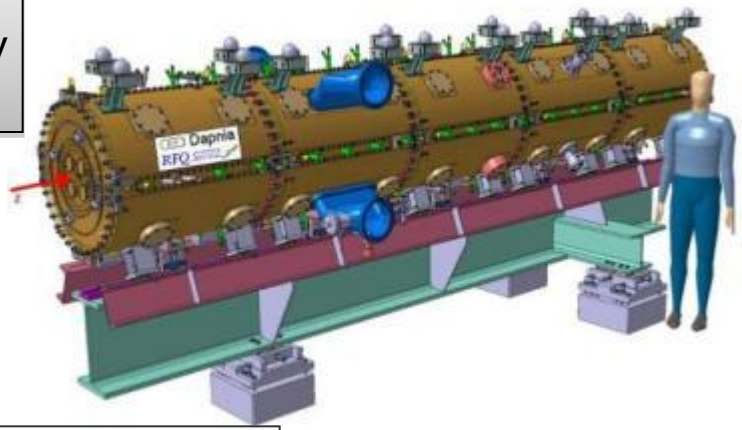


Status of RFQ



4 vanes- 5m long conducting copper cavity

Irfu Saclay

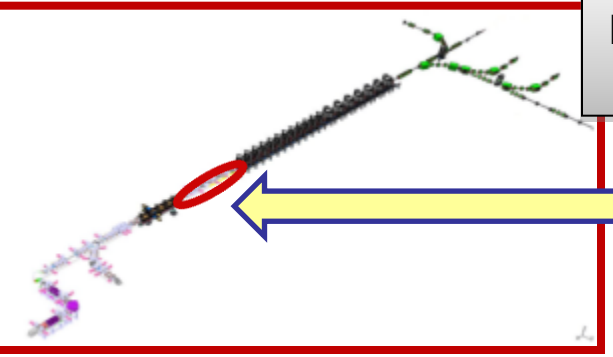


T5 segment - 3D measurements

T5 segment has been assembled but vacuum leaks to solve.
The vanes for 4 other segments have been prefabricated, then preassembled and 3D measurements have been performed.
We expect the measures of leakage rates with segment T4 in order to validate the vacuum seals

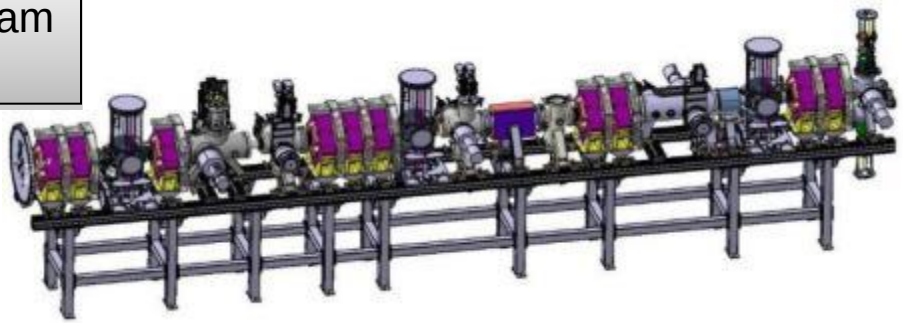
T4 segment machining

Status of MEBT line



Line to match the beam for the LINAC

Ganil
IPHC Strasbourg
Irfu Saclay

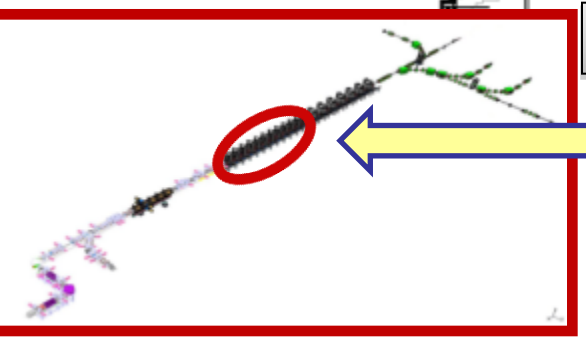


1st buncher power tests over in June 2011
Specifications OK (120kV CW and *180kV* pulsed)
Bunchers 2 & 3 delivered in spring 2013

All ten quadrupoles are built
Magnetic measurements OK

Vacuum chamber orders placed beginning of this year.
Delivery expected end of 2012

Status of LINAC (1)



12 **x** β_0=0.07 superconducting cavities

Irfu Saclay	NIPNE Bucarest
LPSC Grenoble	LPNHE Paris
IPN Orsay	BARC India
LAL Orsay	Ganil

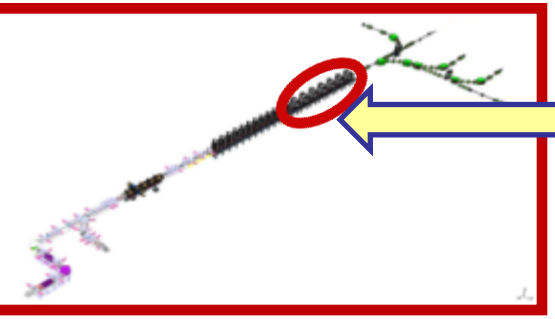
Supports for Cryomodules and Warm Sections manufacturing completed

Quadrupoles (Fabrication and magnetic measurements completed)

Cryomodules β_0=0.07 under tests. Pollution problems seem to be overcome.

All the couplers are received and are being commissionned.

Status of LINAC (2)

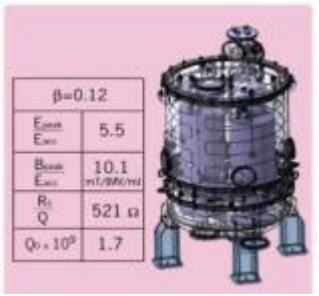


14 x β_0=0.12 superconducting cavities

Irfu	NIPNE Bucarest
LPSC Grenoble	LPNHE Paris
IPN Orsay	BARC India
LAL Orsay	Ganil

All the couplers received and are being commissionned

Solid-state amplifiers used to power the linac cavities are being manufactured. Prototypes have been tested



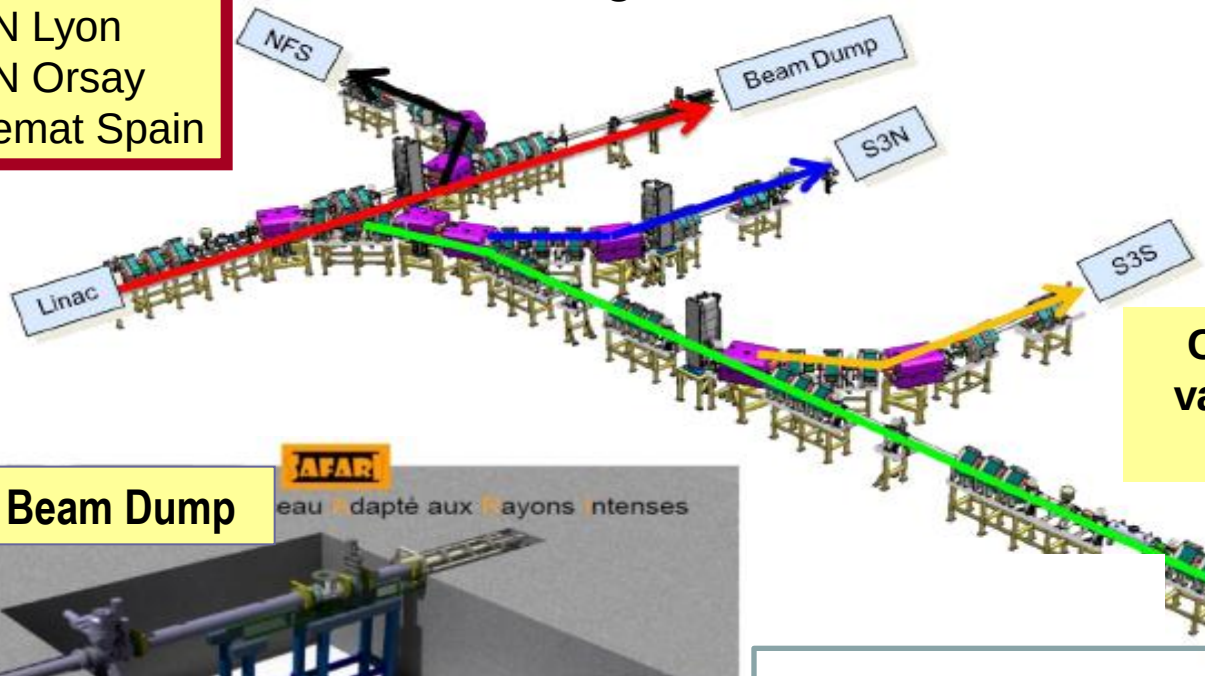
IPNO/Orsay

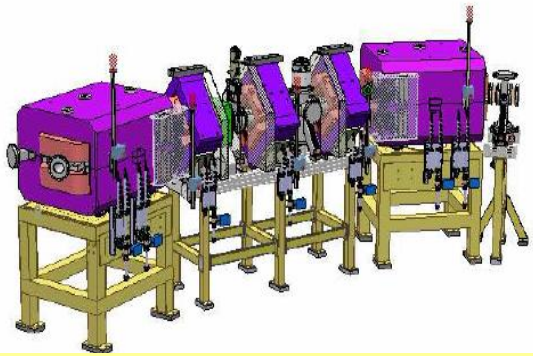
Qualifying cryomodule, for β_0=0.12 cavities, met the specifications but difficulties with series cryomodules

Status of HEBT lines

Ganil
IPN Lyon
IPN Orsay
Ciemat Spain

HEBT design is now frozen

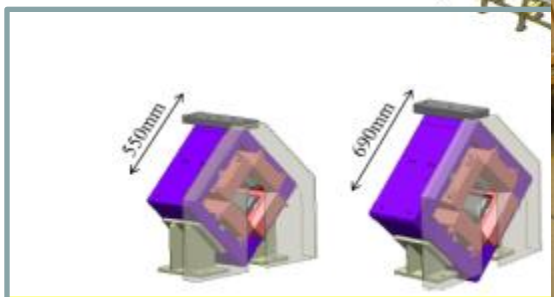




Construction of supports and vacuum pipes will be launched after summer of 2012

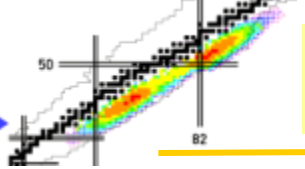
Beam Dump

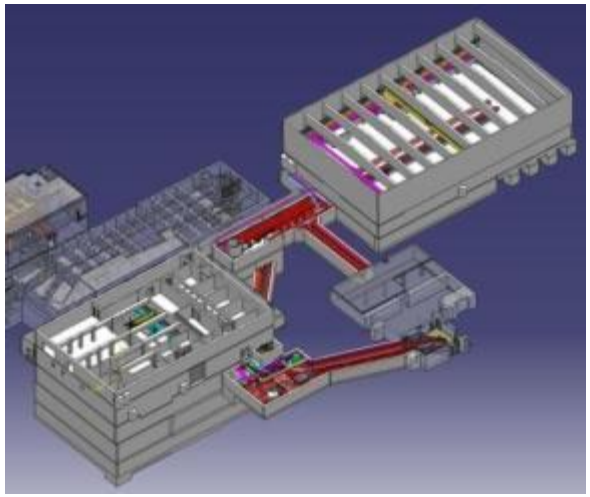
Prototype under thermic test. Construction will be launched at the end of 2012



Quads, dipoles and power supplies are under construction.
First dipole delivered at GANIL for tests

SPIRAL2 Phase 2 buildings





contract is signed with the company in charge of building studies

Beginning of the preliminary design

end of the preliminary design

December 2011

March 2011

September 2011

The preliminary design of the buildings is achieved and is technically validated, but cost estimation too high (+ 4M€)
Proposals of modified specifications made by SPIRAL2, now under analysis by Buildings Prime Contractor for a re-estimated cost.
We hope to start Detailed Studies of buildings beginning of next year

Planning for SPIRAL2 Phase 2

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
	T1T2T3T4	T1T2T3T4	T1T2T3T4	T1T2T3T4	T1T2T3T4	T1T2T3T4	T1T2T3T4	T1T2T3T4	T1T2T3T4	T1T2T3T4
Bâtiment Production et salles expériences associées										
Competition and MOe choice-					★ November 2009					
Choice of company for building study					★					
Preliminary design of buildings (APS)										
Submission of buildings permit							★			
Detailed design of buildings (APD)										
Submission of preliminary safety report					July 2010			★		
Obtaining of buildings permit									★	
Analysis of buildings WP quotations									★	
Signing of buildings WP contracts									☆	
Site preparation - Buildings construction										
Receipt of first underground caves for lines installation									★	
Receipt of production cave for process installation										★
Equipments installation										
Tests and operation										

Planning for SPIRAL2 Phase 2

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
T1T2T3T4	T1T2T3T4	T1T2T3T4	T1T2T3T4	T1T2T3T4	T1T2T3T4	T1T2T3T4	T1T2T3T4	T1T2T3T4	T1T2T3T4

Bâtiment Production et salles expériences associées

Competition and MOe choice- ★ November 2009

Choice of company for building study ★

Preliminary design of buildings (APS)

Submission of buildings permit ★

Detailed design of buildings (APD)

Submission of preliminary safety report ★

Obtaining of buildings permit ★

July 2010

Analysis of buildings WP quotations ★

Signin ★

Site p ☆

Receip llation

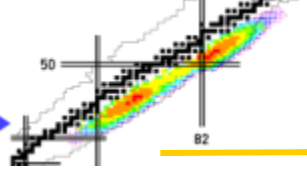
Receip n

Equipr ★

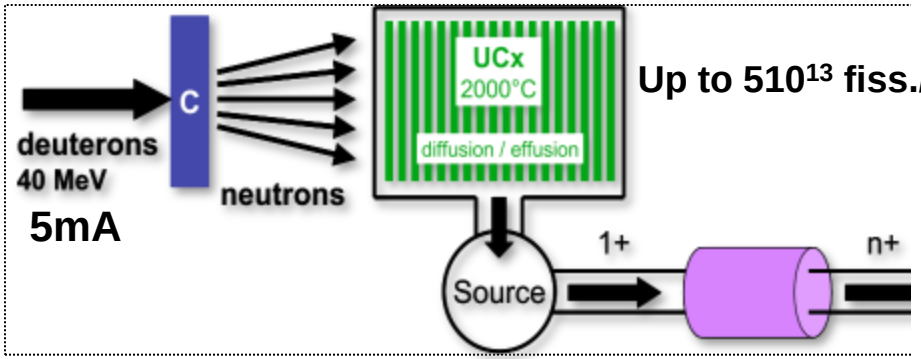
Tests and operation ★

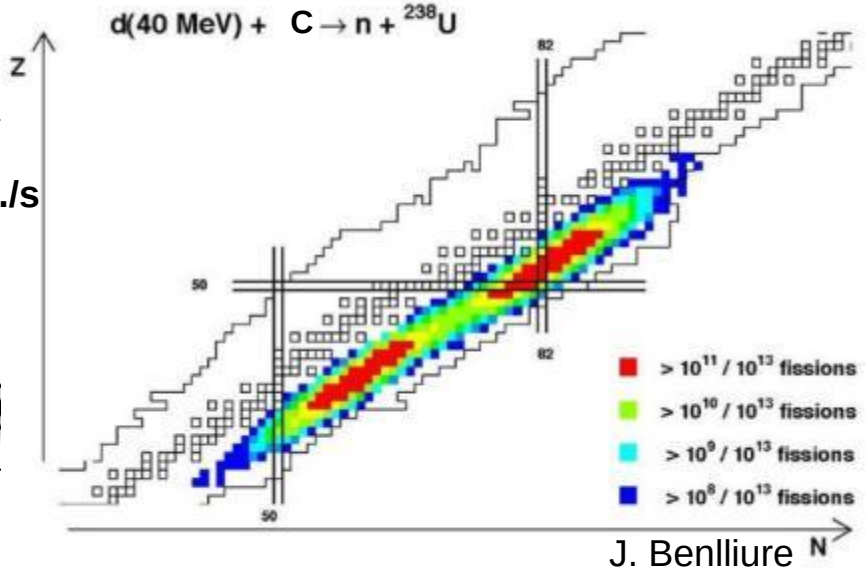
New planning to build due to
- **buildings cost reduction process**
- **new safety licensing procedure (DAM, public enquiry and decree for SPIRAL2 Phase2)**

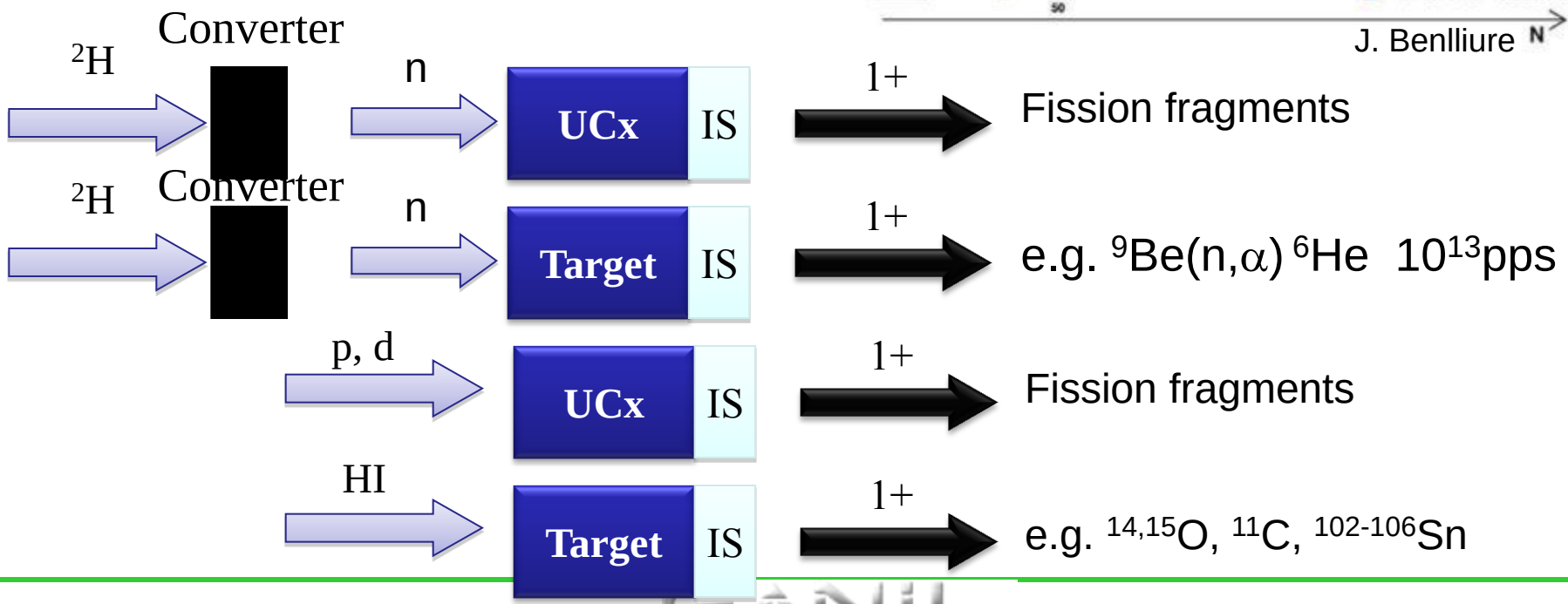
RIB process



Up to 2.3 kg HD UC_2

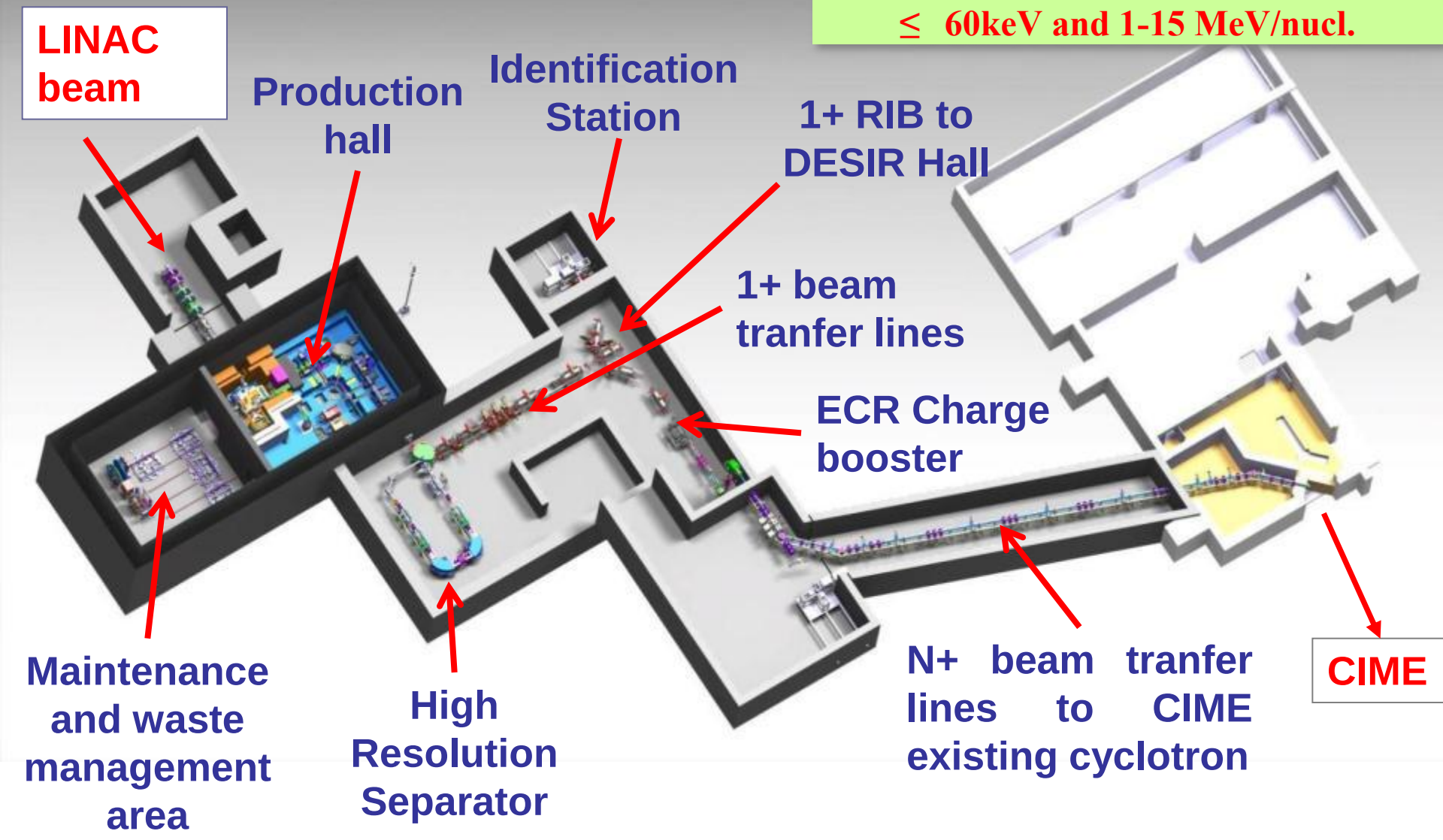




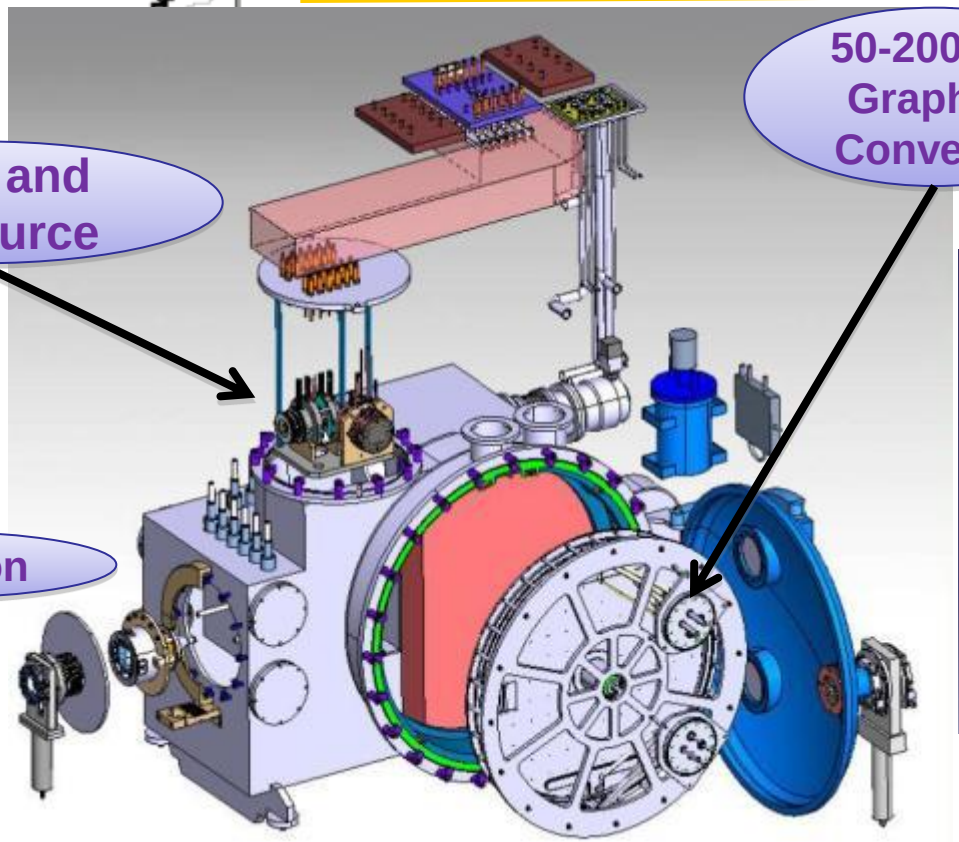


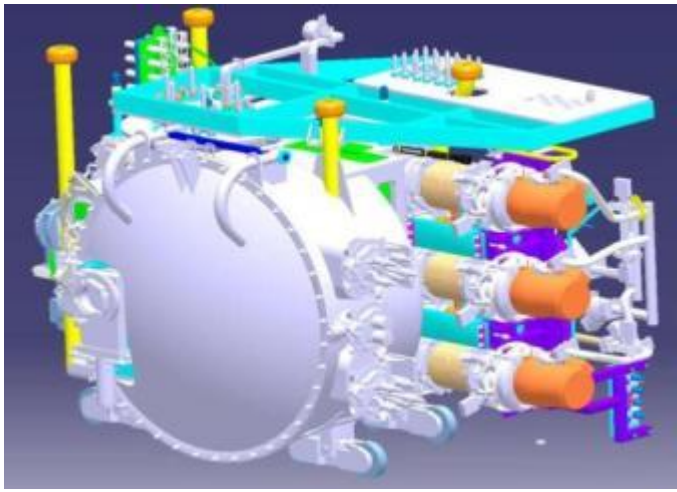
RIB Production and Transport

Energy range of SPIRAL2 ISOL RIB :
≤ 60keV and 1-15 MeV/nucl.



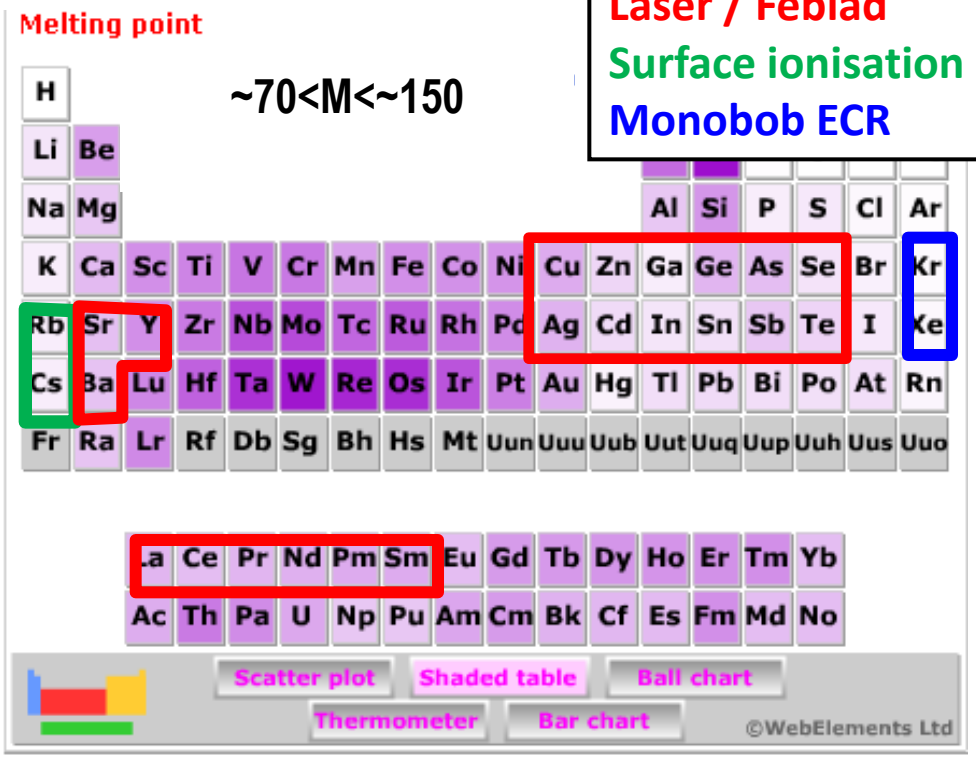
RIB Production Module

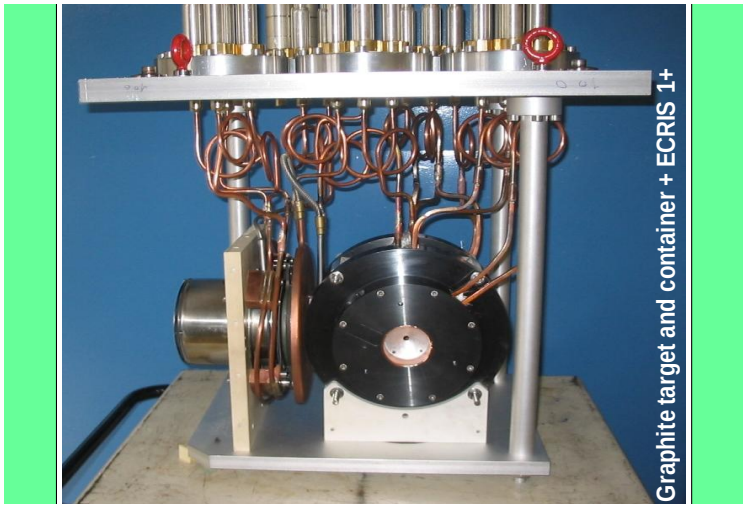


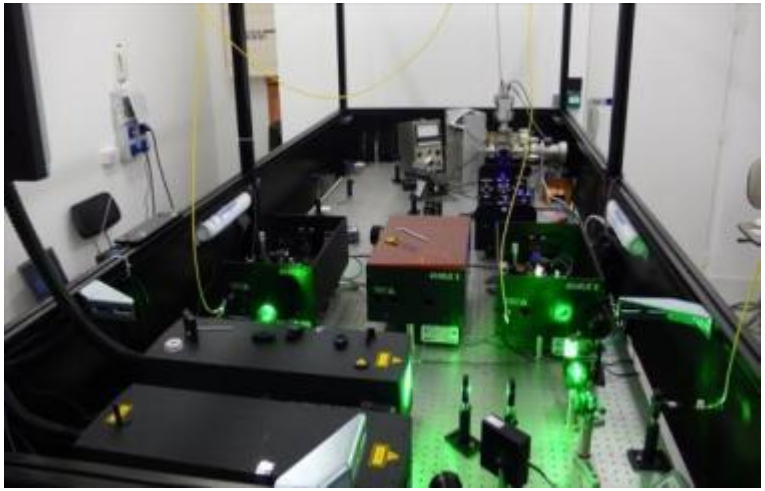


The detailed study of the TIS production module is completed .
The production module is a totally remote-operated system taking into account radiological environment, safety and contamination handling rules.
The construction of a prototype of the production module could begin at the end of this year (ESS Bilbao)

4 ion sources for RIB production



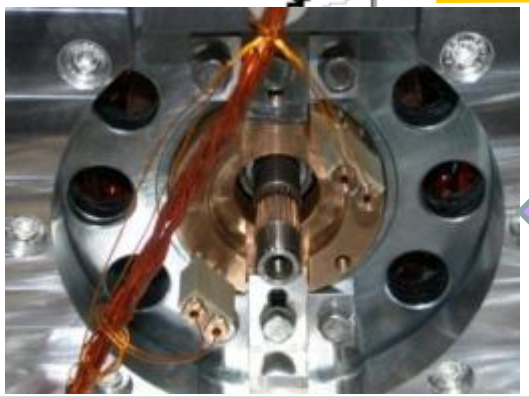




- prototype of ECR tested (80% efficiency),
- Laser Ion source has to be developped, only the laser source is tested,
- FEBIAD Source under development,
- Surface Ionization Source under development,

Ga+ produced with GISELE laser system, in collaboration Mainz University

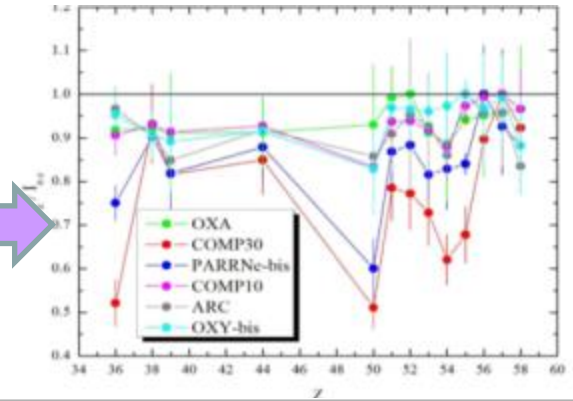
Converter and targets



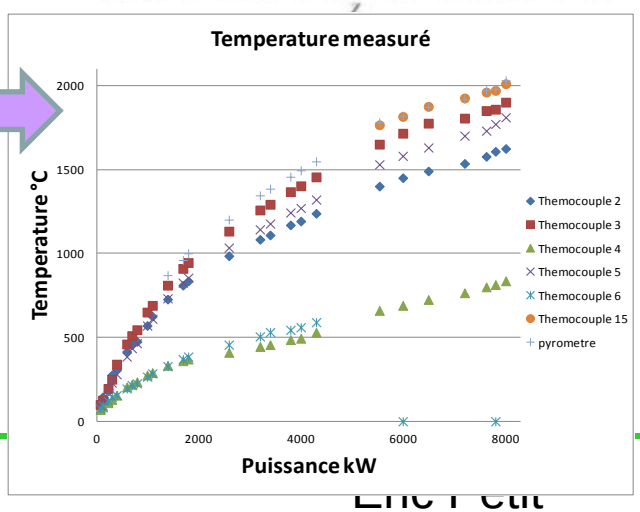
The individual parts (graphite evaporation rate, ball bearings, cooling system and the mechanical rotation) has already been tested
The first complete prototype of the 50kW size converter is under construction at INFN-LNL.

Ucx target:

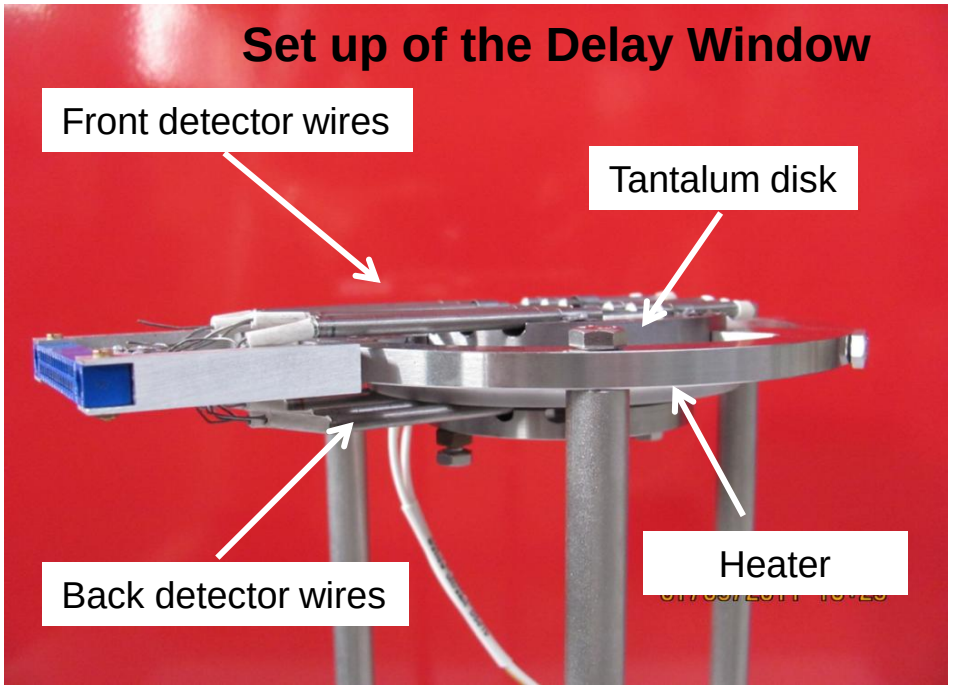
different structure and density have been irradiated at IPNO to find an optimum target for the production.
A new target laboratory dedicated to the Ucx development is under construction at IPNO



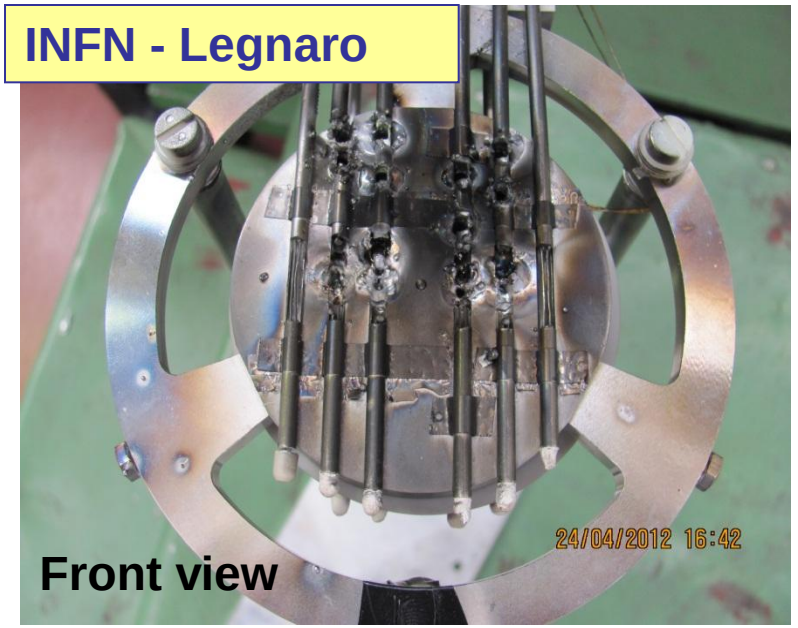
Graphite oven built and tested.
2000°C temperature succesfully obtained in February of this year



Delay window



INFN - Legnaro



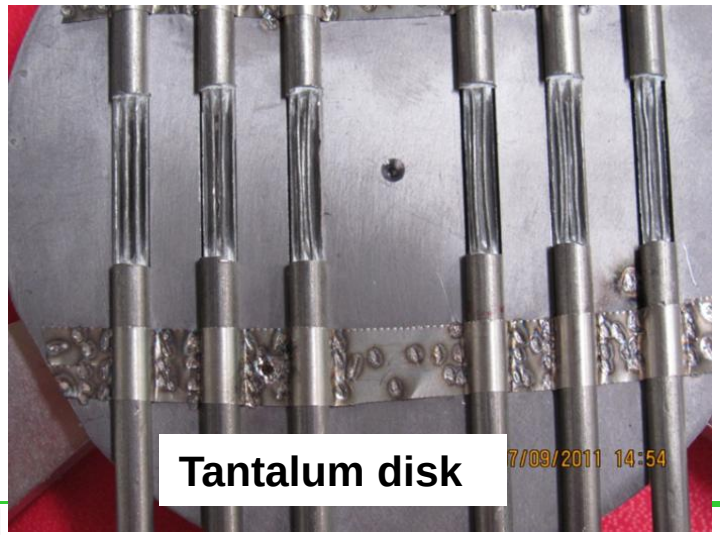
Delay window:

Tested with e-beam similar to SPIRAL2

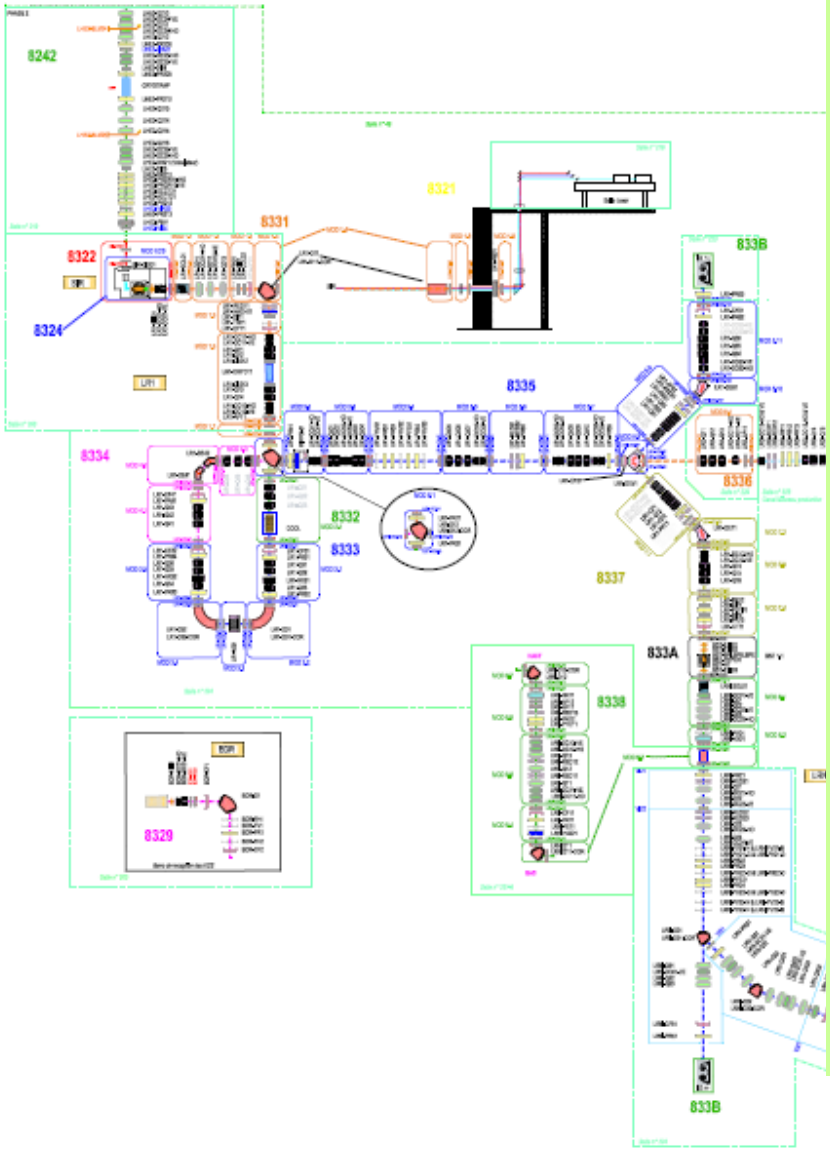
primary beam power

Ta melting time: 580ms (calculated)

≈800ms (measured)



RIB transport lines



✓ 1+ RIB line :

The preliminary design is achieved.

The integration studies in the buildings, taking into account the constraints of maintenance, are in progress.

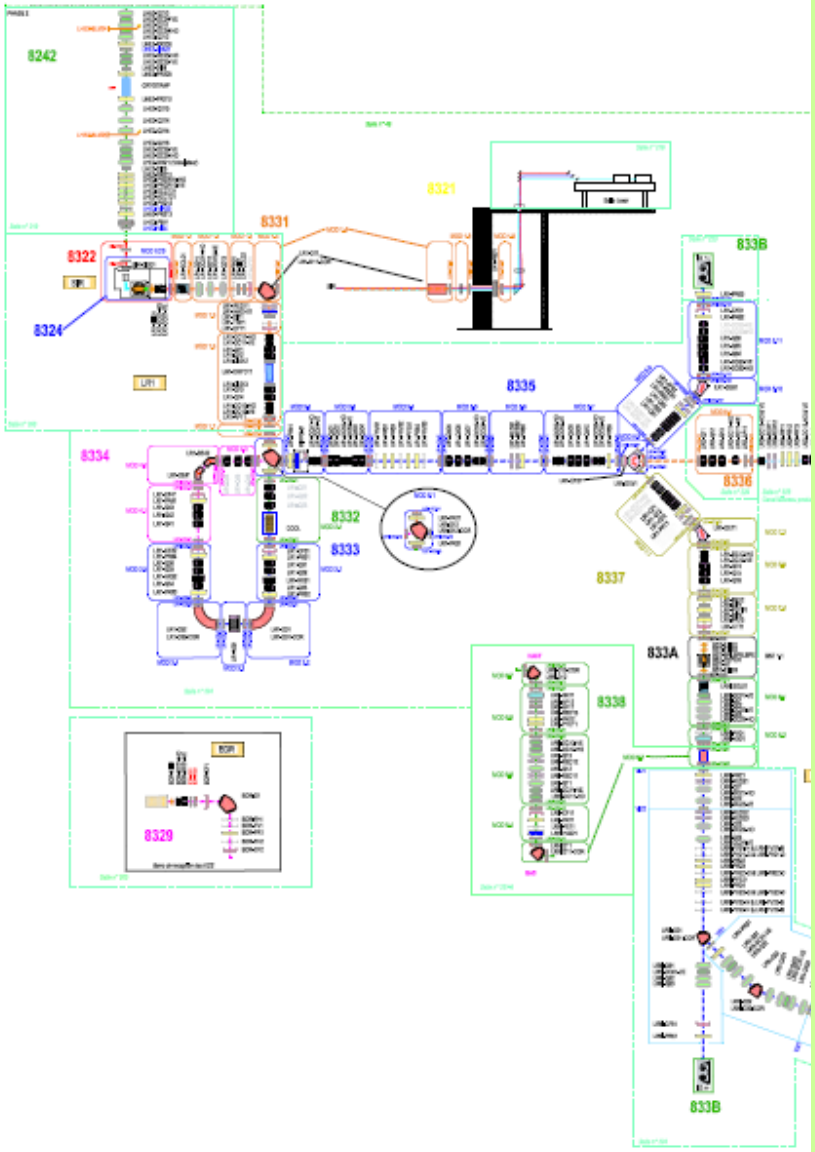
✓ N+ RIB line towards CIME:

(existing cyclotron)

The preliminary design of the n+ line is complete.

Their detailed study has still to be started.

RIB transport lines



✓ Charge booster:

Charge breeder has been tested on the LPSC test bench.
The “nuclearization” is well advanced.

✓ RFQ Cooler :

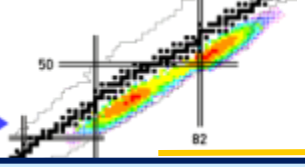
Prototype built and the tests with beam are in progress .
The “nuclearization” is under studies.

✓ HRS:

Beam dynamics is fixed, the feasibility study of the magnet is underway. Construction of magnets should be launched second semester of this year.

✓ Identification station ID1+/N+:

Detailed study is over.



Conclusions

Concerning SPIRAL2 phase1:

- More or less all the equipments are under manufacturing or under tests.
- All the tests in laboratories are very important to debug problems before final installation at GANIL.
- Buildings construction is under way.
- Safety documents are in preparation.
- the Decree is obtained.
- Another main task for Spiral 2 staff is to prepare the installation phase of the equipments in buildings. This task was initiated and is underway.

Concerning SPIRAL2 Phase2:

- Now : Preliminary studies of sub-systems are completed.
- All detailed studies of the process are underway.
- Beginning of 2013 : starting of detailed studies of buildings.
- The planning has to be re-consolidated taking into account the licensing procedure with 1 public enquiry, 1 DAM report and 1 decree.


Thank you for your attention