THE CONTROL SYSTEM OF THE ELLIPTICAL CAVITY AND CRYOMODULE TEST STAND DEMONSTRATOR FOR ESS

Alexis Gaget, Tom Joannem

CEA Saclay Irfu DIS, France

ICALEPCS October 10th 2019
ESS (European Spallation Source):

- European collaboration

The European Spallation Source (ESS) is a European Research Infrastructure Consortium (ERIC), a multi-disciplinary research facility based on the world’s most powerful neutron source.

CEA IRFU Involved in the control system of the following systems:

- Source and LEBT
- RFQ (couplers conditioning, cooling system, vacuum)
- Diagnostics nBLM (MOMPL008)
- Elliptical cavities and cryomodule
CRYOMODULE CONTROL SYSTEM

Cryogenic
- Automatic sequences for cooling down
- Nitrogen and helium tanks management

Vacuum
- Isolation and beam vacuum control

Cavities tuning
- Controlling Phytron motors for slow motion
- ETS200S technology
- Controlling Piezoelectric motor for fast motion
- Automatic sequences for cavities characterization

Warm and cold conditioning
- RF signal measurement
- PM / PUe- measurement
- Automatic sequences for coupler conditioning
Fast Acquisition
- loxos IFC1210 VME Card
  - CPU
  - VME 64x
  - 2 mezzanine card slots
  - Realtime Linux
- loxos ADC3111
  - Mezzanine card
  - Up to 250MSamples/s
  - 8 channels
  - +/- 0,5V

Remote I/O
- Beckoff EtherCAT Modules
  - Wide variety (0-10V, 4-20mA, PT100 ...)

Timing system
- MRF EVG/EVR 230
  - Optical fiber
  - EPICS driver
Siemens PLC 1500 generation

- Made for control automatic process
- Fieldbus ready: Profinet, Profibus, TCP-IP, Modbus
- Wide variety (0-10V, 4-20mA, PT100 …)
- EPICS drivers: S7PLC (Rd) / Modbus (Wr)

Laboratory standards

- Standard hardware and software solutions
- Standard code writing rules
- Standard naming convention
- Quality process
PLC CONTROL

Cryogenic
- Automatic sequences for cooling down
- Nitrogen and helium tanks management

Vacuum
- Isolation and beam vacuum control

Cavities tuning
- Controlling Phytron motors for slow motion
- ETS200S technology
- Controlling Piezoelectric motor for fast motion
- Automatic sequences for cavities characterization

Warm and cold coupler conditioning
- RF signal measurement
- PM / PUe- measurement
- Automatic sequences for couplers conditioning
TEMPERATURE CONTROL

PLC

Analog input card

Profinet

Boranet/ CABTR

Resistor reading

Cernox
Max: 300°K
Min: 0.1°K

PT100
Max: 870°K
Min: 70°K

Resistor reading
CAVITY TUNING

PLC

Profinet

ET200S with Phytron controller

Phytron motor

ET200SP with Phytron controller

Phytron motor with resolver

Position feedback
**EPICS CONTROL**

Cryogenic
- Automatic sequences for cooling down
- Nitrogen and helium tanks management

Vacuum
- Isolation and beam vacuum control

Cavities tuning
- Controlling Phytron motors for slow motion
- ETS200S technology
- **Controlling Piezoelectric motor for fast motion**
- Automatic sequences for cavities characterization

Warm and cold coupler conditioning
- RF signal measurement
- PM / PUe- measurement
- Automatic sequences for couplers conditioning
CAVITY TUNING

MRF Timing System

trigger

Function Generator
Agilent AFG3252C

Piezo Driver
Noliac NDR6220

Piezo M
Automatic cavities characterization

- CAVITY TUNING
- EPICS
- S7PLC
- streamdevice
- Phytron motor
- Network Analyzer
  Agilent E5060A
- SNL Sequence
  - Load motor configuration
  - Motor movement
    Direction / Setpoint
  - Search the centroid
    Freq (max, centroid), Pressure HE, Steps
  - next configuration
  - EPICS Archive Appliance
WARM AND COLD COUPLER CONDITIONING
A. Gaget et al., “Control in EPICS for conditioning test stands for ESS”, in Proc. ICALEPCS2017
A. Gaget, “EPICS modules toolkit for RF test stands”, in Proc. EPICSMEETING2019
CONCLUSION AND FUTURE

- Cryomodule control system working and in use
- Technology knowledge improvement
- Ready for next cryomodules

Acknowledgments:
Q. Bertrand, A. Gomes
J.F. Lecointe, D. Loiseau
Y. Mariette
Questions ?

Thanks for your attention