

FROM RESEARCH TO INDUSTRY



DIAGNOSTIC CONTROLS OF LIPAc

Jean-François DENIS

October 22th 2014

EPICS MEETING

Context

P.03

Description of each diagnostic

P.06

Conclusion

P.23

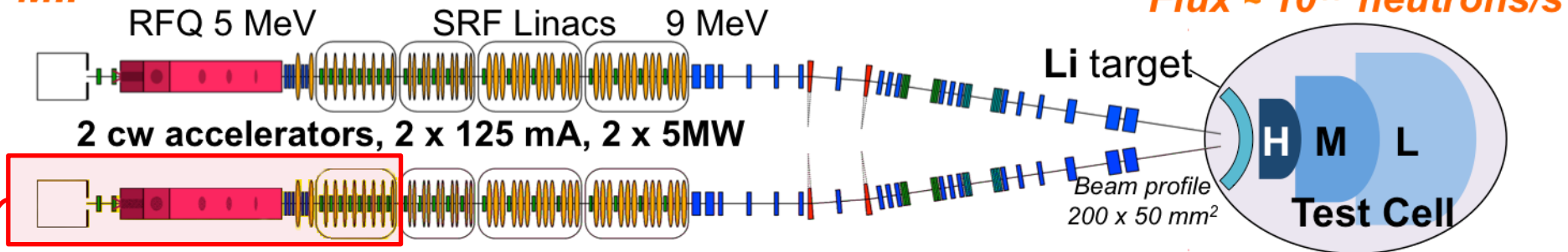
Context

Description of each diagnostic

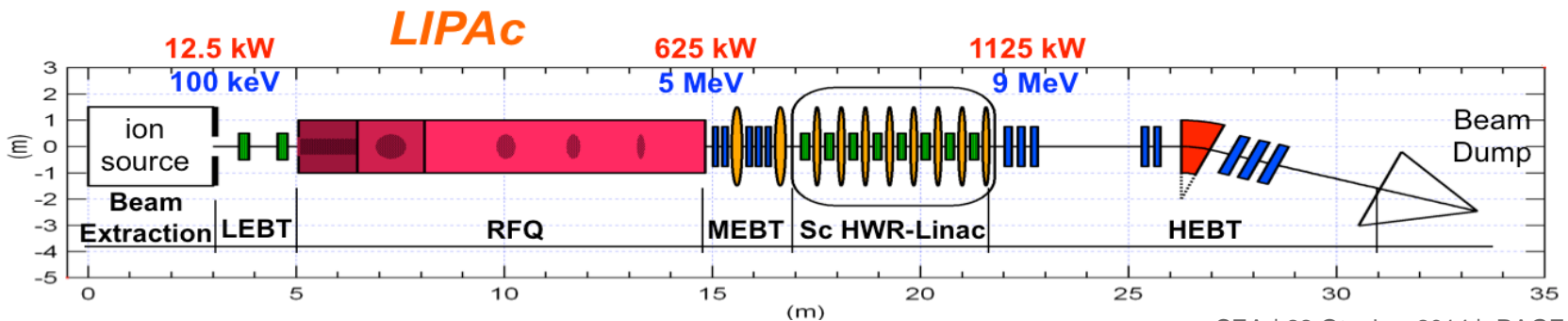
Conclusion

- IFMIF (International Fusion Materials Irradiation Facility) will be built to provide an accelerator based on a neutron source to produce high-energy neutrons (deuterons) at sufficient intensity and irradiation volume to qualify materials for fusion reactors of the future

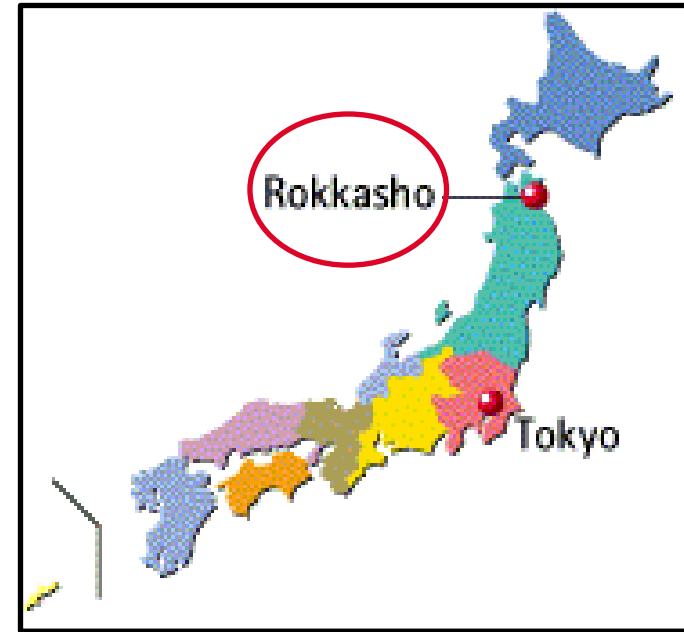
IFMIF



- A prototype LIPAc (Linear Ifmif Particle Accelerator) identical to the low energy section of IFMIF is being built to check the validity of the design before launching the IFMIF construction



- This facility will be installed at Rokkasho JAEA (Japan Atomic Energy Agency) site



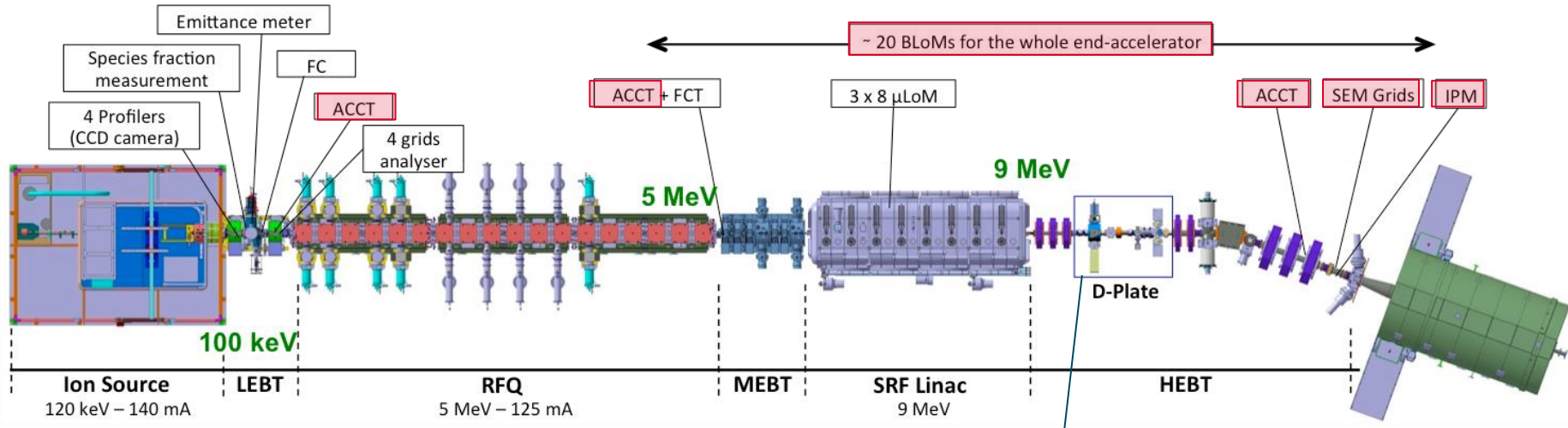
- Ifu-Saclay has developed the control system for several work packages like the injector and a set of the diagnostic subsystem

Context

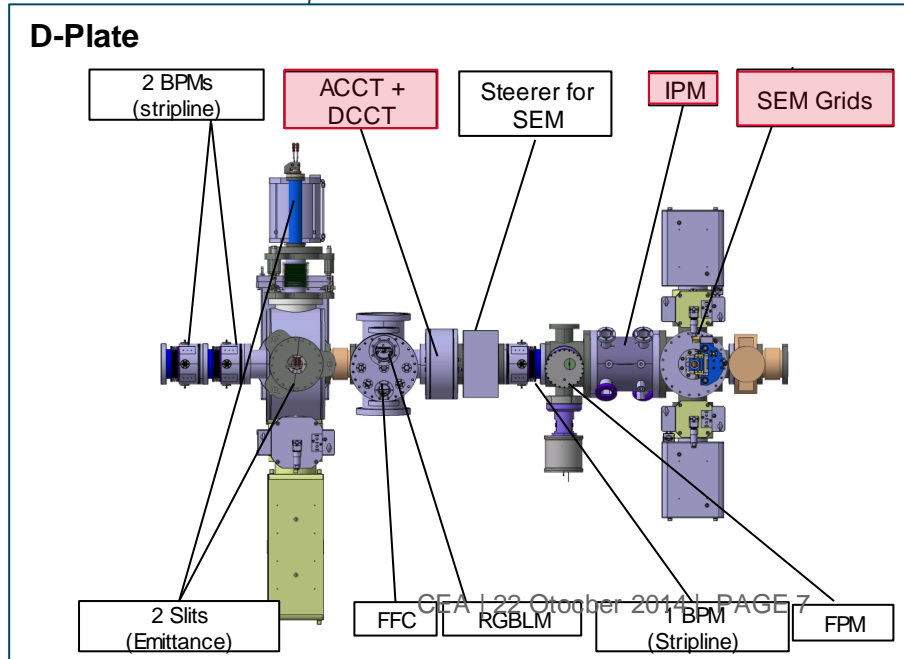
Description of each diagnostic

Conclusion

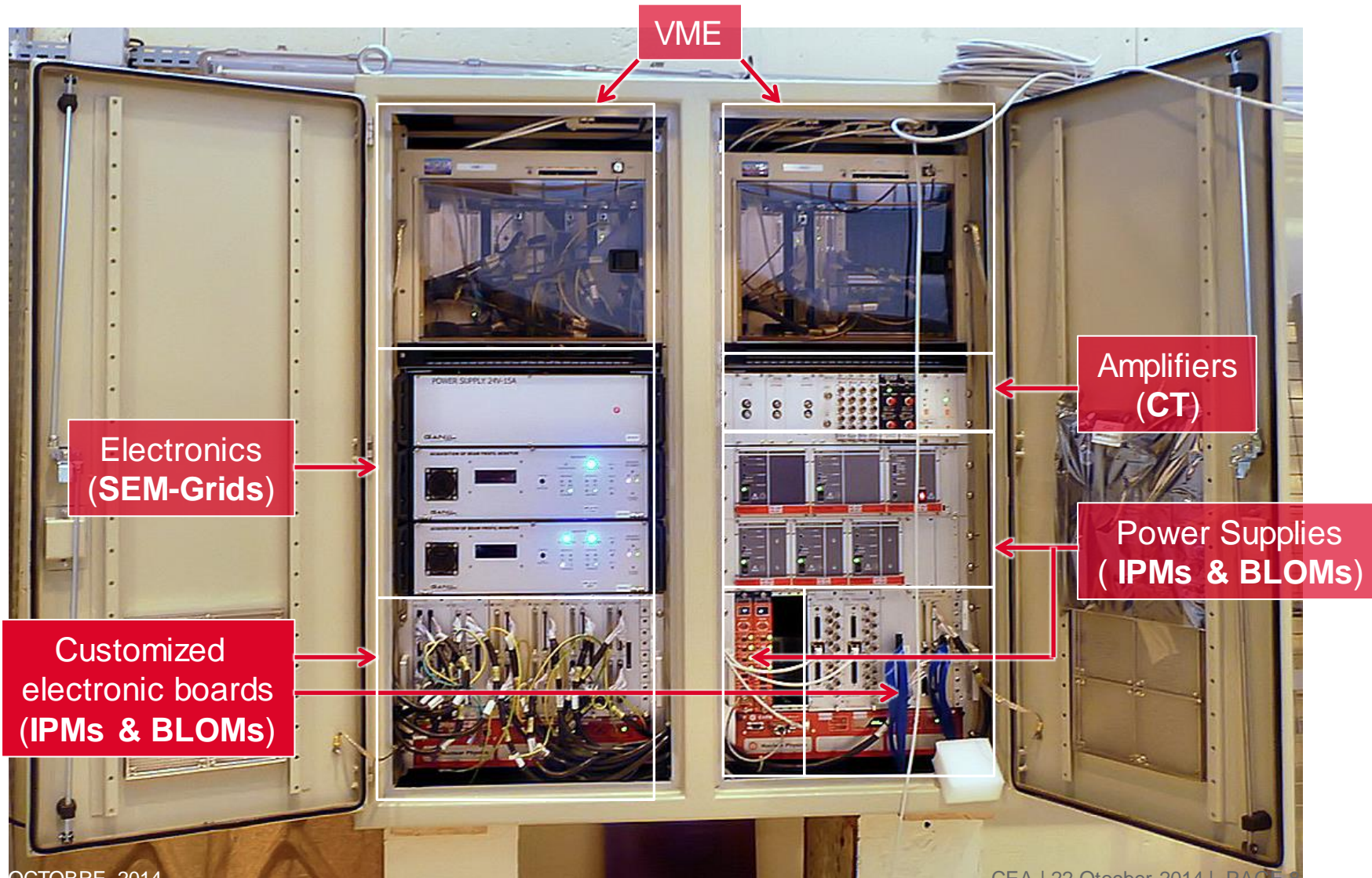
DIAGNOSTICS INVOLVED...



- Current transformers (CT)
- Beam loss monitor (BLoM)
- Electron Emission Grids (SEM-Grid)
- Ionization Profile Monitors (IPM)



LET'S START WITH THE CABINET...



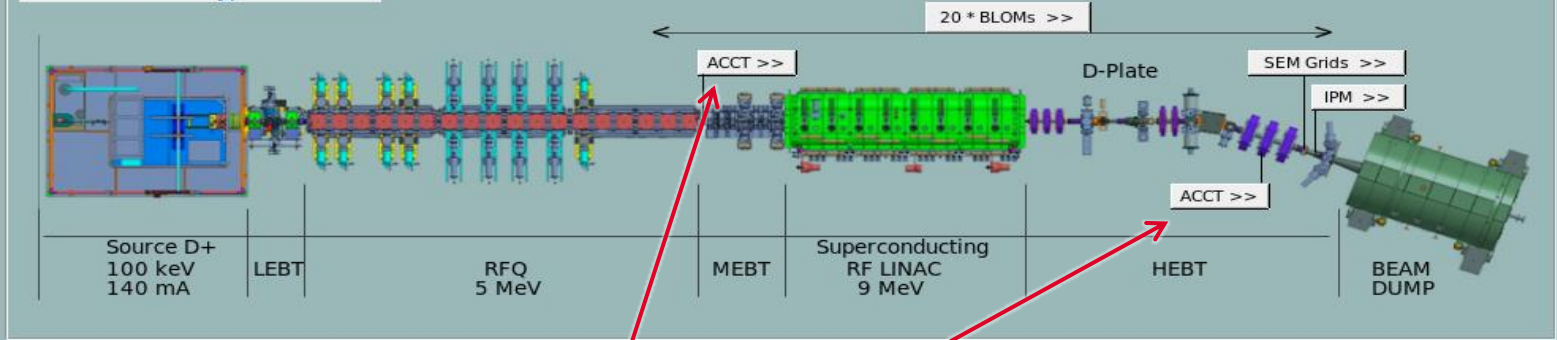
LET'S CONTINUE WITH THE MAIN LAUNCHER...

IFMIF
LIPAc

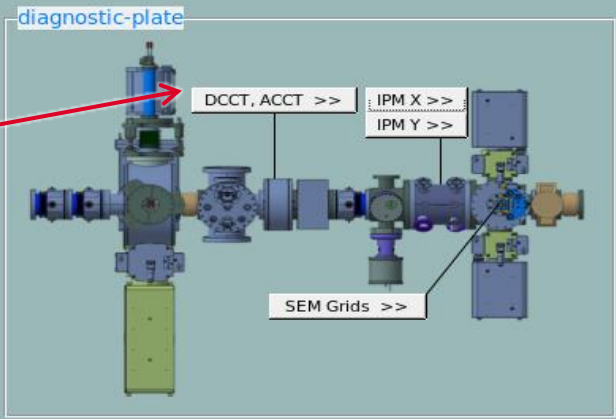
LIPAc Diagnostics

EPICS

Linear IFMIF Prototype Accelerator



Current Transformers



Lipac Diagnostics Archiver

START STOP CTRL VIEW

CURRENT TRANSFORMERS

Diagnostics cabinet



VME

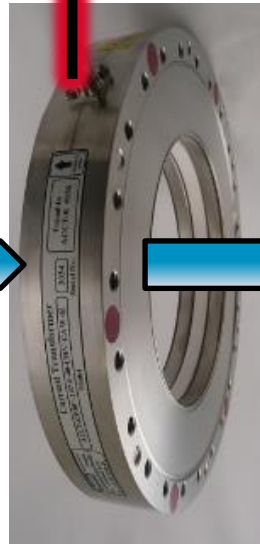


- The fast acquisition is based on two VME boards, ADAS ICV108 and ADAS ICV178
- The ICV108 is a controller board with an external trigger and includes a 4 MB RAM dedicated to measurements with possibility of DMA transfer.
- The ICV178 is an 8 channels board with 16-bit resolution for each ADC.
- The sampling frequency goes from 50kS/s up to 1.2MSamples/s

GOAL

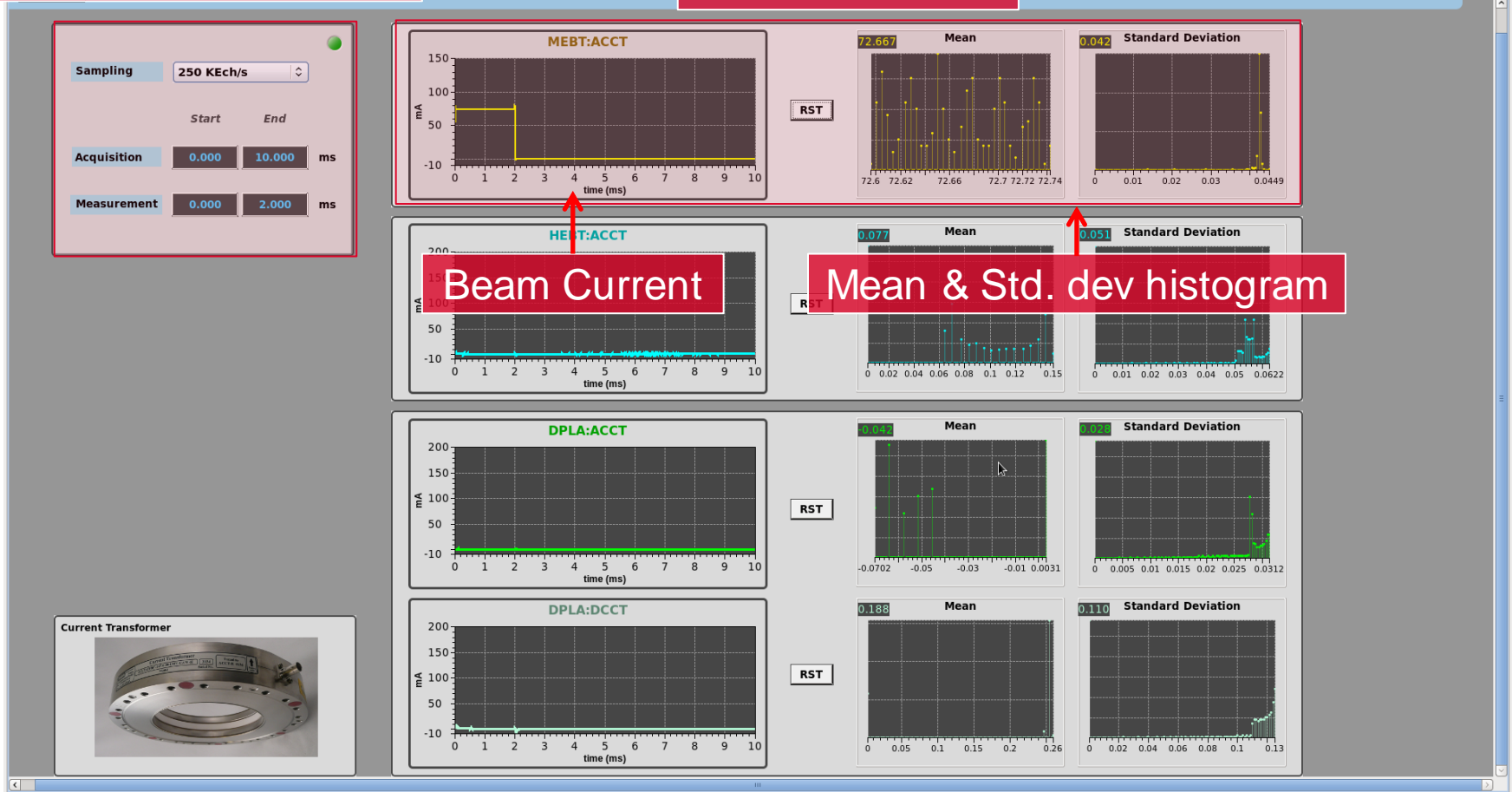
CT is a kind of monitor which allows measuring the beam current with a precision of 0.15 mA

Particule beam



Acquisition parameters

Ctrl of one CT



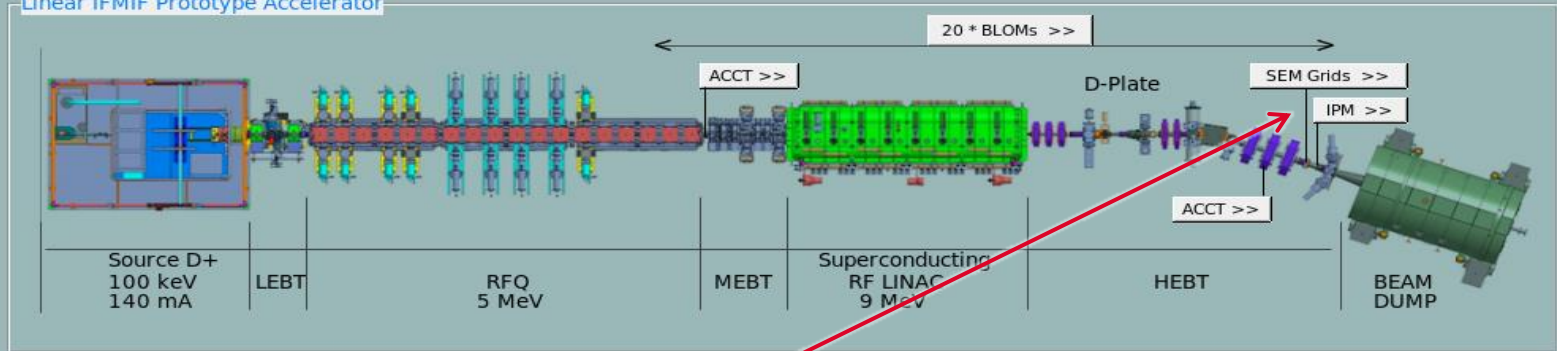
FROM THE MAIN LAUNCHER...

IFMIF
LIPAc

LIPAc Diagnostics

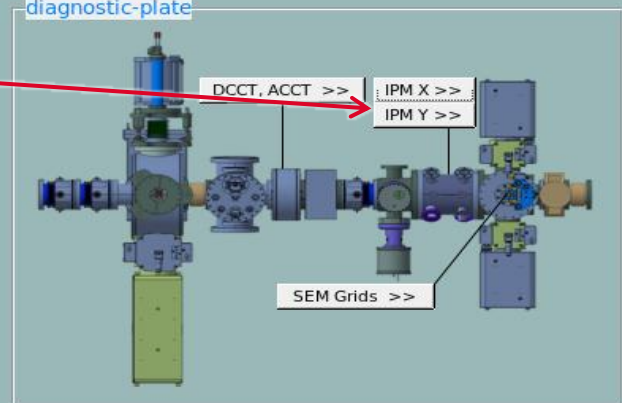
EPICS

Linear IFMIF Prototype Accelerator



IPMs

diagnostic-plate



Lipac Diagnostics Archiver

START STOP CTRL VIEW

IONIZATION PROFILE MONITORS

Diagnostics cabinet



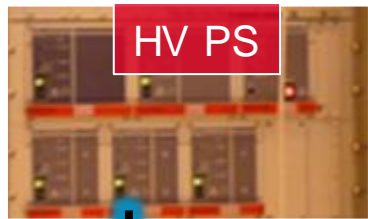
VME

- ADAS VME Board to control Front End Electronic (FEE) and make slow acquisition



FEE

- FEE integrates the output current from the IPM over longer time, typically 0.1 to 1 second and was specially designed to manage the sample and hold functions for all beam configurations (pulse or cw)

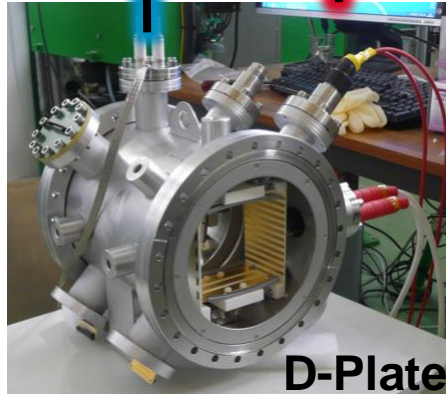


HV PS

- Power supplies (FUG)



HEBT



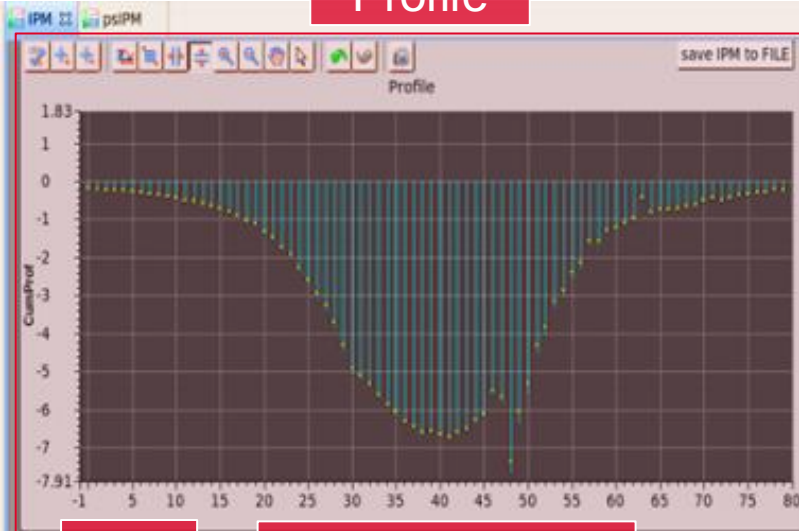
D-Plate

GOAL

- The goal of an IPM is to measure the transverse beam profile

IONIZATION PROFILE MONITORS

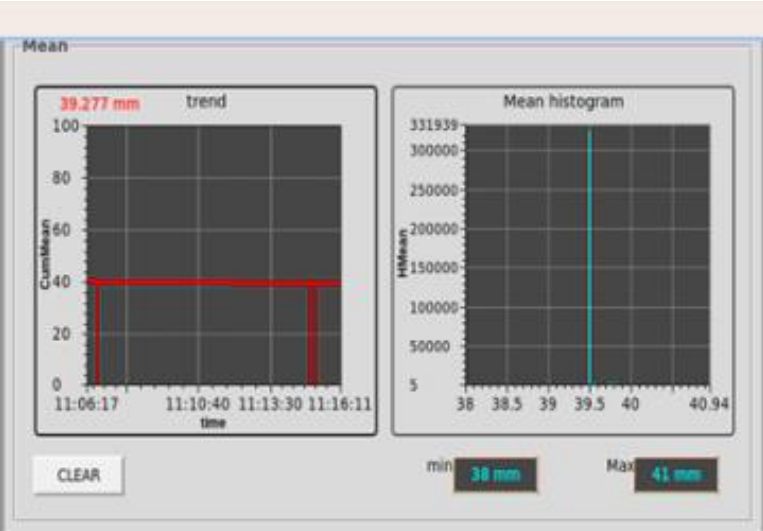
Profile



Measures

PROFILER MEASURES

- mean: 39.277 mm
- averaged Mean: 39.300 mm
- standard deviation: 25.682 mm
- averaged std deviation: 25.620 mm
- number of samples: 56
- acquisition counter: 343,323



ctrl

Control panel with the following settings:

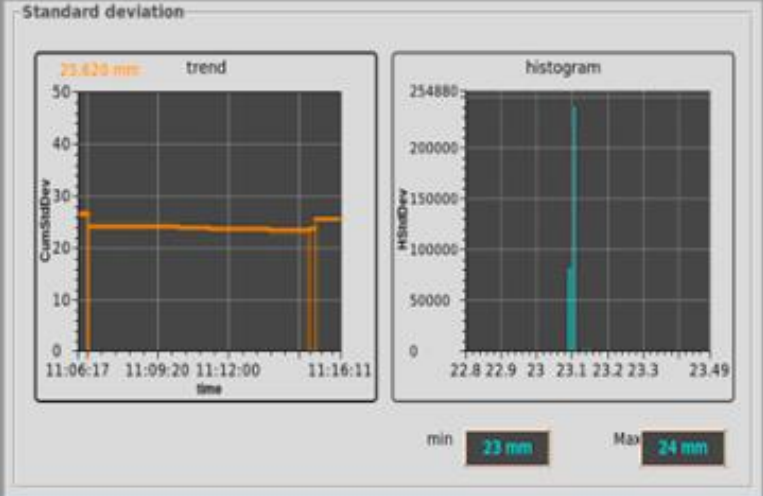
- mode: MANUAL, AUTO
- integration mode: PLS, CW
- beam polarity: BEAM, NO BEAM
- integration: INTEG ON, INTEG OFF
- integration time: INTEG 2

Power supplies

Power supply status:

- FUG 35 kV / 200 uA: 2.4 kV, 3 uA
- FUG 20 kV / 300 uA: 1.8 kV, 9 uA
- CAEN 8 kV / 3 mA: 495.4, 0.1

CTRL Power supplies >>



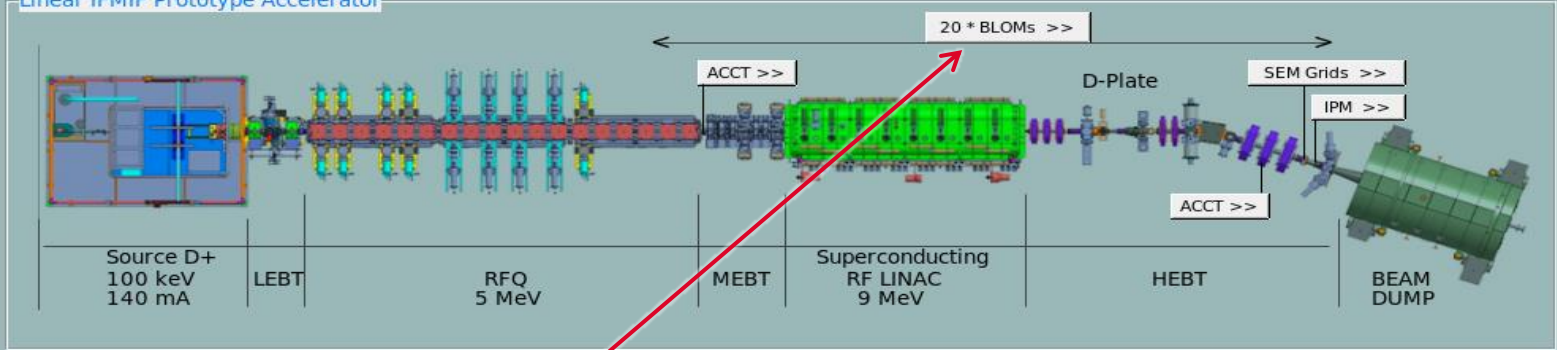
FROM THE MAIN LAUNCHER...

IFMIF
LIPAc

LIPAc Diagnostics

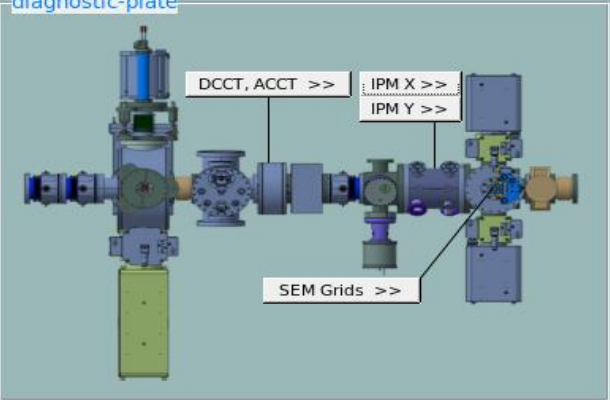
EPICS

Linear IFMIF Prototype Accelerator



BLOMs

diagnostic-plate



Lipac Diagnostics Archiver

START STOP CTRL VIEW

BEAM LOSS MONITOR

Diagnostics cabinet

HV PS

- Powers supplies (CAEN)

VME

FEE

MPS

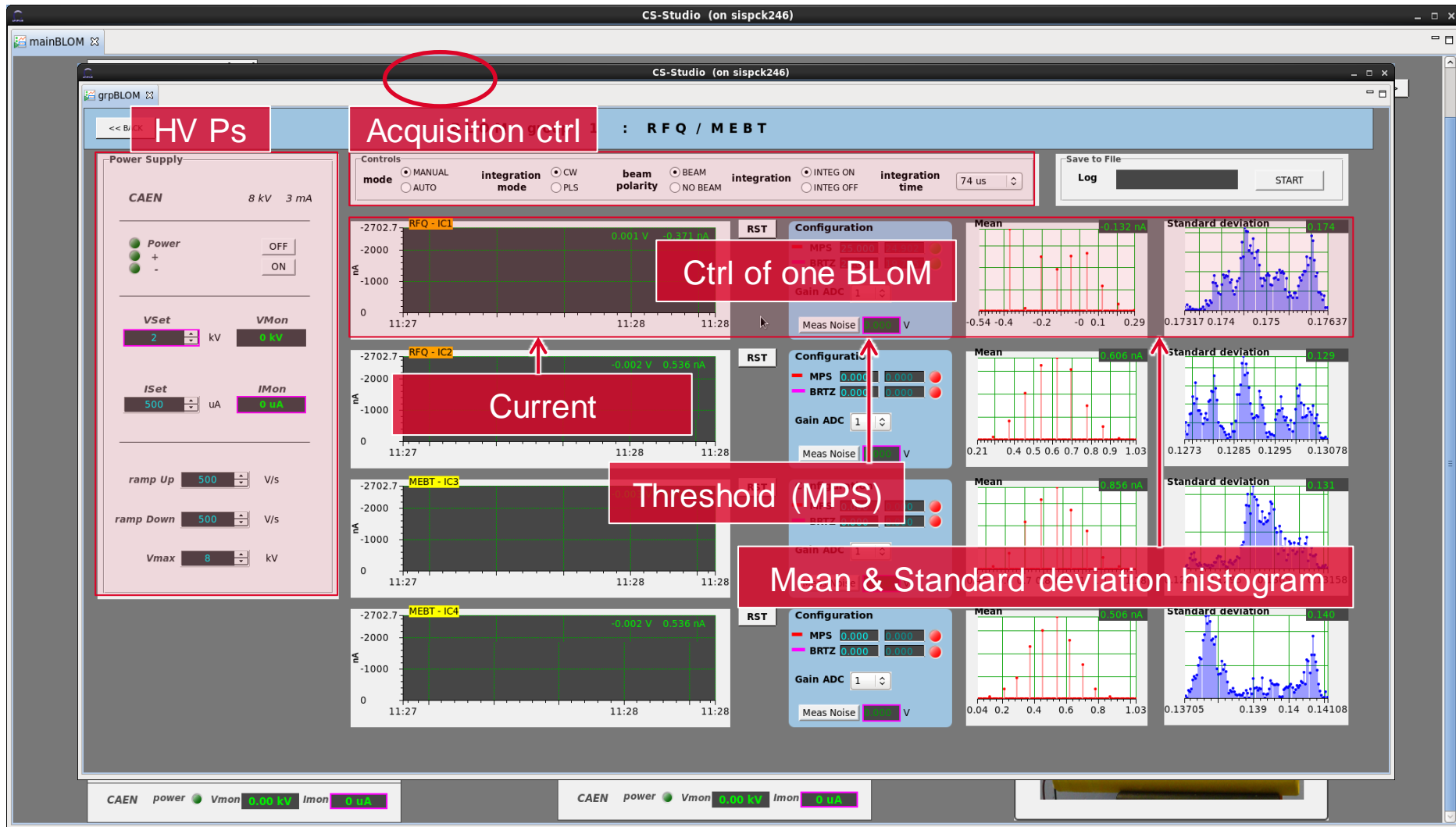
- ADAS VME Board to control Front End Electronic and make slow acquisition

FFE integrates

- Monitoring : the output current from the BLOM over longer time, typically 0.1 to 1 second and was specially designed to manage the sample and hold functions for all beam configurations (pulse or cw)
- Safety: It provides also a fast interlock signal to the Machine Protection System (MPS).

GOAL

- The main goal of the BLoM system is to measure the particle loss to insure the machine safety

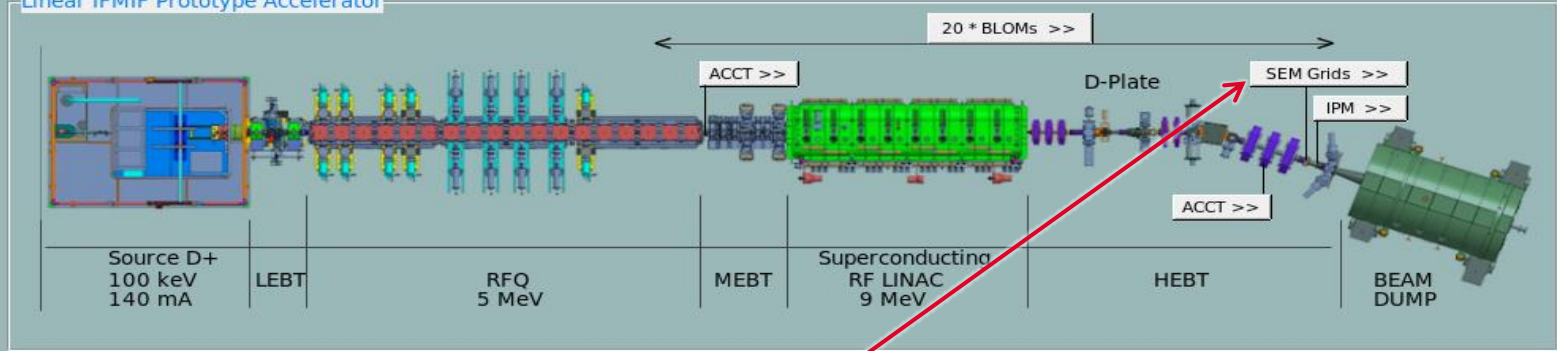


FROM THE MAIN LAUNCHER...



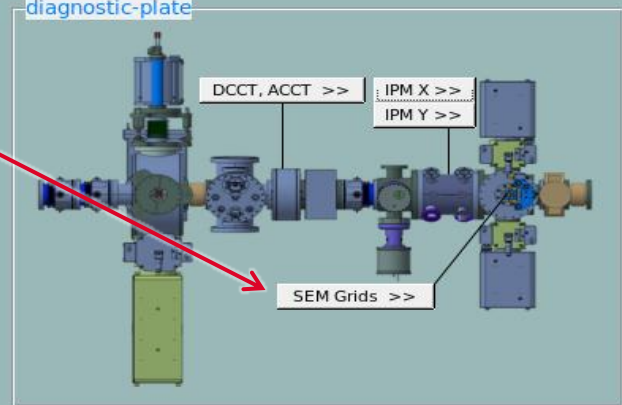
LIPAc Diagnostics

Linear IFMIF Prototype Accelerator



SEM-Grid

diagnostic-plate



Lipac Diagnostics Archiver

START

STOP

CTRL

VIEW

SEM-GRID

VME



Diagnostics cabinet



Modbus



- A complete integrated solution with the EPICS driver, provided by Ganil laboratory, will be used to manage the measurement and acquire the data

GOAL

The goal of a SEM-Grid is to have a beam profile measurement at low duty cycle in case of IPM measurement is not sensitive enough.



PS Studio

HT1 5V 5uA HT2 5V 5uA HT3 100V 0uA SYNC Reset SyncExtFM PRF IN INTEG 80 usec 80 usec

H profile

SEM Grid - H Sigma : 6.99
center : 3.1

V profile

SEM Grid - V Sigma : 6.81
center : -3.09

Measures

Center: 3.1 mm
Sigma: 6.99 mm/mm
FWHM: 3.11 mm
Sum: 0.000 mV

Center: -3.09 mm
Sigma: 6.81 mm/mm
FWHM: 3.83 mm
Sum: 0 mV

CONFIGURATION ctrl

General Acq. Acquisition PLC

Integration time: 80 usec 80 usec
Increment: 80 usec 80 usec
Nb of measures to average: 1 1
Shift HO (mm): 0.2
Shift VE (mm): 0.1
Step HO (mm): 0
Step VE (mm): 0
Temperature: 33.28

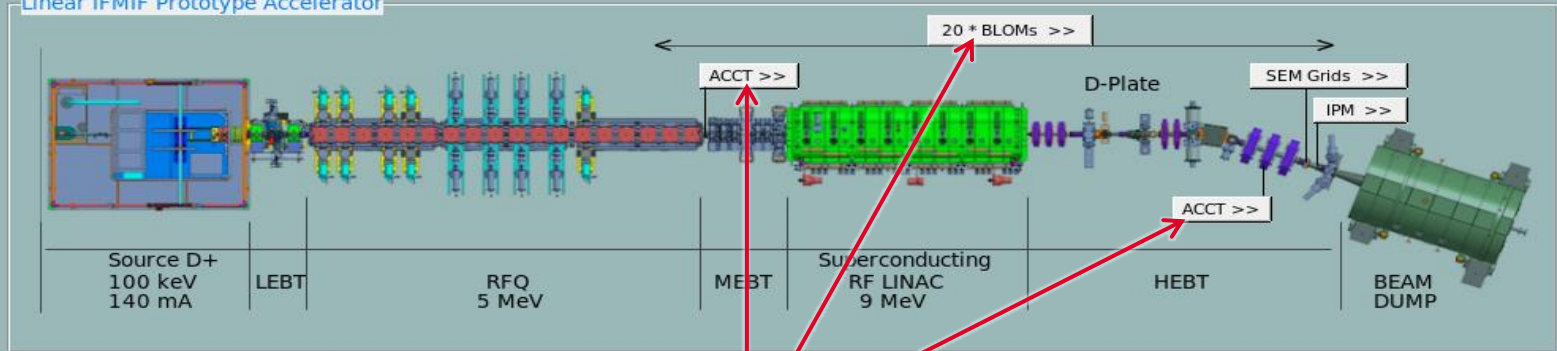
Save to File
Log Stop START
expert screen

FROM THE MAIN LAUNCHER...

IFMIF
LIPAc

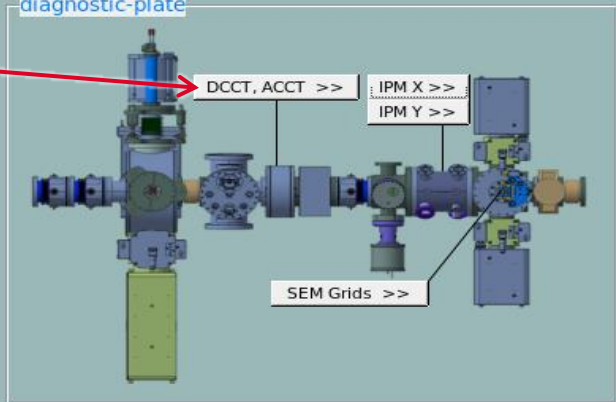
LIPAc Diagnostics

Linear IFMIF Prototype Accelerator



Post mortem

diagnostic-plate



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START STOP CTRL VIEW

POST MORTEM...

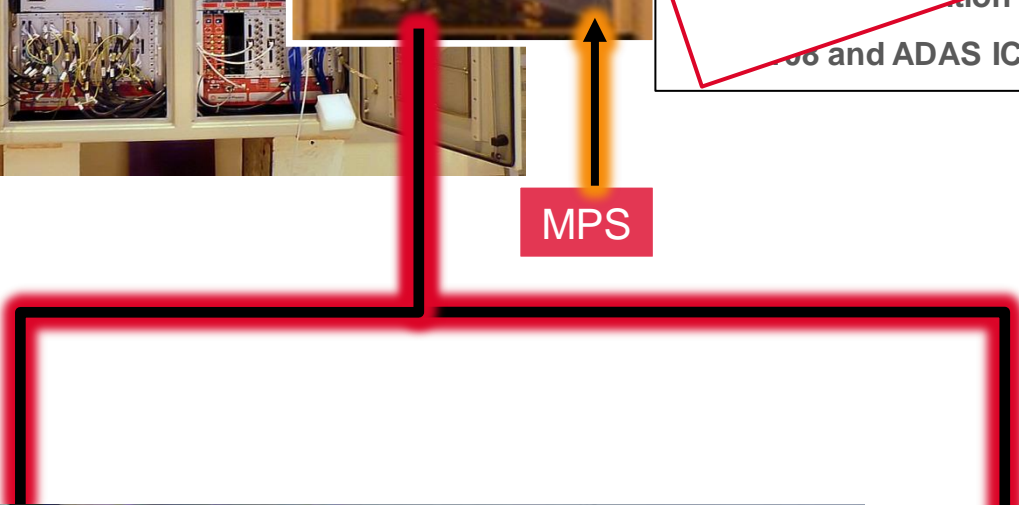
Diagnostics cabinet



VME



MPS



- Signals from all BLoM & CT will be sampled at 1 MHz and recorded on the circular buffer of the VME board.
 - When a trigger from the CT is received, the data acquisition is stopped and the VME board gets frozen for analysis.
- In progress**
- The data acquisition is based on two VME boards, ADAS 178 and ADAS ICV178



BLoMs



CT

GOAL

In order to understand what has just happened when the beam shuts down

Context

Description of each diagnostic

Conclusion

- **European Acceptance tests were successfully done at Saclay for every kind of diagnostics**

- **The cabinet left Saclay in September, and arrived last week at Rokkasho! 😊**

- **The commissioning will be done in 2 phases :**
 - **Injector + RFQ + Dplate : in 2016**

 - **The whole accelerator : in 2017**

THANKS FOR YOUR ATTENTION !

Commissariat à l'énergie atomique et aux énergies alternatives
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IRFU
DSM
SIS

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