CNES-ESA Radiation Final Presentation days, 09-10 mars 2015

DEVELOPMENT AND VALIDATION OF CRYOGENIC RADIATION TESTING SETUP

2 « ETUDES MÉTIER » CNES

R-S13/MT4-151

Mathieu BOUTILLIER
DCT/AQ/EC

Bernard BARADAT
DCT/SI/CD

OUTLINE

- CONTEXT
- CRYOSTAT SPECIFICATION
- CRYOSTAT PRESENTATION
- EXPERIMENTAL VALIDATION
- CONCLUSION
- FUTURE WORK

ENV
Space and Atmospheric Environment

cnes

CONTEXT

Through project return of experiment, CNES constats needs for experimental setup enabling electronic devices radiations testing at cryogenic temperature.

Results of four contracts included in this presentation:

- Internal DCT/SI funding: Cryostat design and manufacturing
- « Etude métier 2011» funding: validation of cryogenic SEL testing
- « Etude métier 2012» funding: electronic interface for SEU testing
- R&T R-S13/MT4-151: validation of cryogenic SEU testing

Those four contracts aim to demonstrate and validate a cryogenic set up enabling cryogenic SEE testing

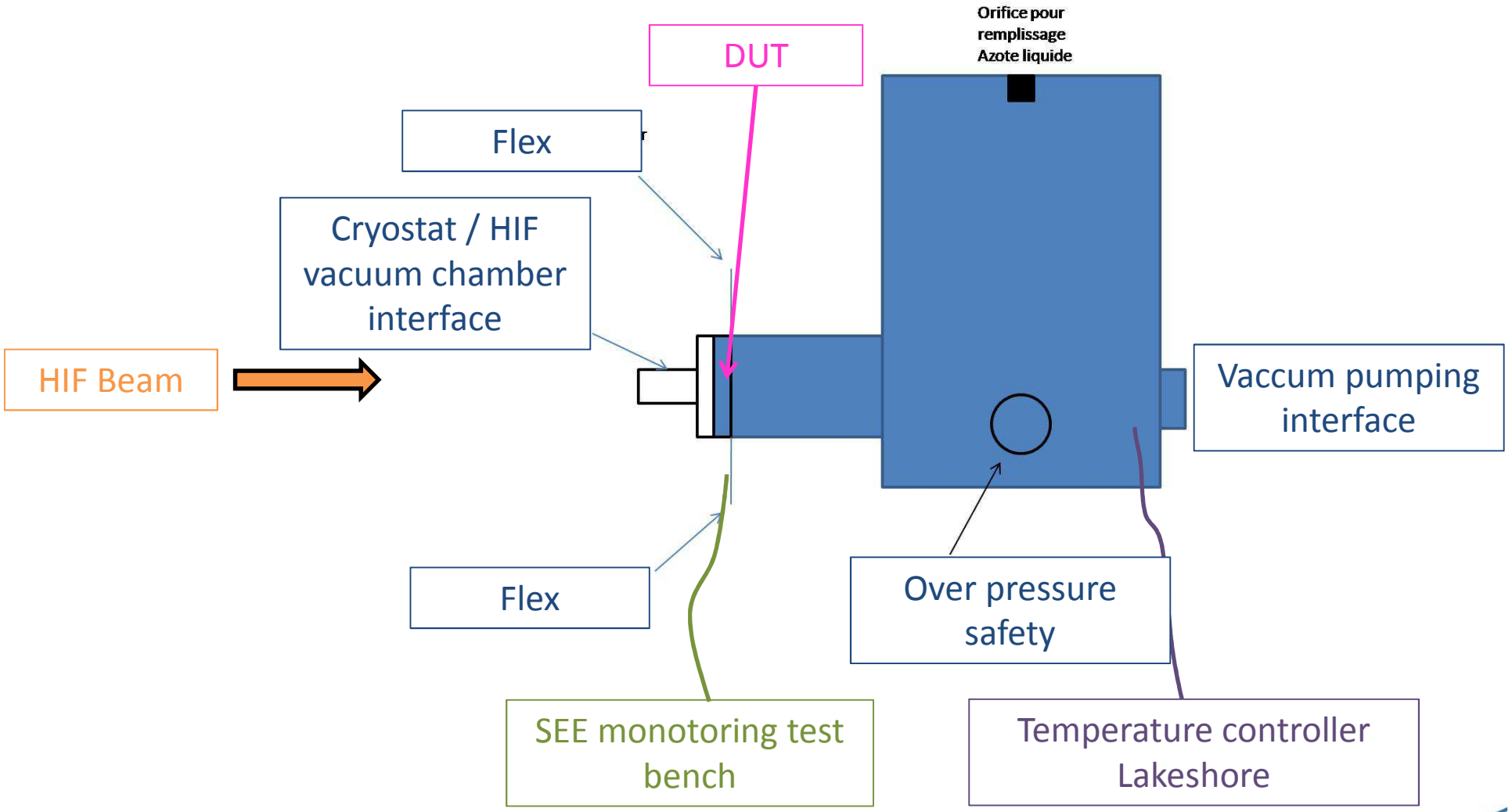
CRYOSTAT SPECIFICATIONS

To answer the identified needs, here are the targeted specifications used for cryostat design

- Cooling system: liquid nitrogen
- Temperature range [80K – 300K]
- Autonomy: 24h
- Possibility to add temperature control system
- Electronic output by flex

- Compatibilty with UCL HIF line without specific vacuum pumping
- « Easy » Transportation
- Quick cooling and heating system for easier operability

CRYOSTAT PRESENTATION (1/3)



CRYOSTAT PRESENTATION (2/3)

How does it look like ?

CRYOSTAT PRESENTATION (3/3)

Real cryostat performances

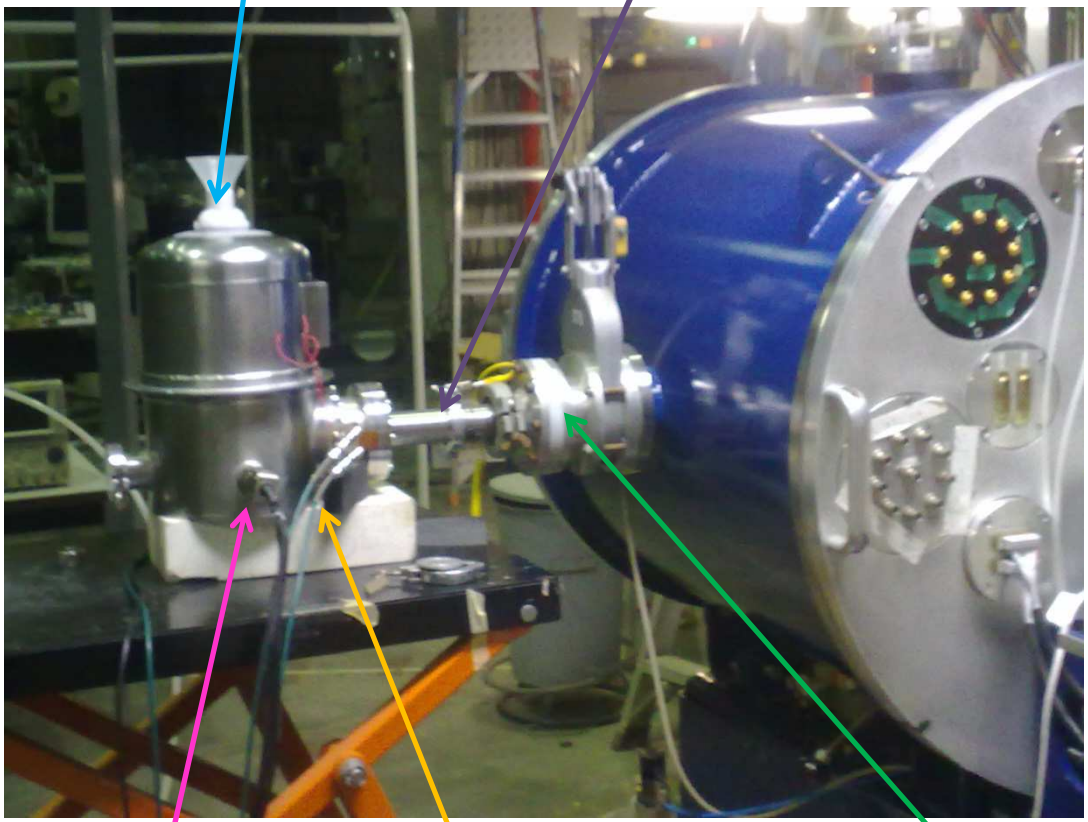
- Cooling system: liquid nitrogen: OK
- Temperature range [80K – 300K]: OK
- Autonomy: 24h 20h
- Possibility to add temperature control system OK

- Compatibilty with UCL HIF line OK
- « Easy » Transportation OK
- Quick cooling and heating system for easier operability OK

- Possibility to control temperature in [80K – 320K] when liquid nitrogen in

  ⟹ unplug cryostat from vacuum even with liquid N2 tank full

EXPERIMENTAL VALIDATION

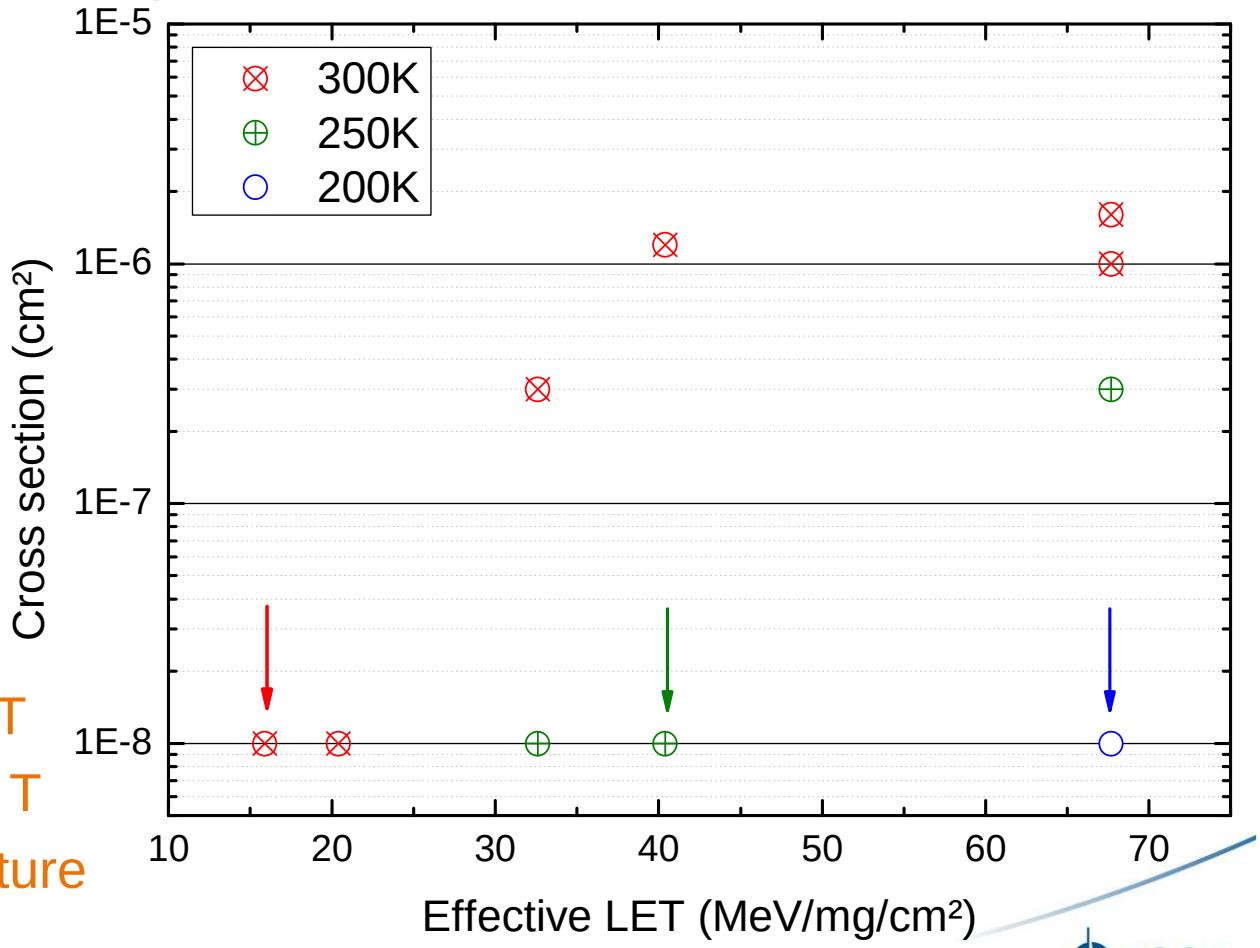


EXPERIMENTAL VALIDATION

Start with SEL testing (easiest electronic setup)

Cooperation with SOFRADIR to get DUTs

- Readout circuit for cooled infrared sensor
- Old technology known to be SEL sensitive



Xsection decreases with T

Threshold increases with T

In accordance with litterature

EXPERIMENTAL VALIDATION

SEU testing on dedicated test vehicles from SOFRADIR

First campaign UCL summer 2014

Second campaign scheduled UCL W17 2015 (TBC)

- Test vehicle includes shif registers and memory points.
- First campaign focusses on shift registers
- Temperature, state and test pattern effects on SEU X section

- Shift registers: no major effect from temperature on SEU Xsection (TBC).

- On going preparation of second test campaign on the same test vehicle. Test plan under discussion

No issue with cryostat during this UCL HIF campaign.

CONCLUSION

CNES develops a cryostat to enable cryogenic radiations testing.

Cryostat fulfills main specifications

- autonomy > 20h
- quick and easy temperature control
- temperature range [80 – 320K]

Cryostat fully operationnal on UCL HIF beam line

Cryostat may be compatible with Jyvakyla facility thanks to DN40 interface (TBC). No trial done or foreseen.

FUTURE WORKS

Second campaign of SEU testing and dedicated SODRAFIR test vehicle.

New 2015 « Etude métier » funding: study the feasability to use the cryostat in proton beam: thanks to the high autonomy, possibility to perform post radiation testing without breaking cryogenic temperature,

radiations / cryostat interaction simulations

design & manufacture custom dosimeter for first trial

dedicated campaign:

- ⇒ assess radiations at DUT level
- ⇒ assess cryostat activation
- ⇒ define protons radiation conditions compatible with cryostat