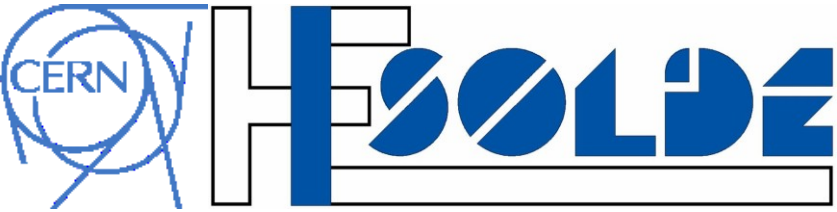


Research and development activities for the HIE-ISOLDE linac

M. Pasini on behalf of the HIE-ISOLDE study team
CERN BE-RF and Instituut voor Kern- en Stralingsfysica, K. U. Leuven

Overview

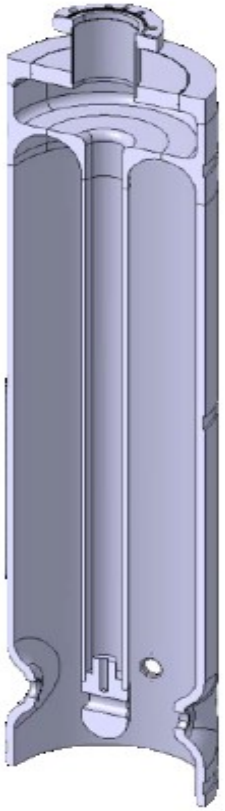
- The HIE-linac: a SC linac for Radioactive Ion Beams @ ISOLDE
- R&D activity
- Summary

HIE-ISOLDE Project: SC-linac

- SC-linac between 1.2 and 10 MeV/u (energies below 1.2 MeV are achievable but the machine is not optimized)
- 32 SC QWR (20 @ β_0=10.3% and 12@ β_0=6.3%)
- Energy fully variable; energy spread and bunch length are tunable.
- 2.5<A/q<4.5 limited by the room temperature cavity
- 16.02 m length (without matching section)
- New beam transfer line to the experimental stations

QWR cavities (Nb sputtered)

Low β



High β

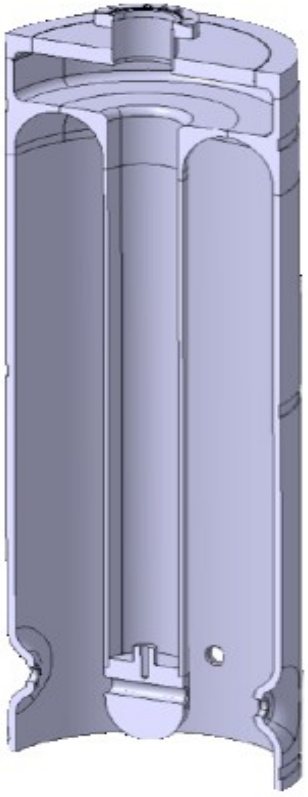
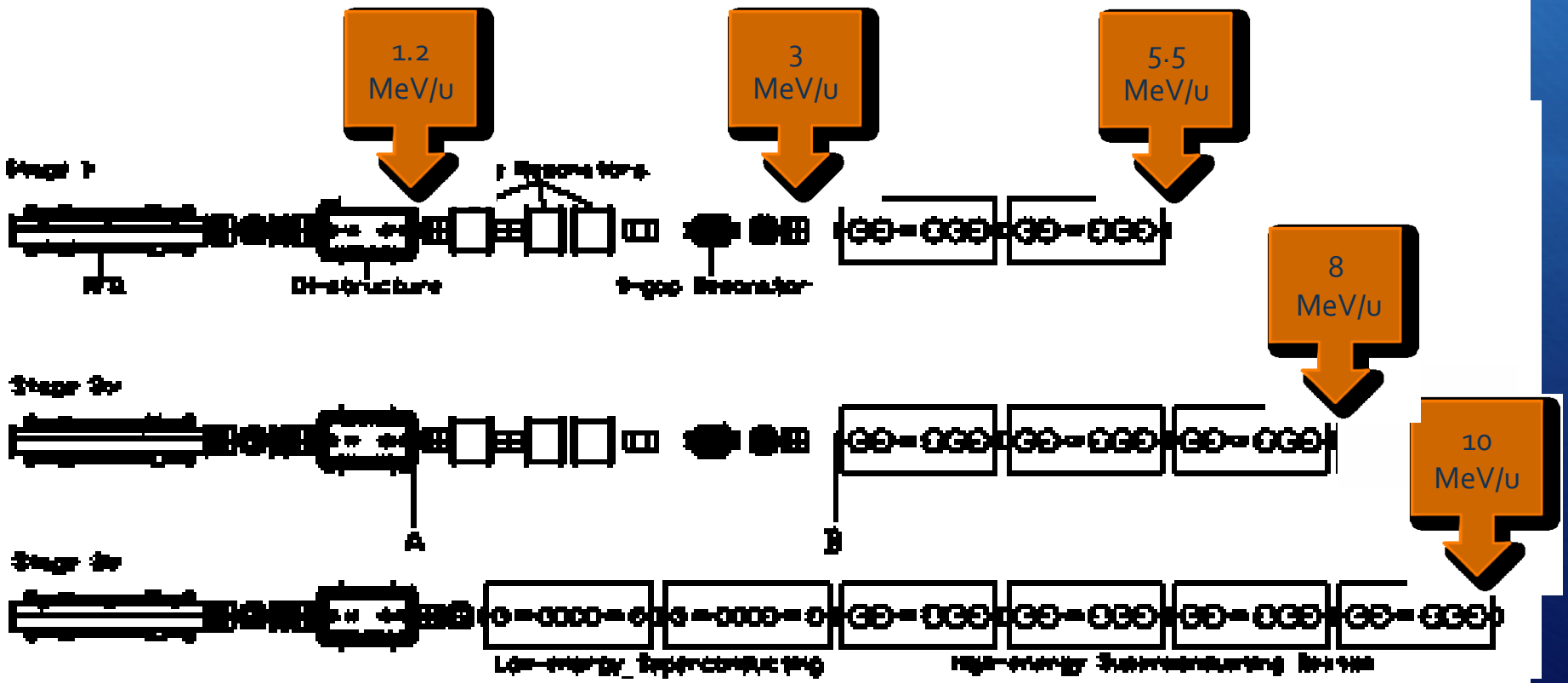


Table 1: Cavity design parameters

Cavity	**Low β**	**highβ**
No. of Cells	2	2
f (MHz)	101.28	101.28
β_0 (%)	6.3	10.3
Design gradient E_{acc}(MV/m)	6	6
Active length (mm)	195	300
Inner conductor diameter (mm)	50	90
Mechanical length (mm)	215	320
Gap length (mm)	50	85
Beam aperture diameter (mm)	20	20
$U/E_{\mathrm{acc}}{}^2$ (mJ/(MV/m)^2	73	207
$E_{\mathrm{pk}}/E_{\mathrm{acc}}$	5.4	5.6
$H_{\mathrm{pk}}/E_{\mathrm{acc}}$ (Oe/MV/m)	80	100.7
R_{sh}/Q (Ω)	564	548
$\Gamma = R_{\mathrm{s}} \cdot Q_0$ (Ω)	23	30.6
Q_0 for 6MV/m at 7W	$3.2 \cdot 10^8$	$5 \cdot 10^8$
TTF max	0.85	0.9
No. of cavities	12	20

HIE-ISOLDE LINAC - layout

staged installation



R&D activity

- High β cavity prototype
  - Copper substrate manufacturing
  - Chemical etching
  - Nb sputtering
- RF – Beam dynamics studies
- RF sub-system prototypes
  - Tuner
  - Power coupler
- SC solenoid prototype
- Cryomodule design
- Infrastructure design

➢ In parallel preparation of a test stand for QWR at CERN

Inner and Outer conductors

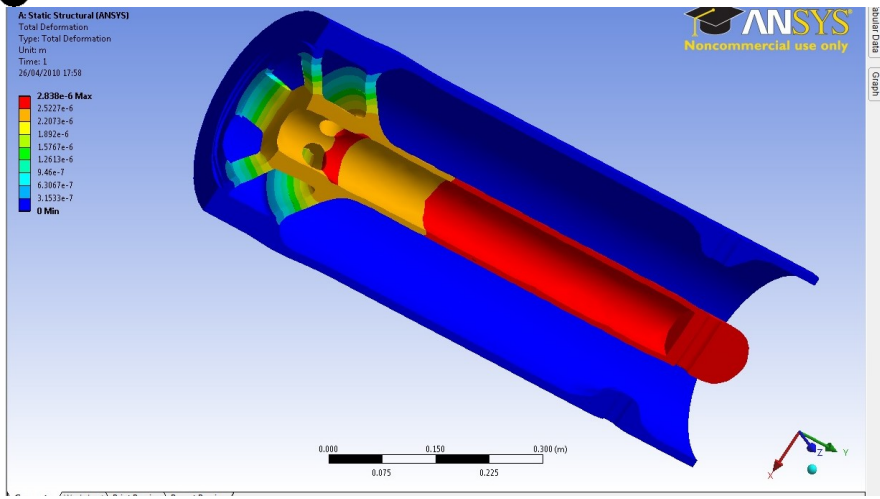
Cavity copper substrate

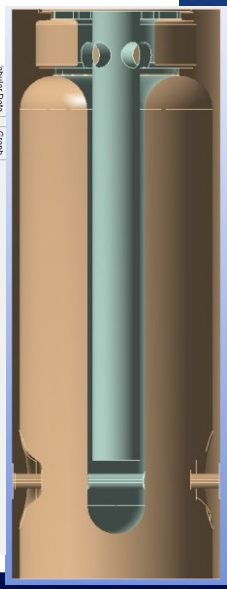
New Cu substrate Fabrication technique

Reason for developing a new Cu substrate:

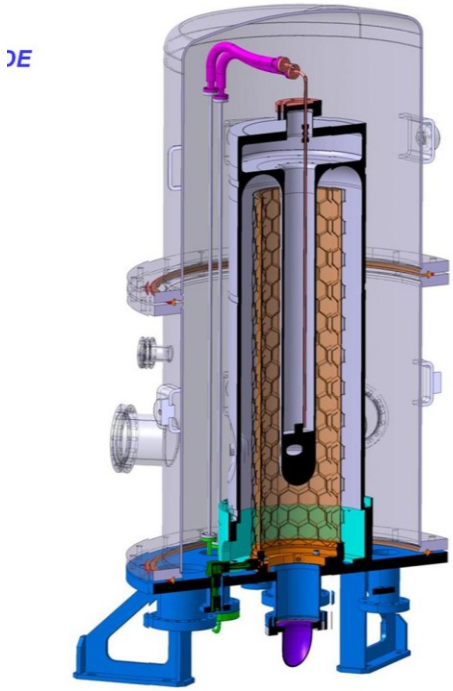
- RF test @TRIUMF showed a high sensitivity to He pressure variation: 1.3Hz/Torr
- presence of micro porosities along the longitudinal welding
- difficult reproducibility of the beam port geometry
- Non-uniformity of the copper grains due to local heating

New procedure require full 3D machining of the outer and inner part with only one weld. Double fixing solution assures higher rigidity and hence less sensitivity to He pressure variation

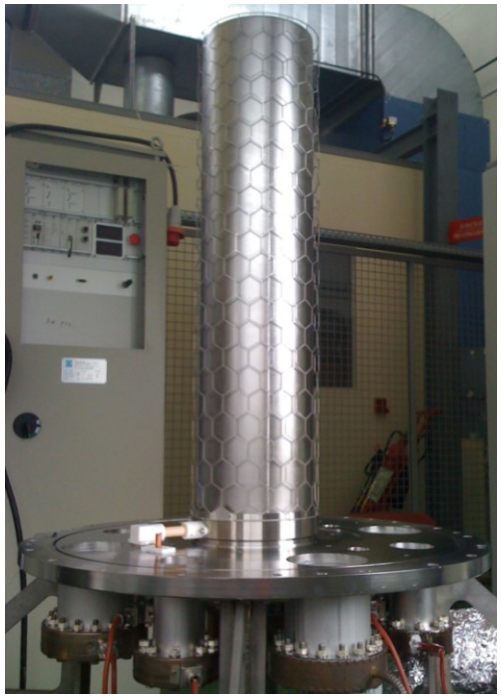




Bias and Magnetron sputtering

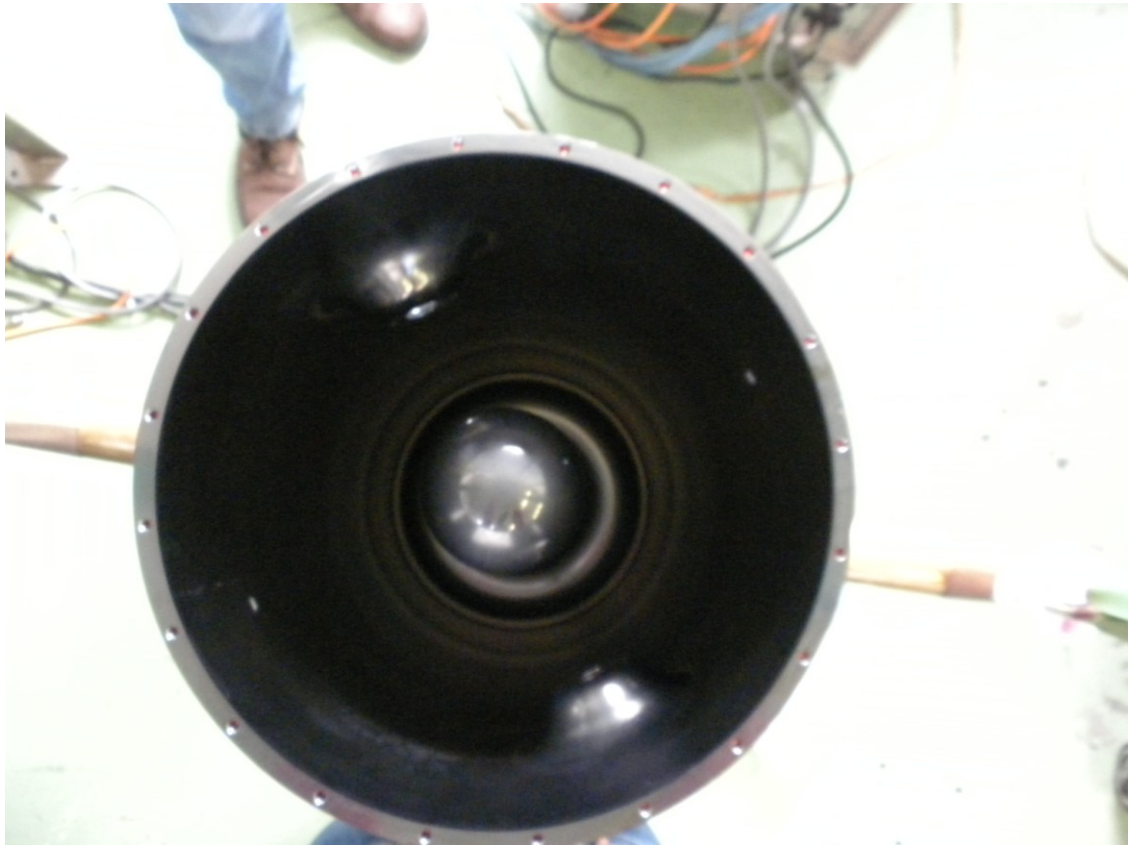


Bias Diode Sputtering:



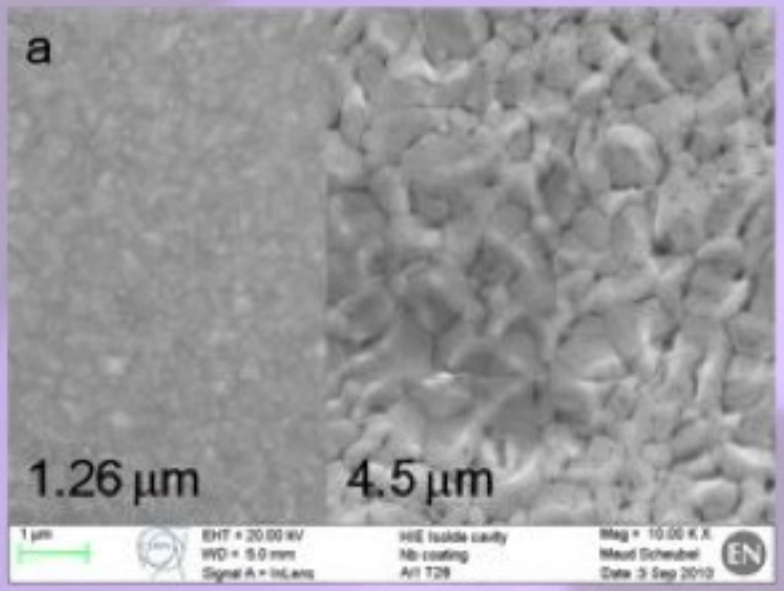
Magnetron Sputtering:

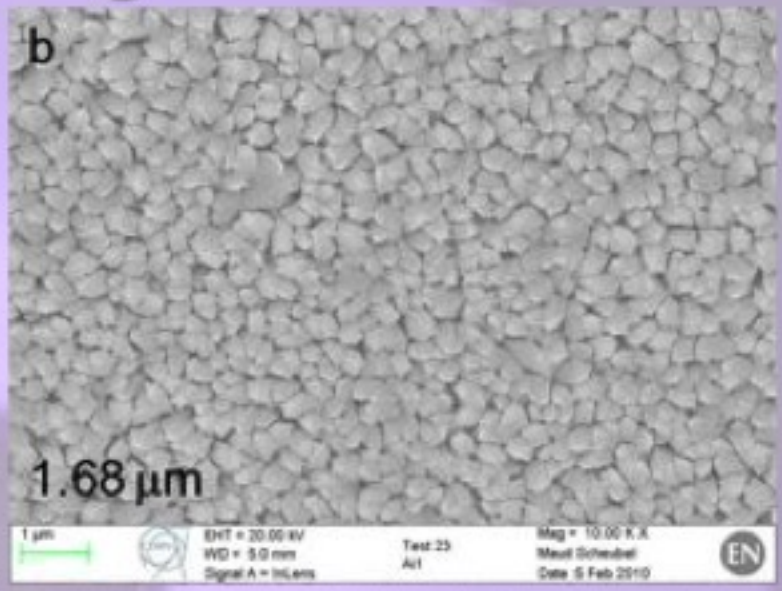
Cavity sputtered

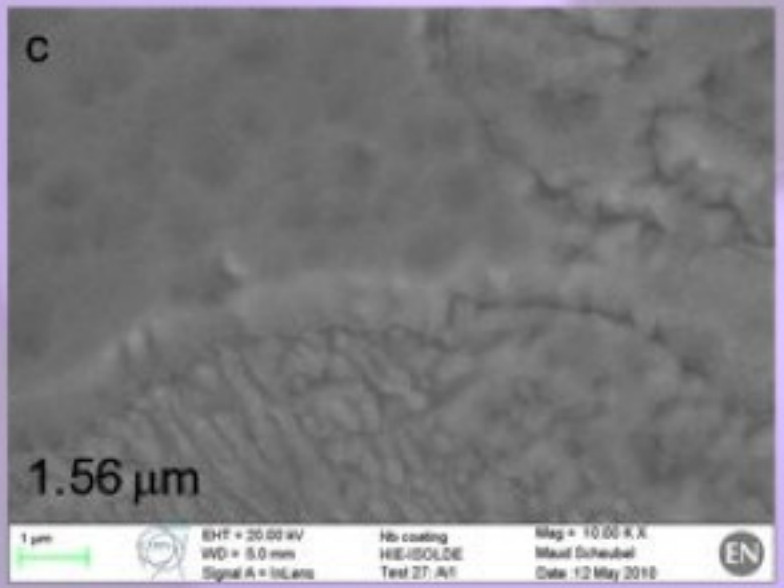


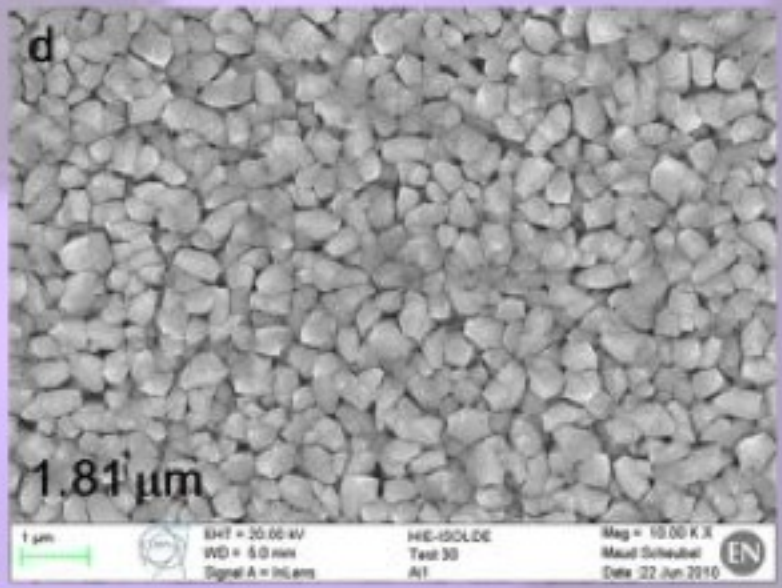
November 5th 2009

SEM images

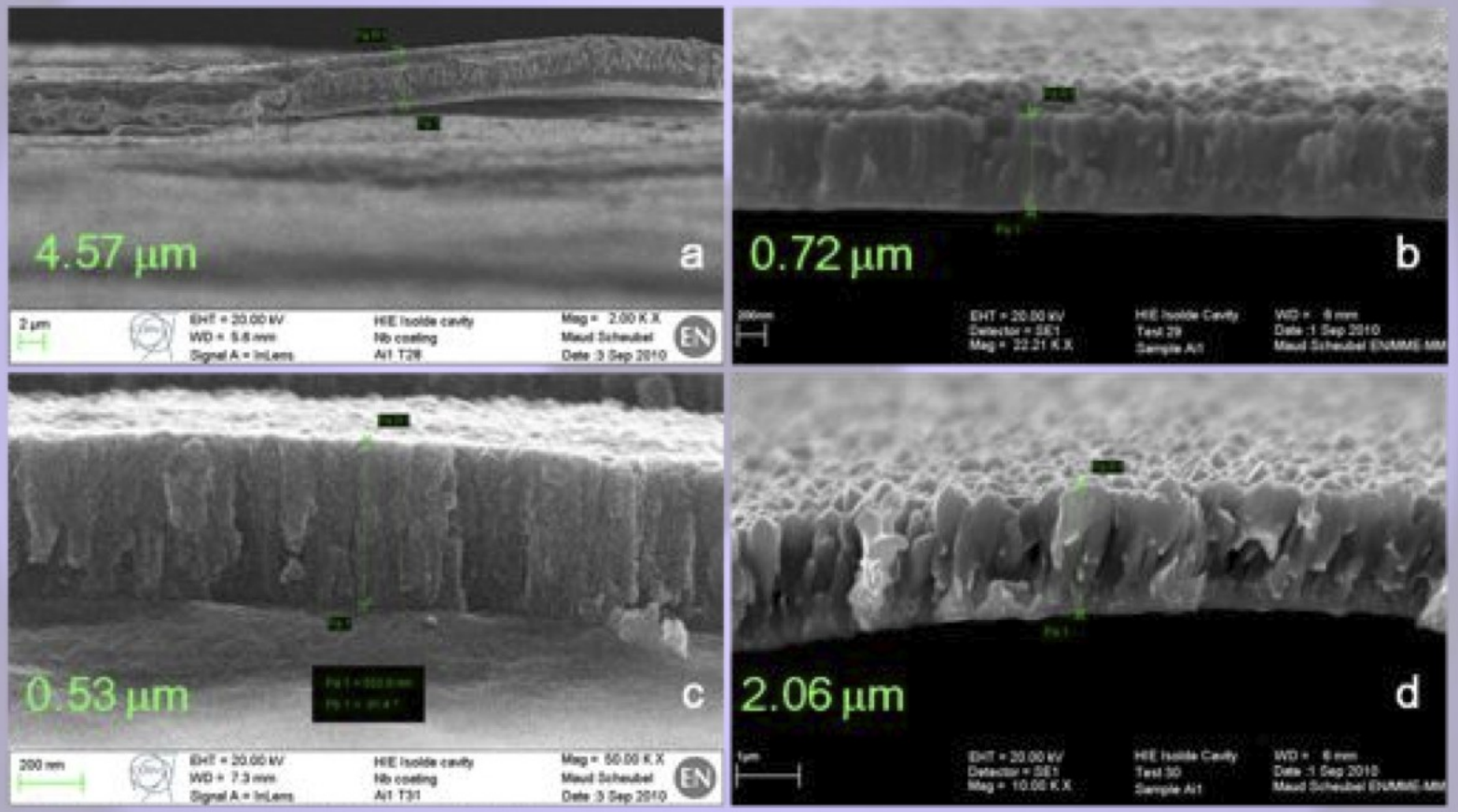






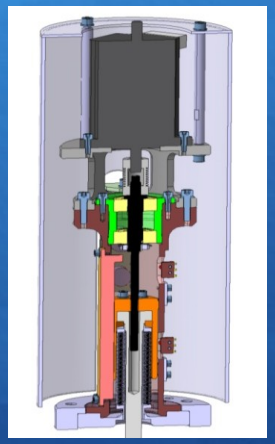


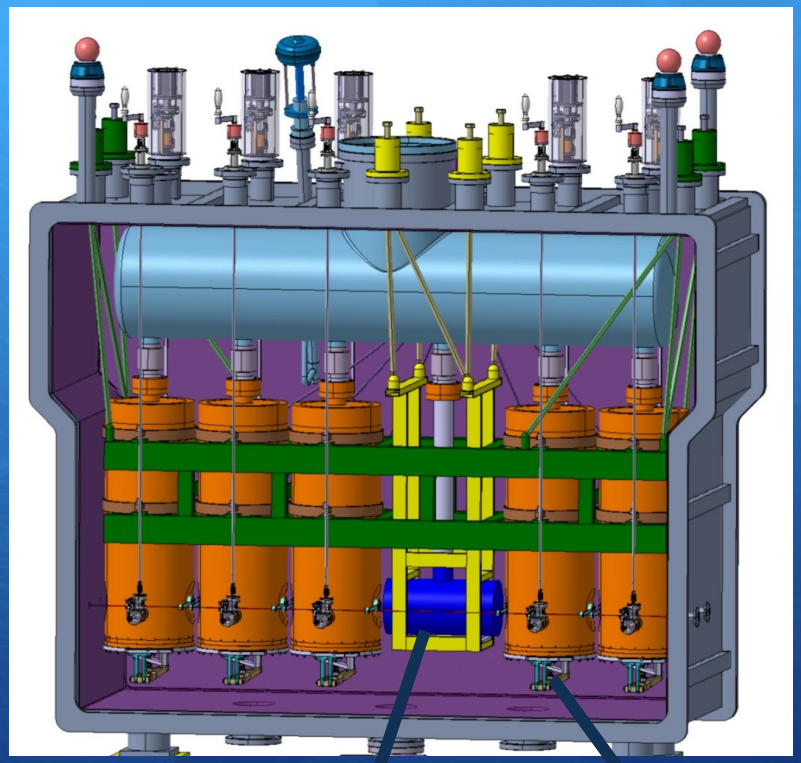
SEM images: film sections



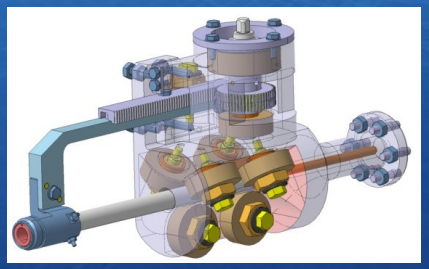
High β cryomodule

MOTORISATION
DRIVE
TUNER



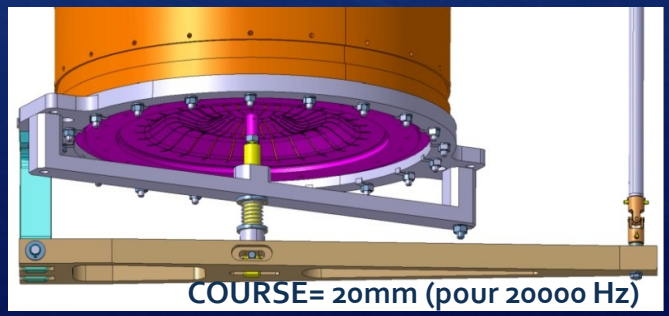


COUPLER



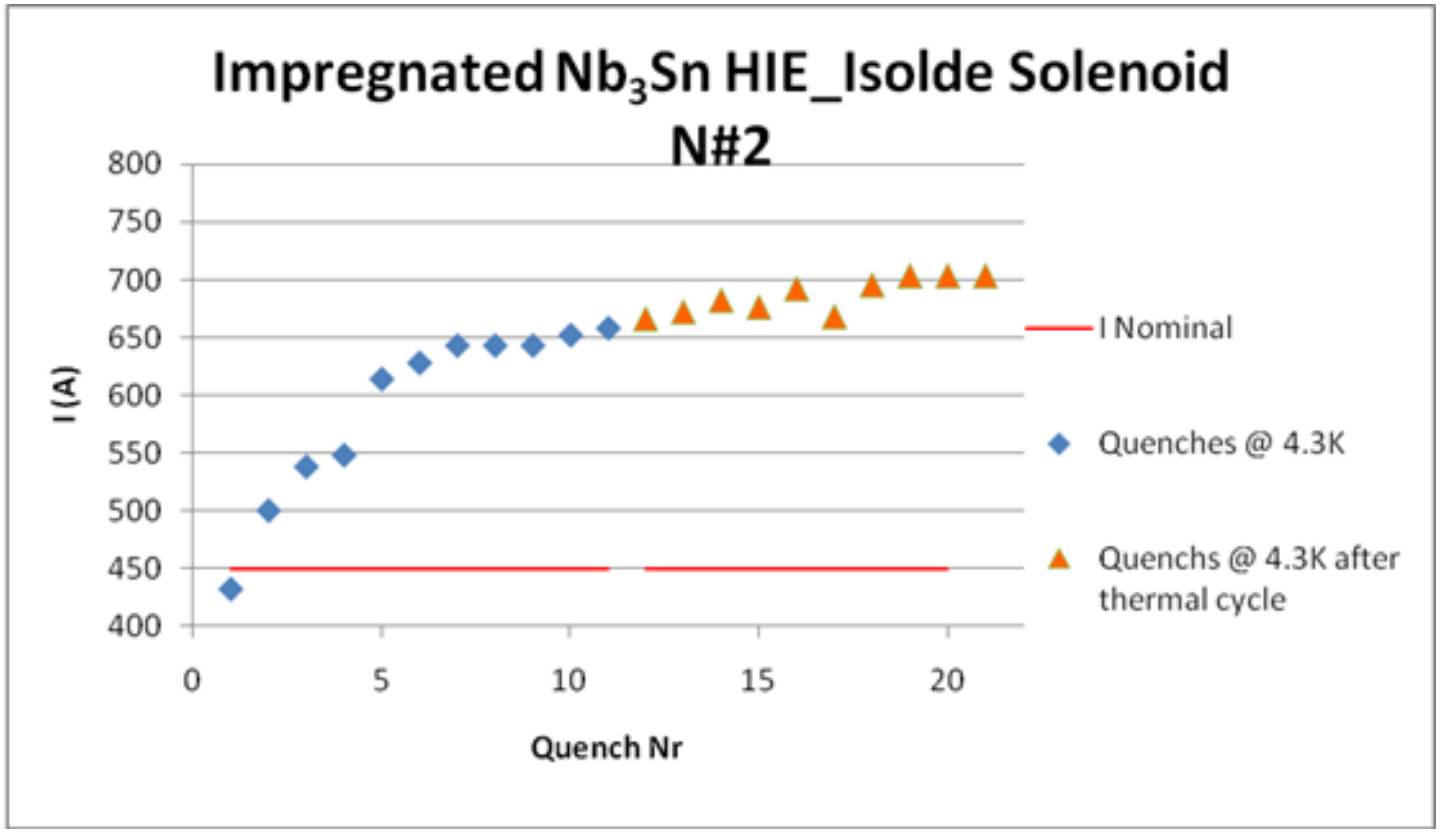
TUNER RF

PROTOTYPE
SOLENOID
Nb3Sn



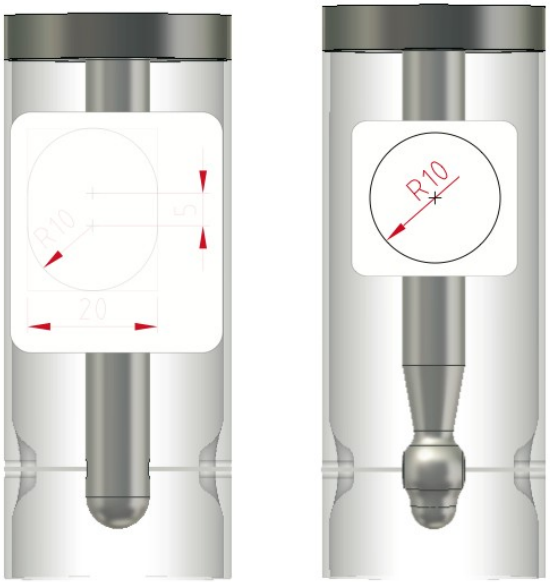
COURSE= 20mm (pour 20000 Hz)

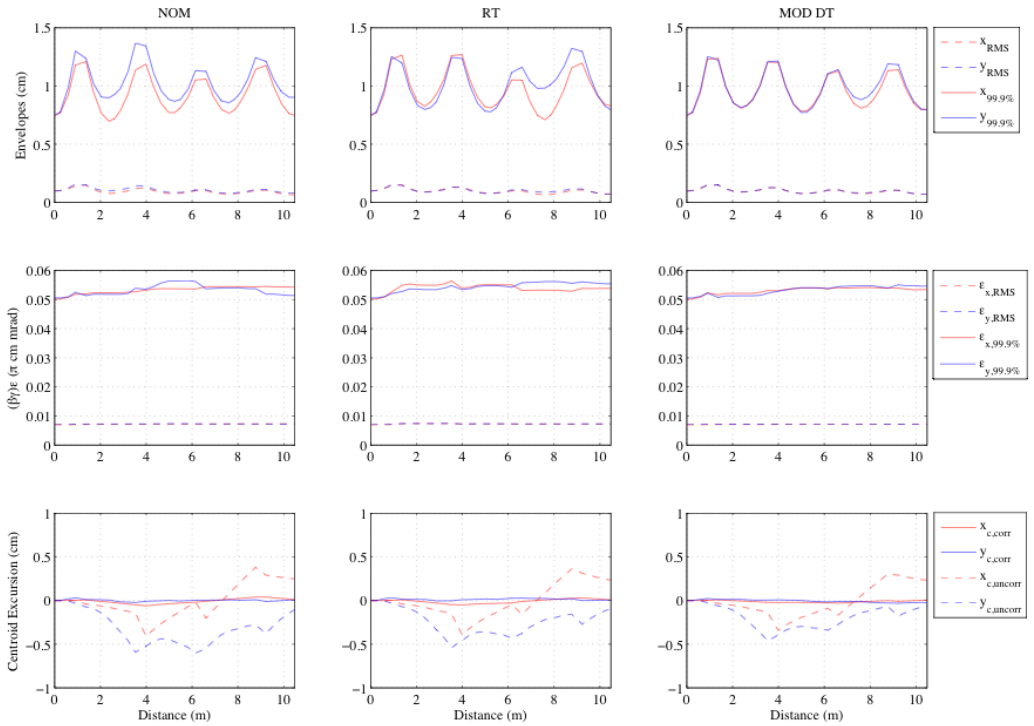
Nb3Sn Solenoid prototype results



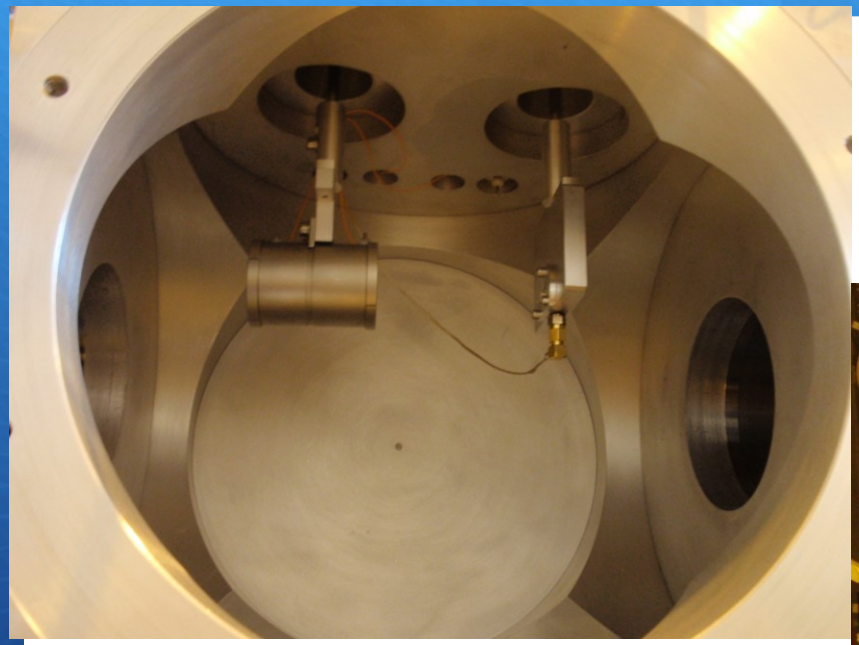
High β section Beam Dynamics studies

- Beam Port shape studies

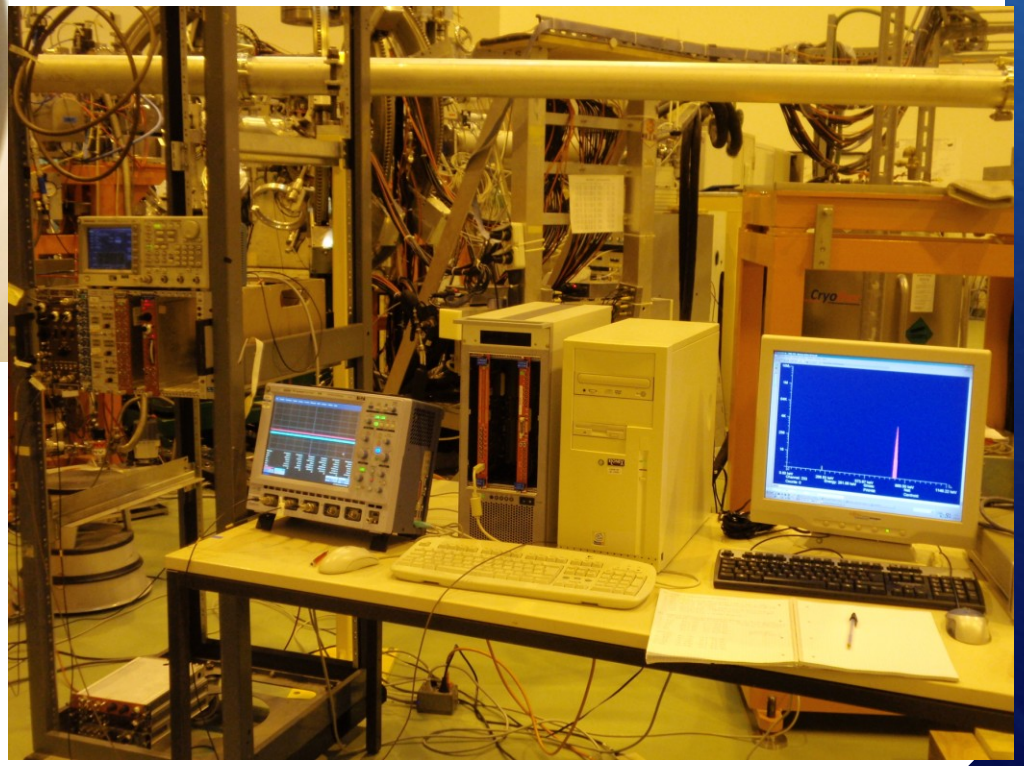




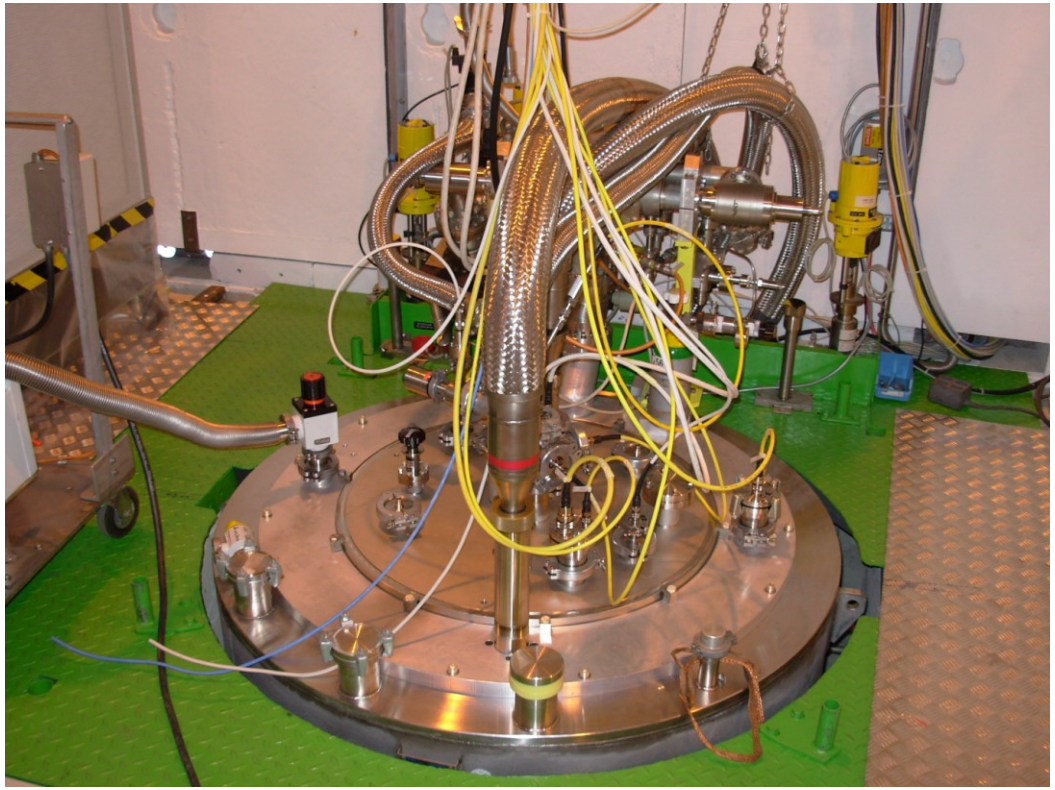
Beam Instrumentation



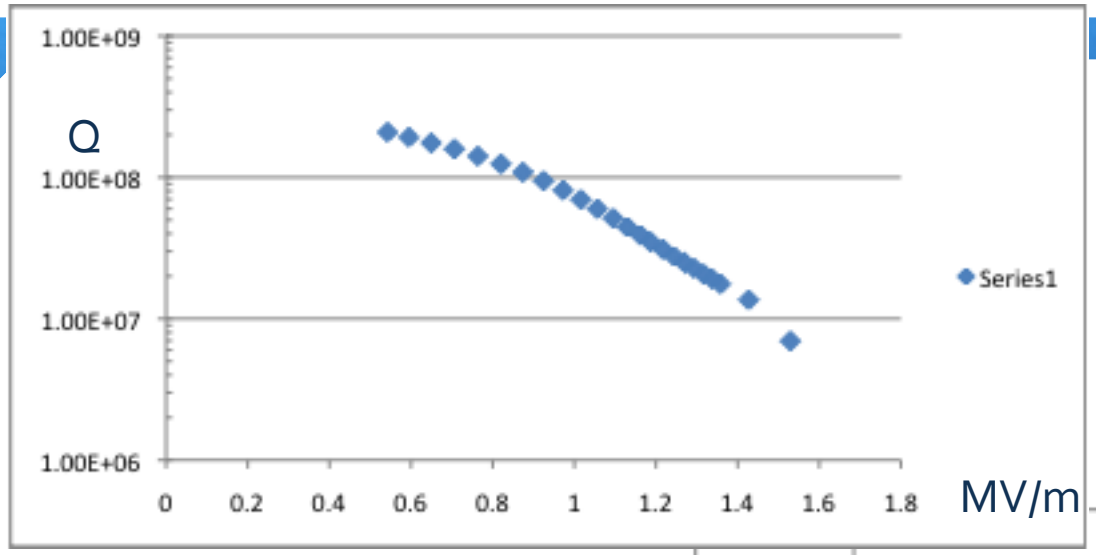
Work done by F. Zocca and M. Fraser



SM18 QWR test stand

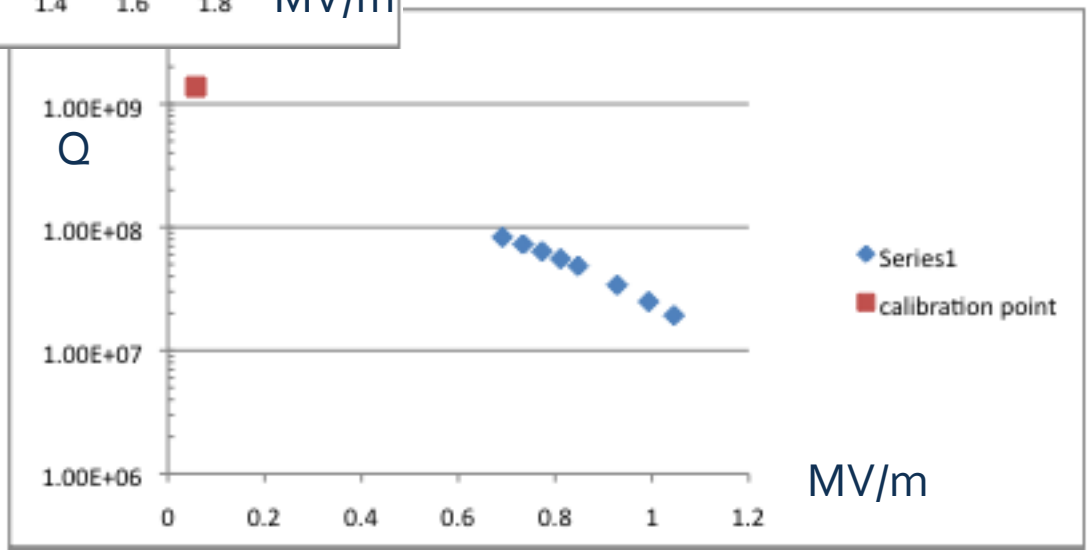


First Measurements at 4.5K

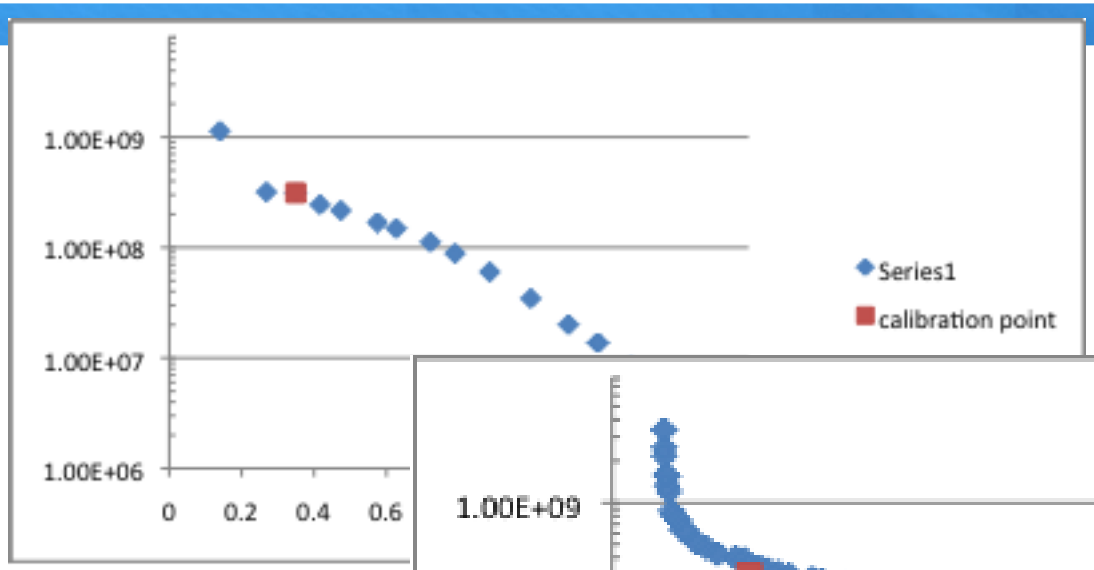


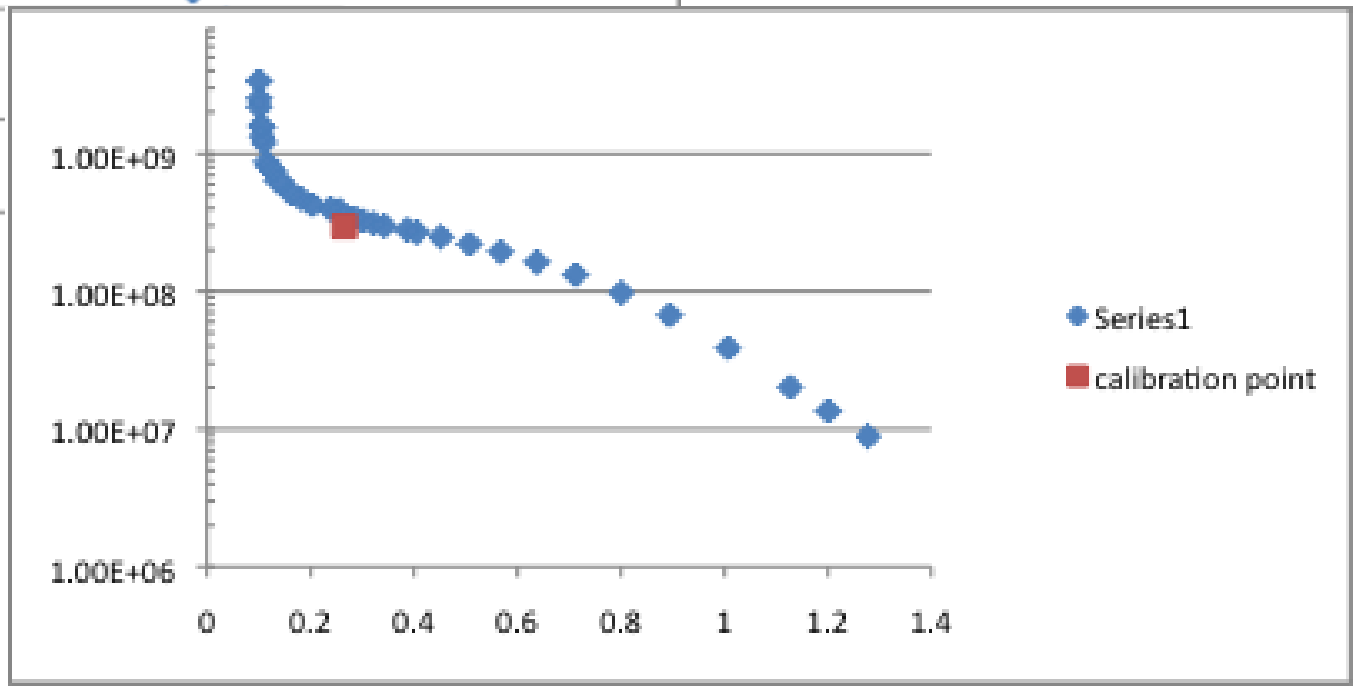
18Oct2010

19Oct2010



Measurement at 3K





Summary

- Cavity prototype completed. Tests @ CERN are ongoing
- Cavity Development is going ahead. Preseries prototype foreseen for mid of 2011
- Cryomodule design is advanced, we expect to have the first almost complete detailed design by mid of 2011
- For more info concerning the Linac please check out the website: http://hie-isolde.web.cern.ch

Acknowledgments

- HIE-ISOLDE design group
- ISOLDE physics and operation group
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