SCRF Activities at IPN Orsay

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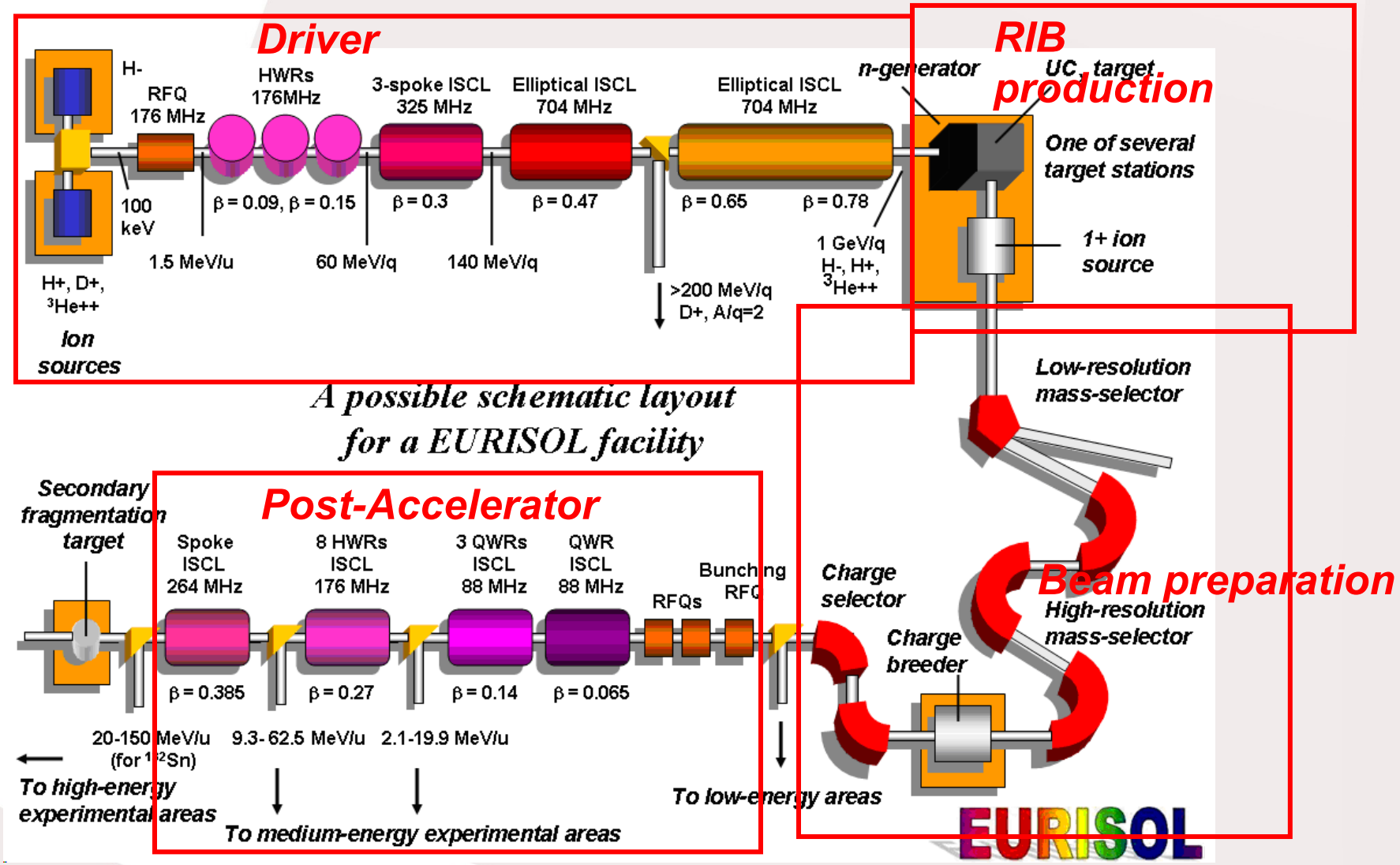
On behalf of the SCRF group

Eurisol Net Meeting – CERN, 28th June 2011

Outlook

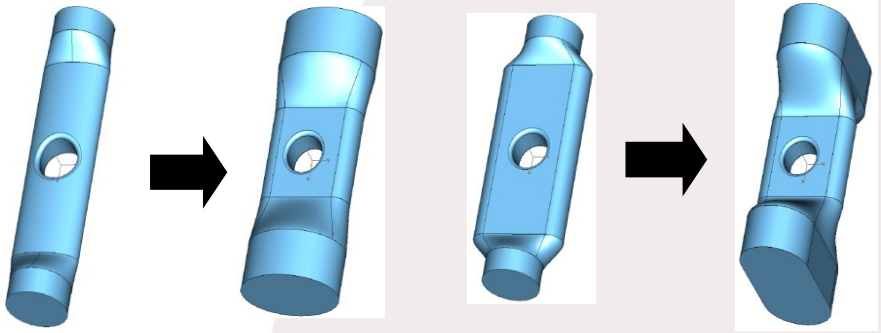
- R&D on spoke cavities (Eurisol TSR)
- TIARA (WP 9)
- SPL related activities & EUCARD R&D Program
- Cavity developments for Spiral-2
- Developments for MYRRHA
- ESS

The EURISOL Accelerator layout

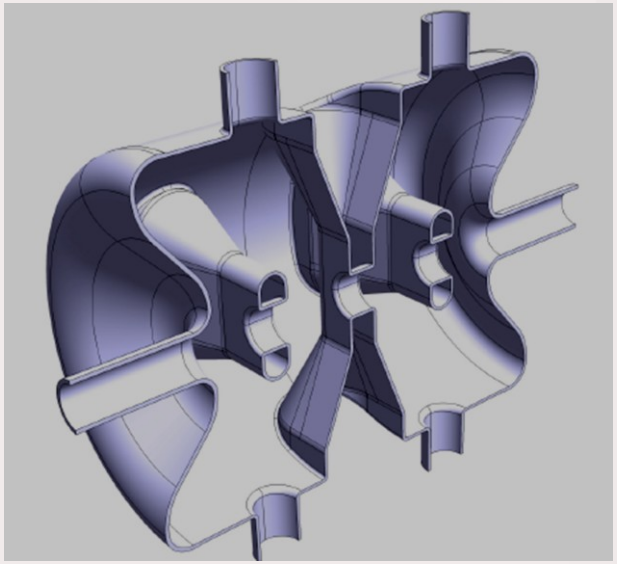


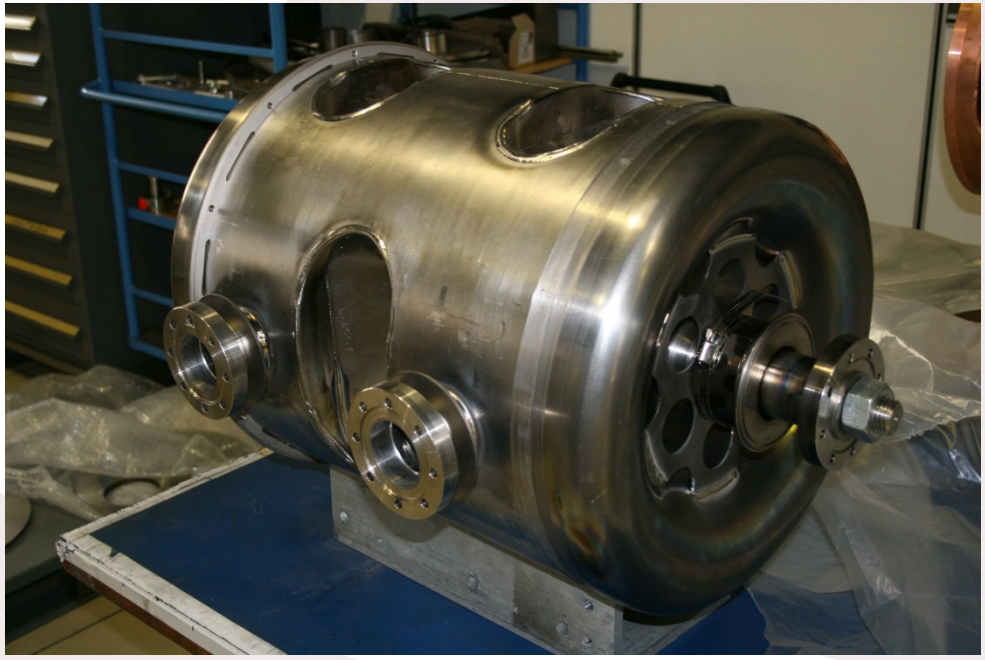
R&D on spoke cavities (Eurisol TSR)

One example : optimization of the spoke bar shape



Elliptical shape **Racetrack shape**





The triple spoke prototype fabrication is completed. The cavity will be prepared (chemical etching and high pressure rinsing).

First cryogenic test in September

TIARA-PP (FP7) : WP 9 (Eurisol)

Creation of a coordinated panEuropean multi-purpose distributed Test Infrastructure

- Monitoring and coordinating the use and the development of the European test infrastructures for accelerator R&D
- Monitoring accesses, including industry involvement
- Identifying weaknesses and needed upgrades/investments and assessing their costs
- Making recommendations and contributing to upgrade and/or construction of new R&D Infrastructures as well as their corresponding R&D programs

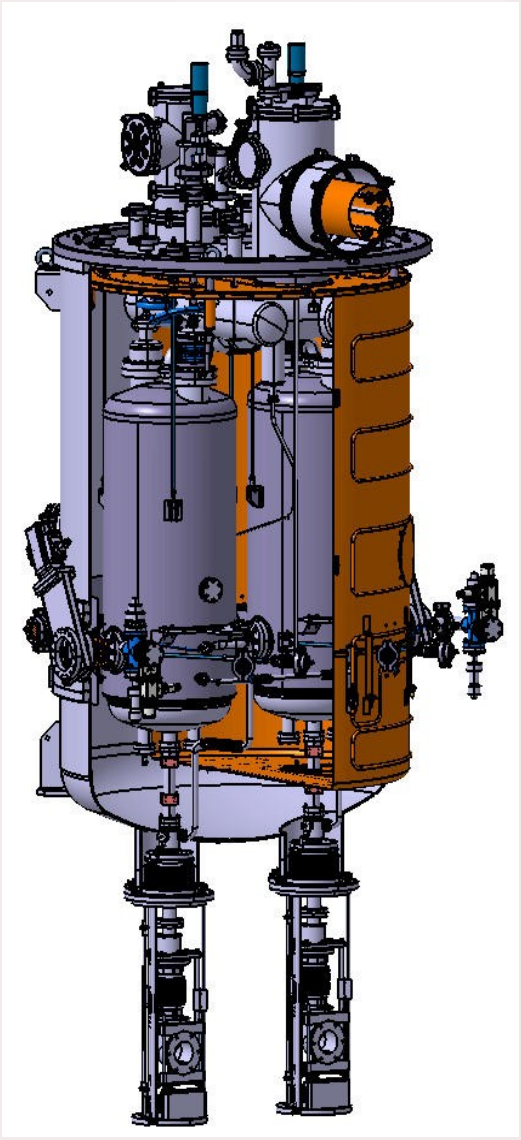
TIARA-PP (FP7) : WP 9 (Eurisol)

The objective of this WP is to coordinate the definition and the engineering design of two test benches:

- **an irradiation test facility for the high power target developments**
- **a test cryostat for testing fully equipped low beta superconducting cavities.**

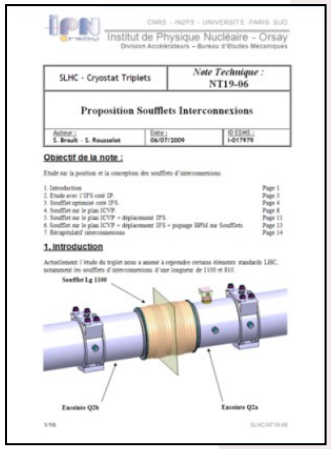
Test Infrastructure for High Power Accelerators Components
TIHPAC

- **Specifications**
  - Adapted for various geometries; QWR, HWR, Spoke (single gap, multigap)…
  - Various configuration of power couplers and cold tuning systems
  - Could integrate a SC solenoid to test influence on the cavity performances
  - Operation at 4K and 2K



Special contribution of France to CERN : SLHC

<u>Framework</u>: Replacing the focusing triplets close to Atlas and CMS: study and construction of a prototype cryostat (Ø914mm lg 8m) and associated asssembly tooling for the new Nb-Ti magnets.

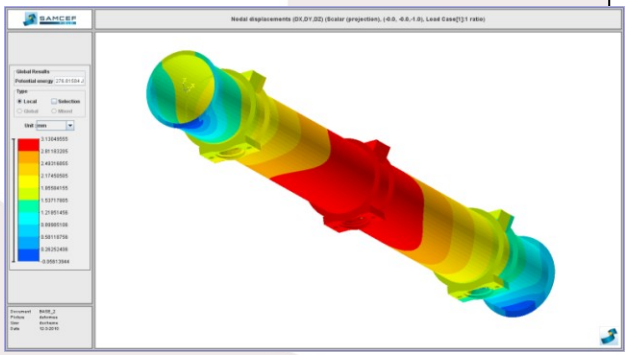

Institut de Physique Nucléaire - Orsay

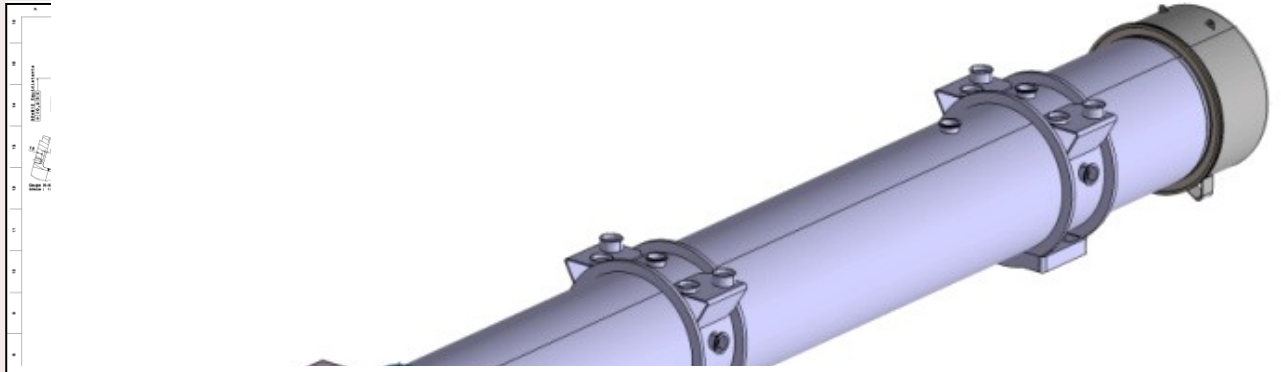
SLHC - Cryostat Triplets | *Note Technique :* NT19-06

Proposition Soufflets Interconnexions

Objectif de la note :

1. Introduction

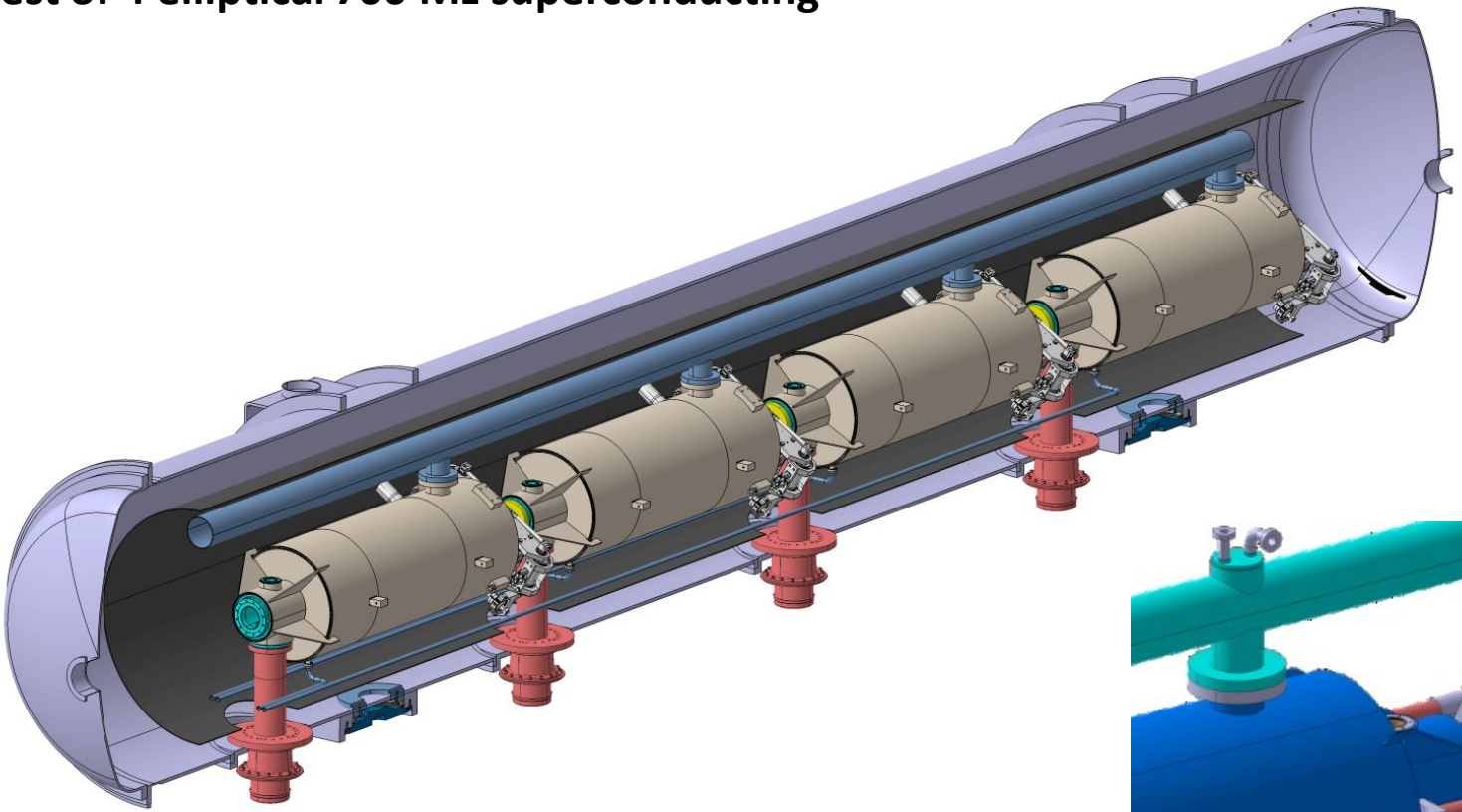


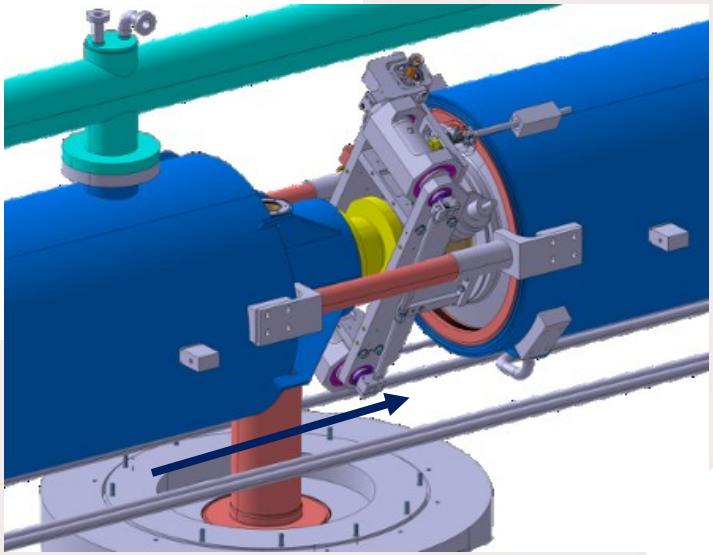


Bilan de collaboration S-LHC
Sept. 2008 – Mai 2010
1447 pages EDMS : I-021298

Special contribution of France to CERN : SPL

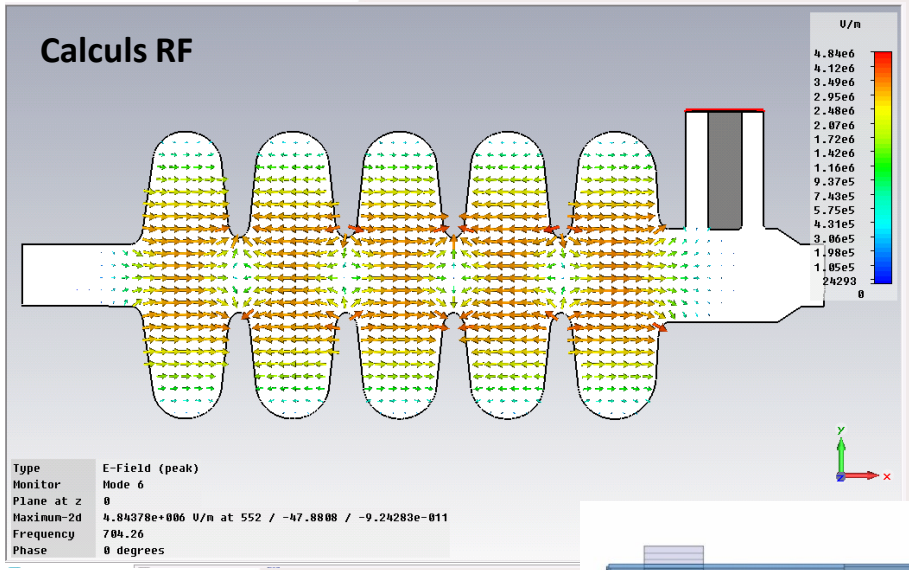
<u>Framework</u>: Study and fabrication of one short cryomodule and its associated tooling for the test of 4 elliptical 700 Mz superconducting

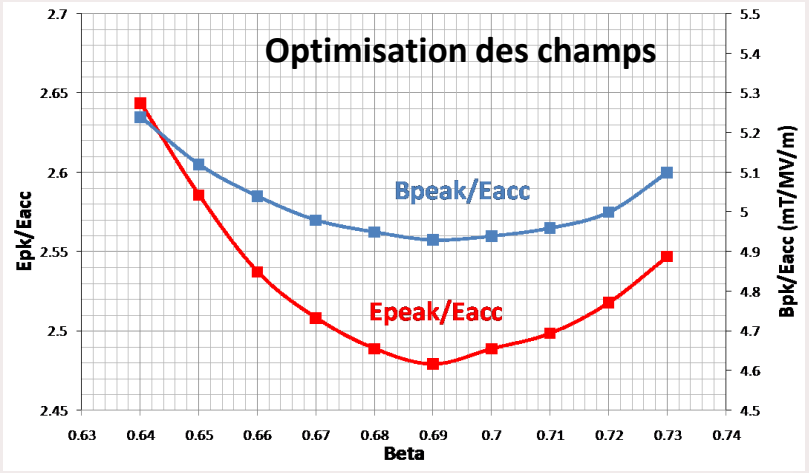


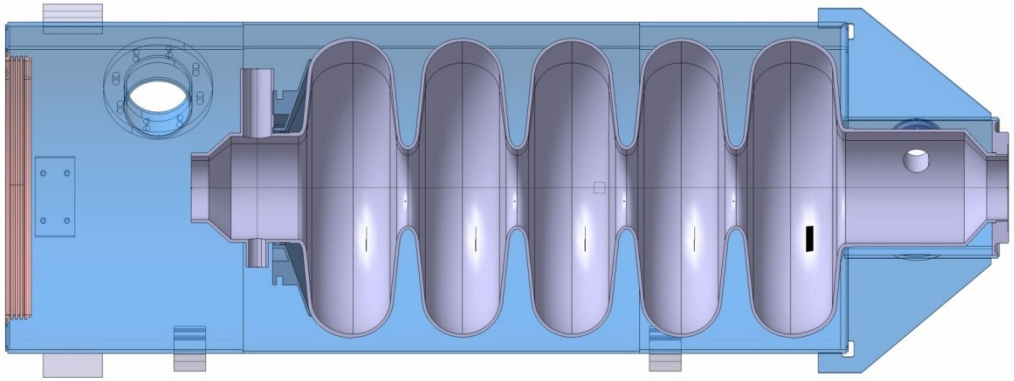


EUCARD (FP7) European program : WP 10.2 : SPL

<u>Framework</u>: Design, fabricate and test one prototype of a 700 MHz beta 0.65 elliptical (5-cells) superconducting cavity





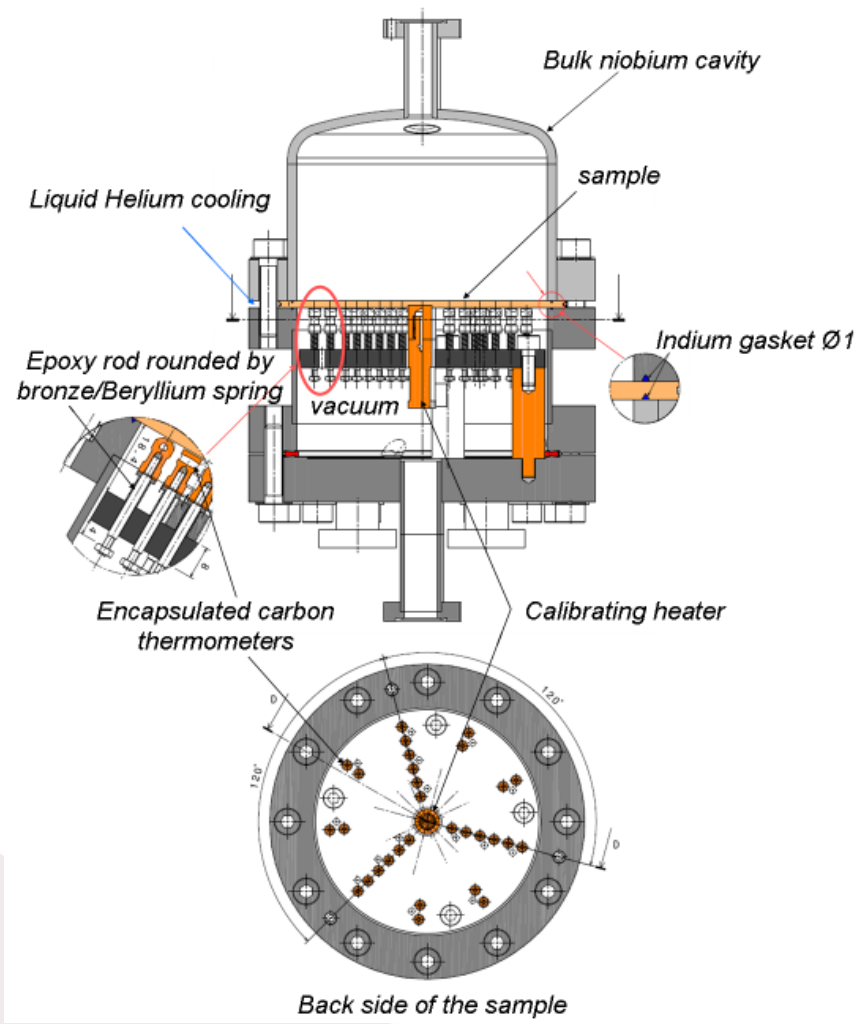


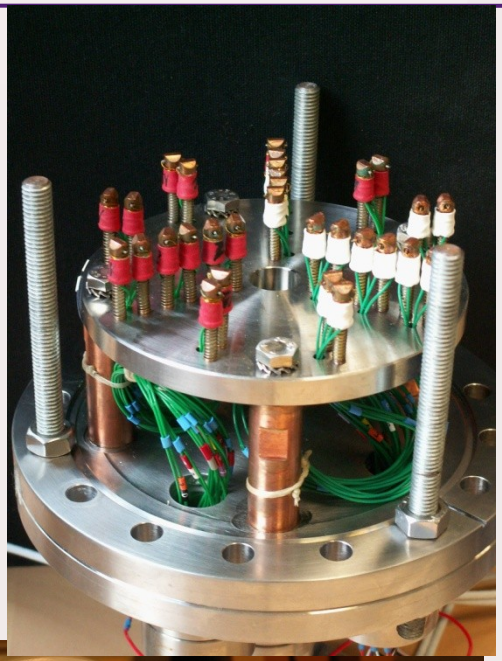
Etude d'intégration cavité / tank hélium

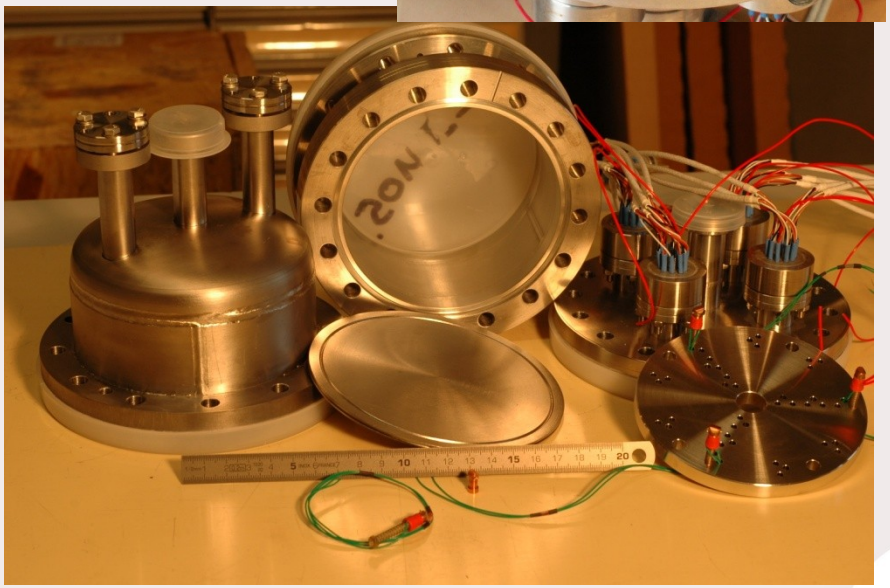
EUCARD (FP7) European program : WP 10.4 : Thin Films

TEST CELL for SRF Thin Films

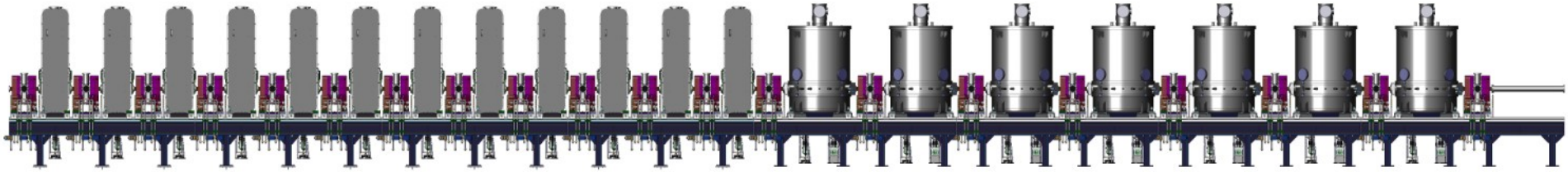
Measure fundamental parameters of new SRF thin films





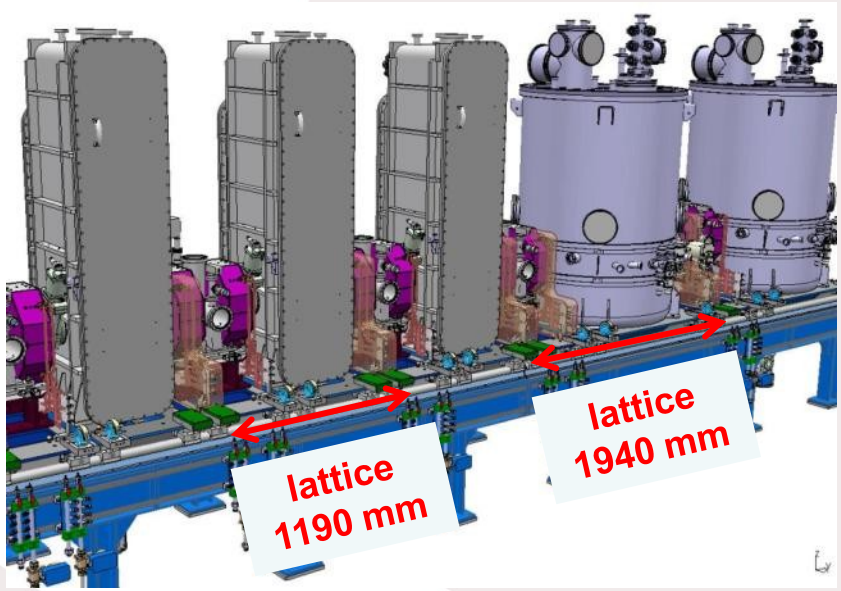


SPIRAL-2 SCRF activities at IPN Orsay



Beta 0.07 energy section — **Beta 0.12 energy section**

L~35 m

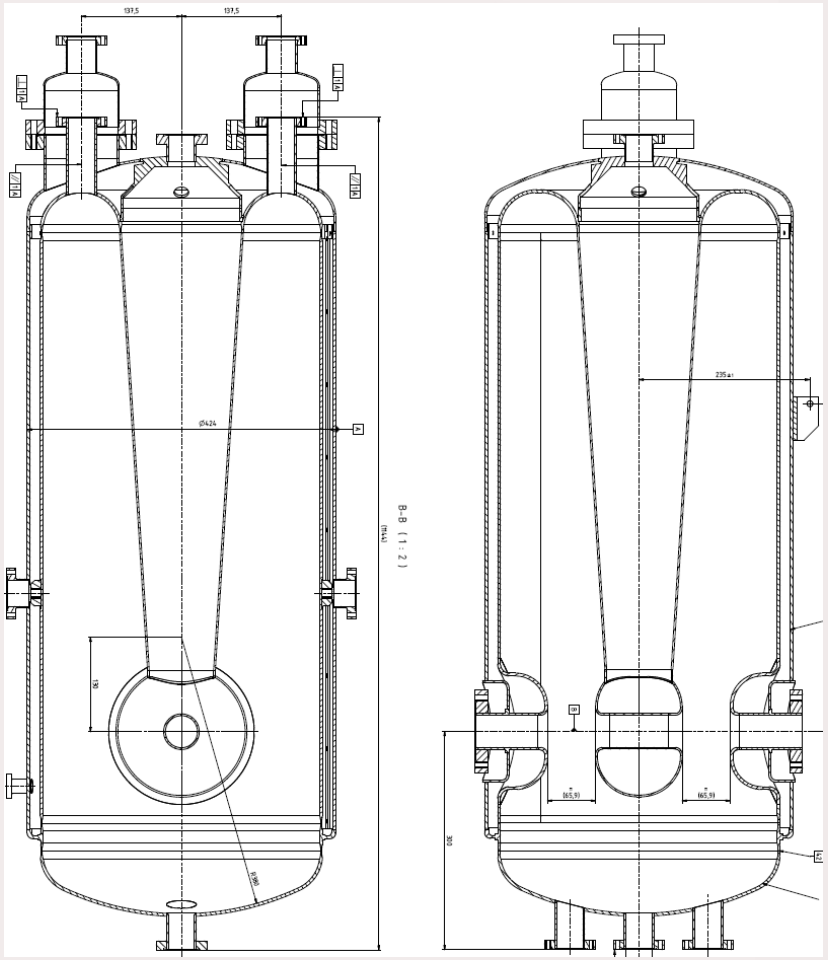


Cryomodule A	Cryomodule B	Power coupler
CEA Saclay	IPN Orsay	LPSC Grenoble

Cryomodule	A	B
Valve-to-valve length [mm]	610	1360
# cavities	12	14
f [MHz]	88.05	88.05
β_{opt}	0.07	0.12
Epk/Eacc	5.36	4.76
Bpk/Eacc [mT/MV/m]	8.70	9.35
r/Q [Ω]	599	515
Vacc @ 6.5 MV/m & β_{opt}	1.55	2.66
Lacc [m]	0.24	0.41
Beam tube ∅ [mm]	38	44

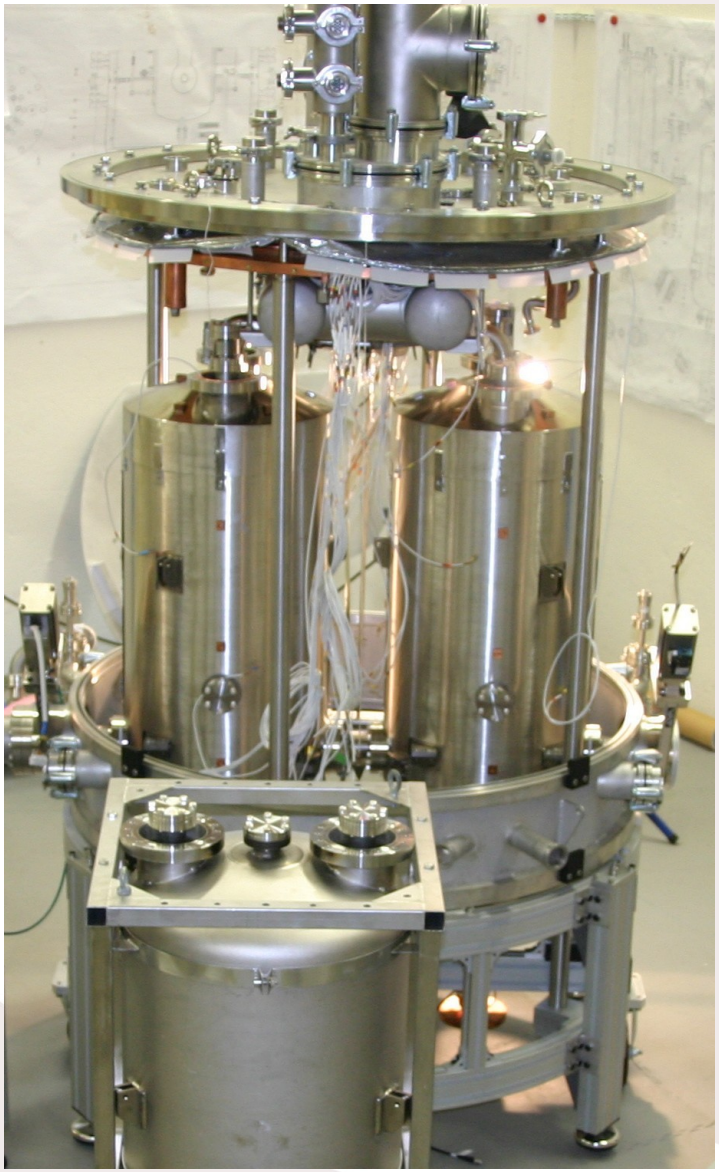
SPIRAL-2 SCRF activities at IPN Orsay

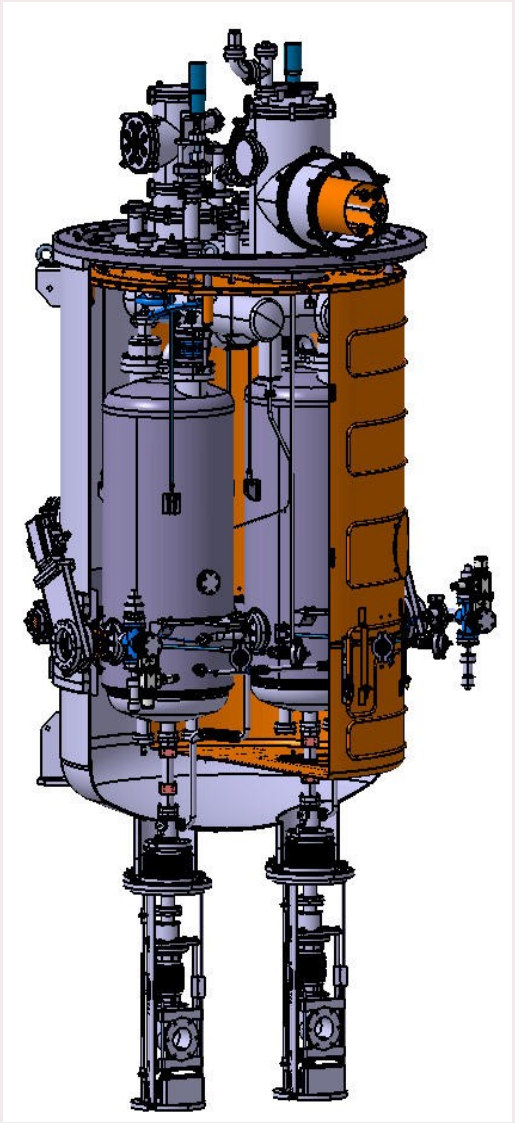
- 16 Quarter-Wave Resonatosr, 88.05 MHz, beta 0.12 (made by RI)
- Bulk Niobium RRR>250 (Tokyodenkai)
  - Body: 4.2 mm
  - Stem: 2.7 mm
  - Ports and beam tubes: 3.2 mm
- Cavity flanges: CF 316LN Stainless Steel
- Helium vessel made of Titanium (4 mm)
  - Flanges CF16→ Ti
  - Flanges CF40→ Ti
  - Flanges CF100→ SS
- No bellows
- No dismountable bottom flange



- SPIRAL2 specs: Eacc = 6.5 MV/m and Pcav < 10W

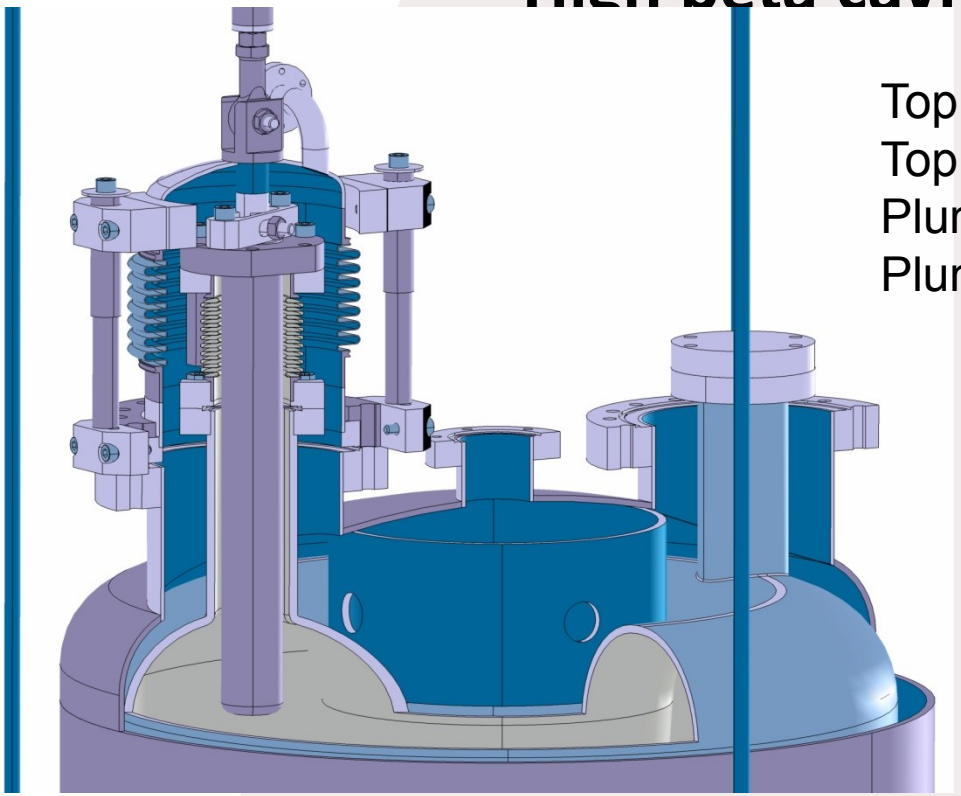
SPIRAL-2 SCRF activities at IPN Orsay





SPIRAL-2 SCRF activities at IPN Orsay

High beta cavity cold tuning system



Top port diameter: 36 mm
Top port length: 100 mm
Plunger diameter: from 20 to 30 mm
Plunger penetration length: up to 50 mm

2 ports on the top of the cavity:
a) One static plunger (optional)
b) One moving plunger

⇒ Sensitivity ~1 kHz/mm with Ø 30 mm plunger

Introducing one plunger(Ø 30 mm, $L_{introduced}$= 50 mm):

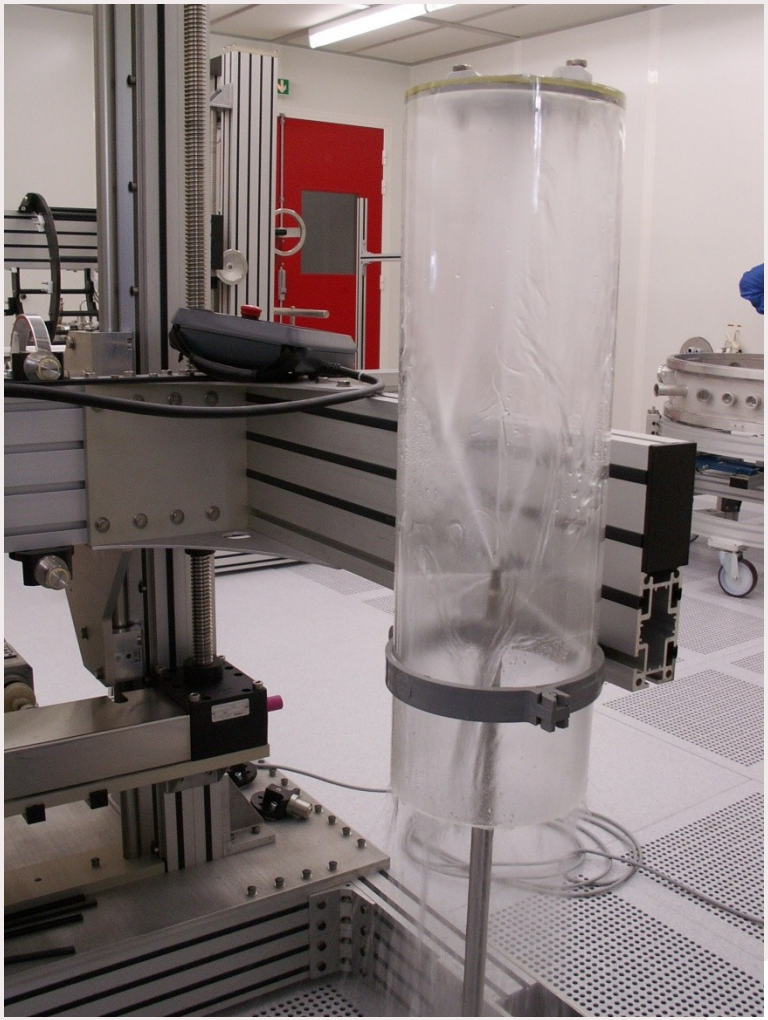
First “coarse” tuning: + 50 kHz

then fine tuning: +/- 4 kHz

SPIRAL-2 SCRF activities at IPN Orsay

Clean room cart (IPNO design)

Ultra-pure water rinsing (100 Bar)



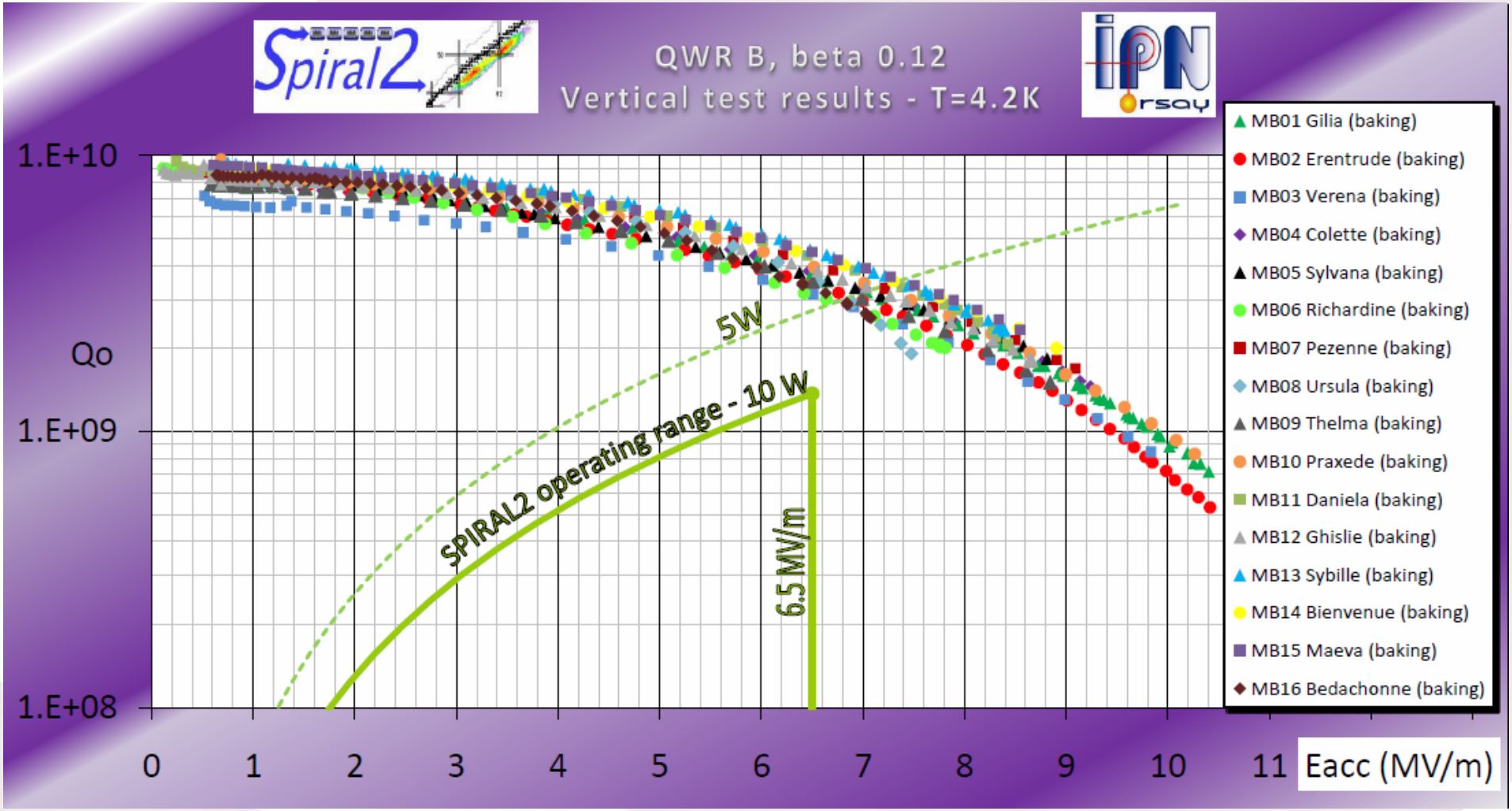
SPIRAL-2 SCRF activities at IPN Orsay

MB01: Gilia
MB02: Erentrude
MB03: Verena
MB04: Colette
MB05: Sylvana
MB06: Richardine
MB07: Pezenne
MB08: Ursula
MB09: Thelma
MB10: Praxède
MB11: Daniela
MB12: Ghislie
MB13: Sybille
MB14: Bienvenue
MB15: Maeva
MB16: Bédachonne
+
Rocco
Tokyo
Cabot

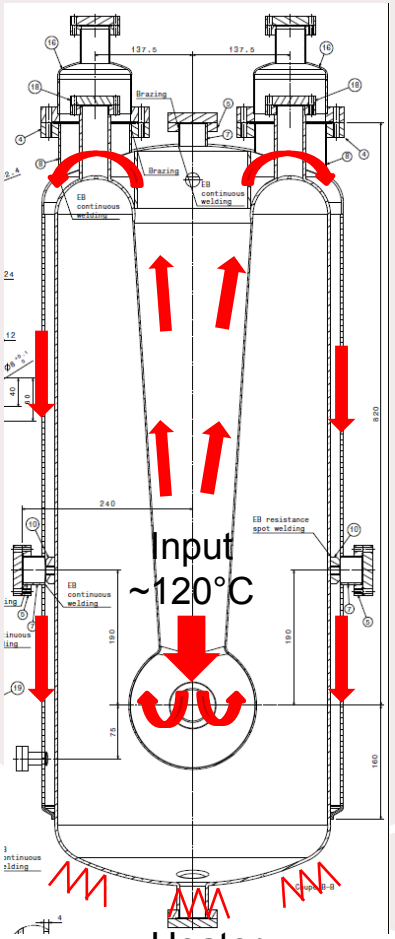
Strategy: One protoype – 2 pre-series – 16 series cavities

SPIRAL-2 SCRF activities at IPN Orsay

Results of all high beta series cavities



High beta cavity baking in clean room

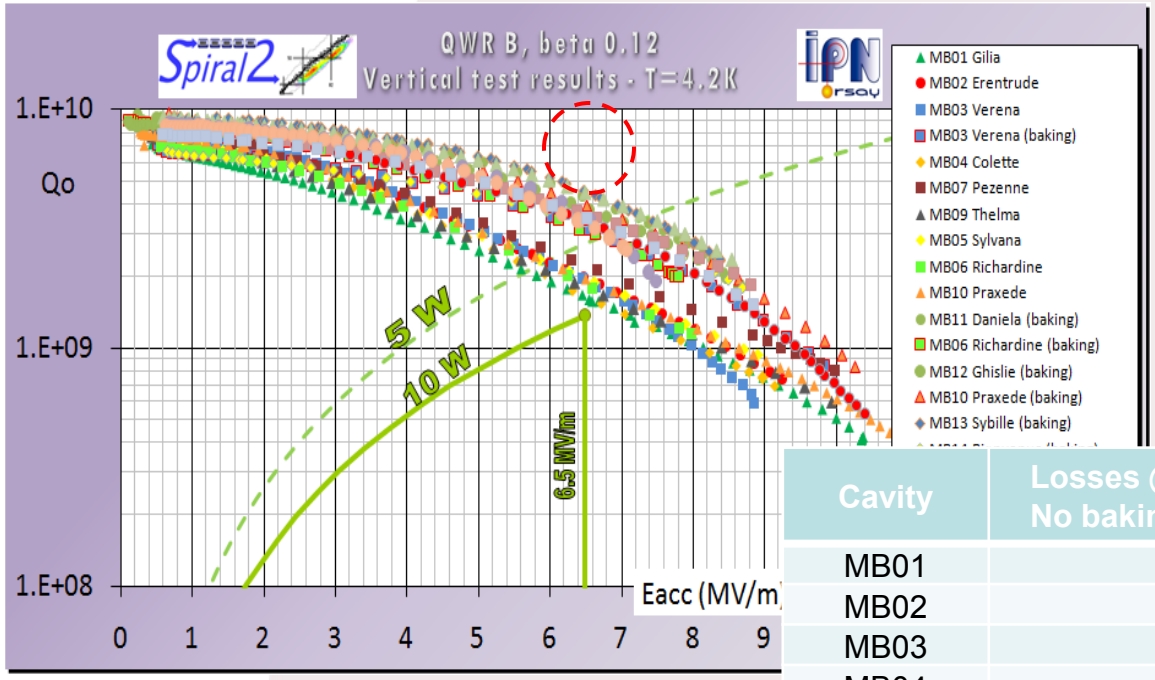


- After 72h drying → 48 h baking @ 120°C
- "Forced" air flow inside the helium vessel + heater on the cavity bottom
- Cavity wrapped in a foil blanket

Heater (not shown) glued onto the copper cap

SPIRAL-2 SCRF activities at IPN Orsay

High beta cavity baking in clean room



Results after baking

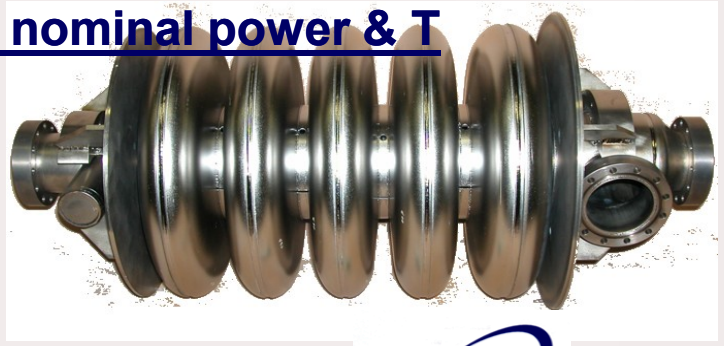
Cavity	Losses @ 6.5 MV/m [W] No baking	Losses @ 6.5 MV/m [W] With baking
MB01	8.5	3.7 (-56%)
MB02	6.9	4.1 (-41%)
MB03	7.0	4.4 (-47%)
MB04	8.4	3.6 (-58%)
MB05	7.2	3.5 (-51%)
MB06	7.5	4.8 (-36%)
MB07	6.9	3.4 (-51%)
MB08	X	4.0
MB09	8.9	3.9 (-56%)
MB10	7.1	3.5 (-51%)
MB11	X	3.1
MB12	X	3.8
MB13	X	3.0
MB14	X	4.0
MB15	X	3.1
MB16	X	3.9

Losses divided by ~2 @ Eacc=6.5 MV/m

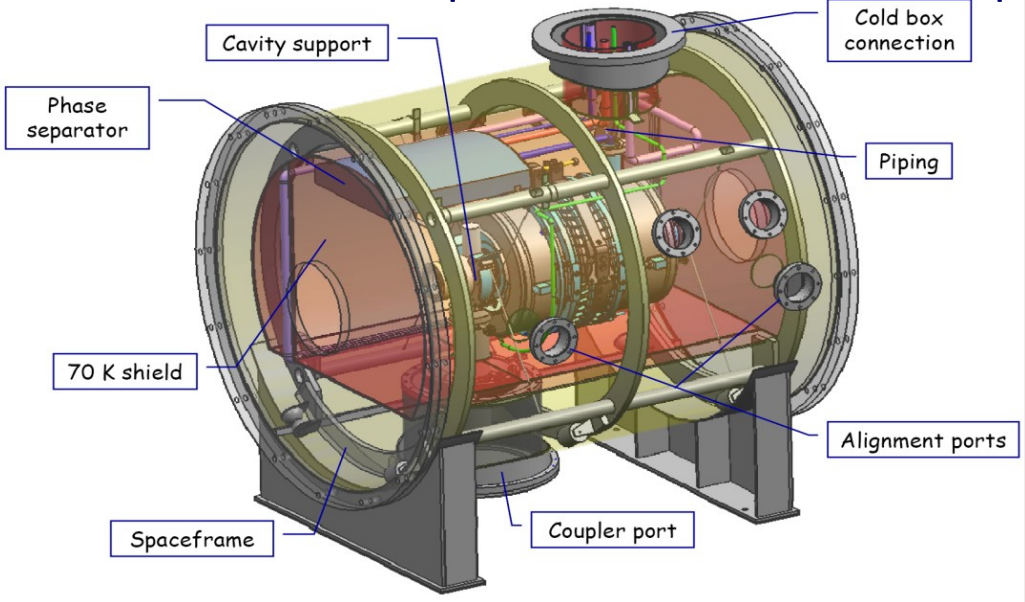
MAX (FP7): Accelerator R&D for MYRRHA

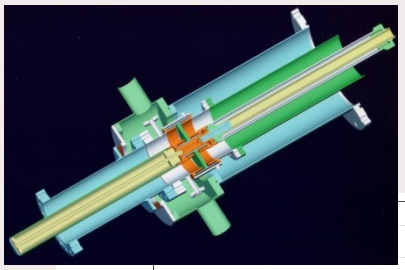
Framework: Intensive cryogenic tests at nominal RF power (performances, reliability, fault-tolerancy concept) of a short prototype700 MHz elliptical cryomodule.

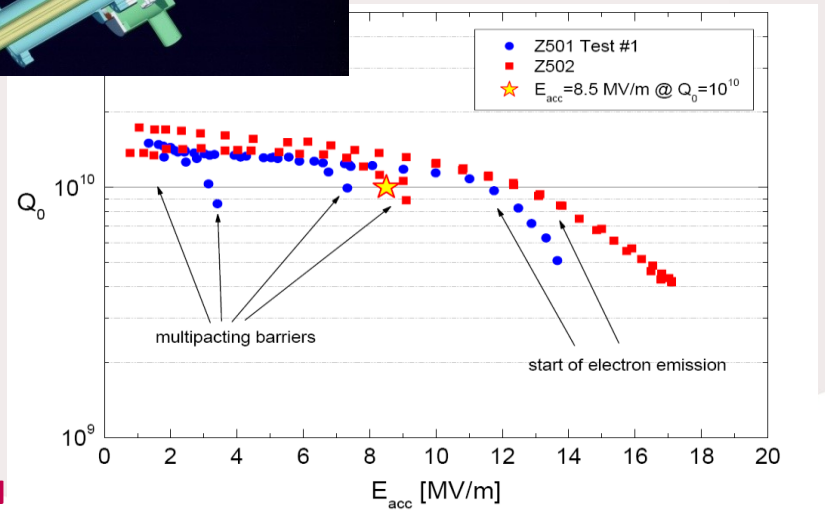
Design, fabrication & test of an elliptical module at nominal power & T



- β =0.47 prototype constructed and tested
- Vessel & valve box installed and operational
- CW RF power coupler to be conditioned
- 700 MHz RF 80 kW power source received and operational

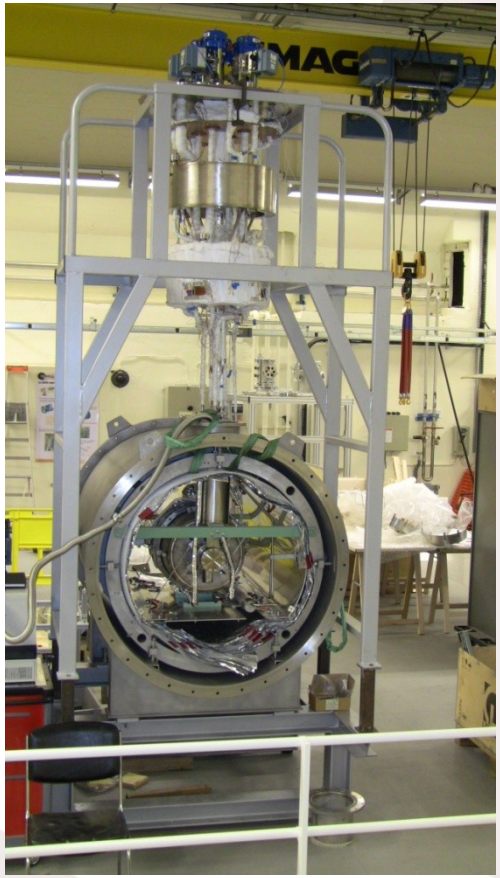


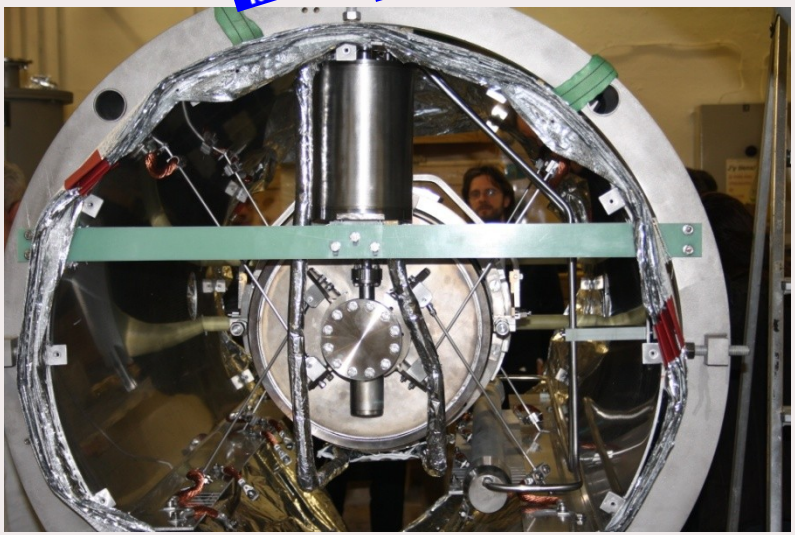




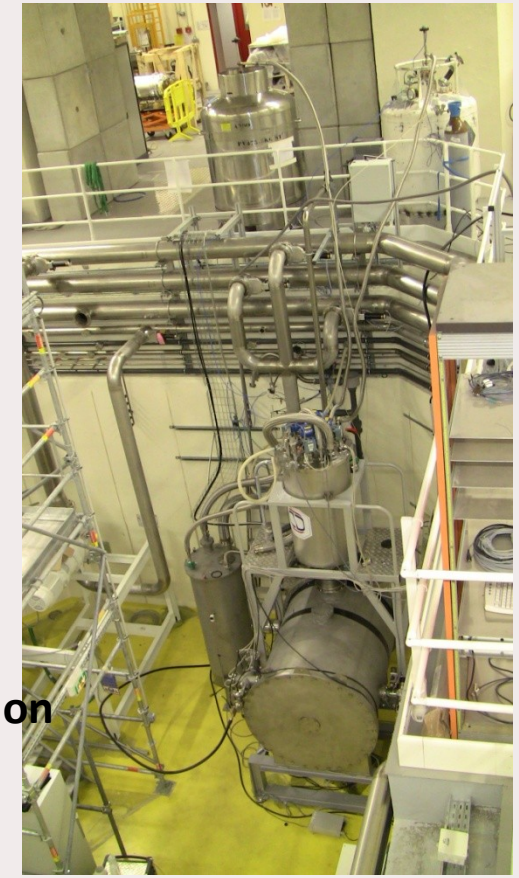
MAX (FP7): Accelerator R&D for MYRRHA

MAX
MYRRHA Accelerator eXperiment, research & development programme





Collaboration with INFN Milano



ESS: the European Spallation Source

Framework: **IN2P3/IPN Orsay is in charge of the spoke section of the superconducting linac (design, prototyping work up to the test of a full scale spoke cryomodule)**

Main specifications:

5 MW source (upgrade 7.5 MW)
Pulse long (~2.86 ms), 14 Hz rep. rate.
Proton beam 2.5 GeV
High reliability (>95%), low losses