13th International Workshop on RF Superconductivity

Peking University, Beijing, China 2007

THE SPIRAL 2 PROJECT

- **CONSTRUCTION PROGRESS**
- **RECENT DEVELOPMENTS ON THE SC LINAC DRIVER**

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on behalf of the Spiral 2 project group
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Direction des Sciences de la Matière

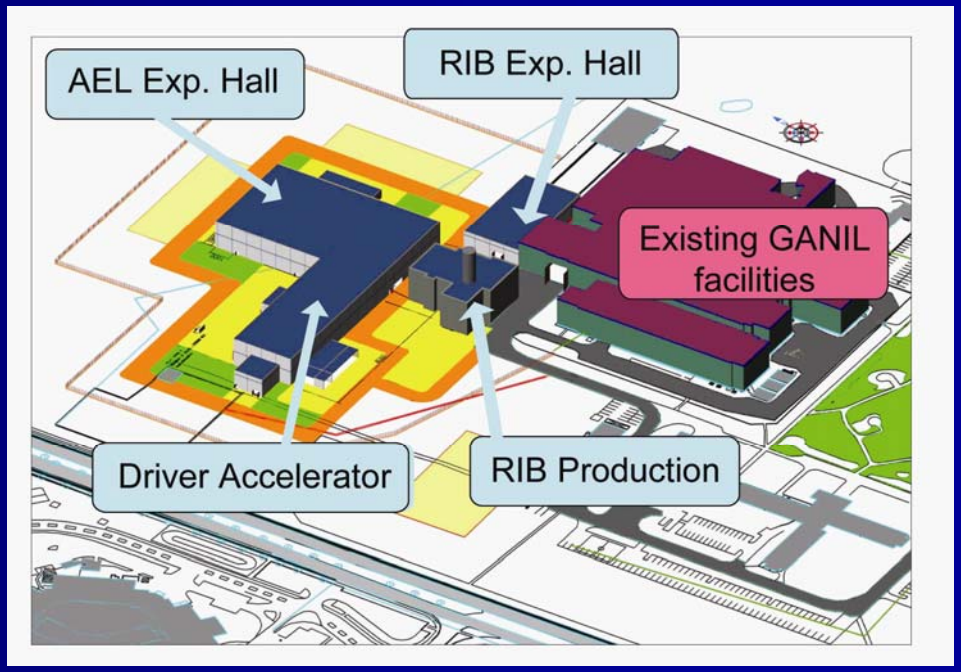
CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE

IN2P3 Institut National de Physique Nucléaire et de Physique des Particules

Région Basse-Normandie

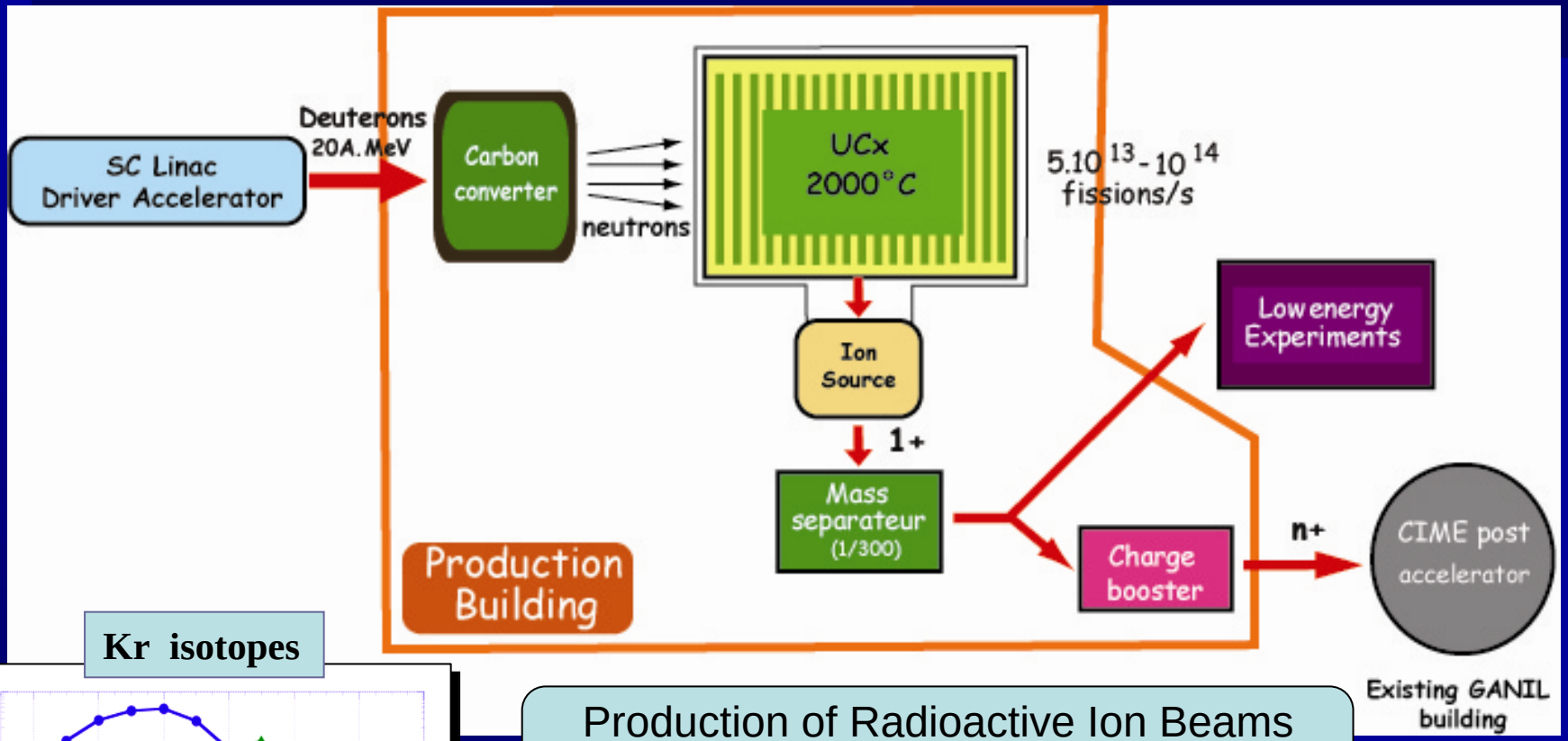
Spiral2

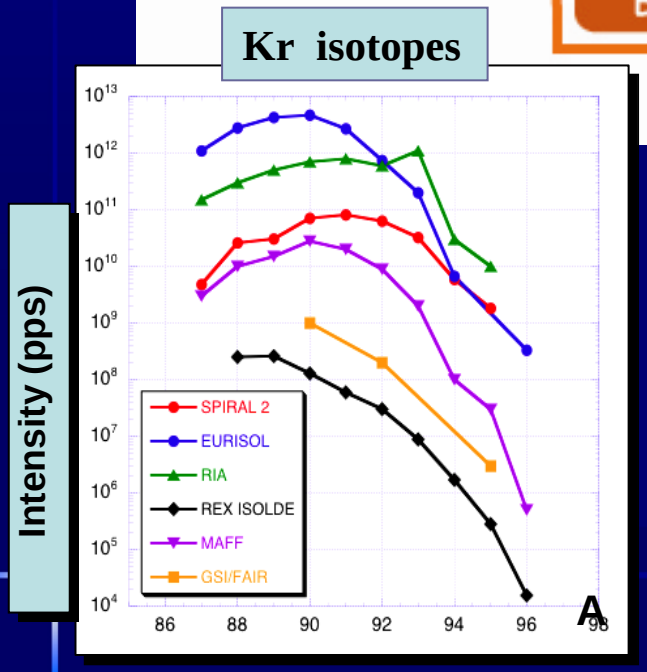
Spiral2



European facility for exotic nuclei at GANIL (Caen, France)

- Based on a high power, **<u>superconducting driver linac</u>** (40 MeV deuteron beam, 5mA)
  - Intense beams of neutron-rich exotic nuclei (10^{6}-10^{11}pps)
  - High intensity stable isotope beams (q/A = 1/3, energy up to 14.5 MeV/nucleon, 1 mA)
  - High power fast neutrons





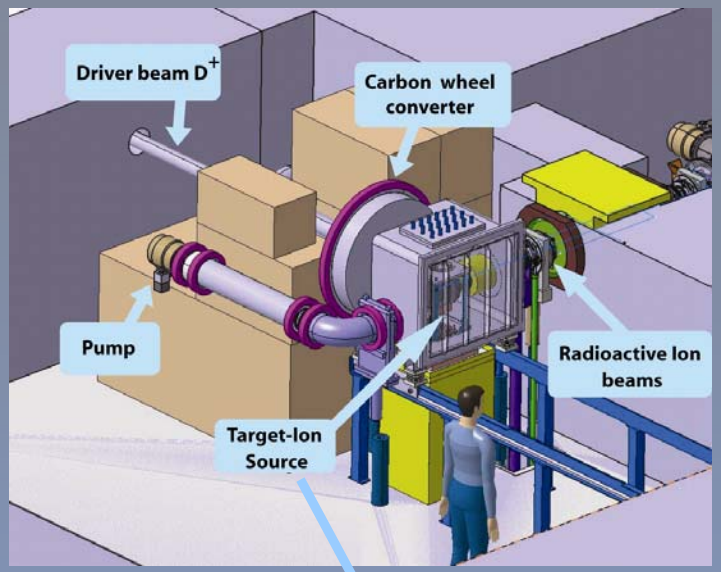
Production of Radioactive Ion Beams
(ISOL method)

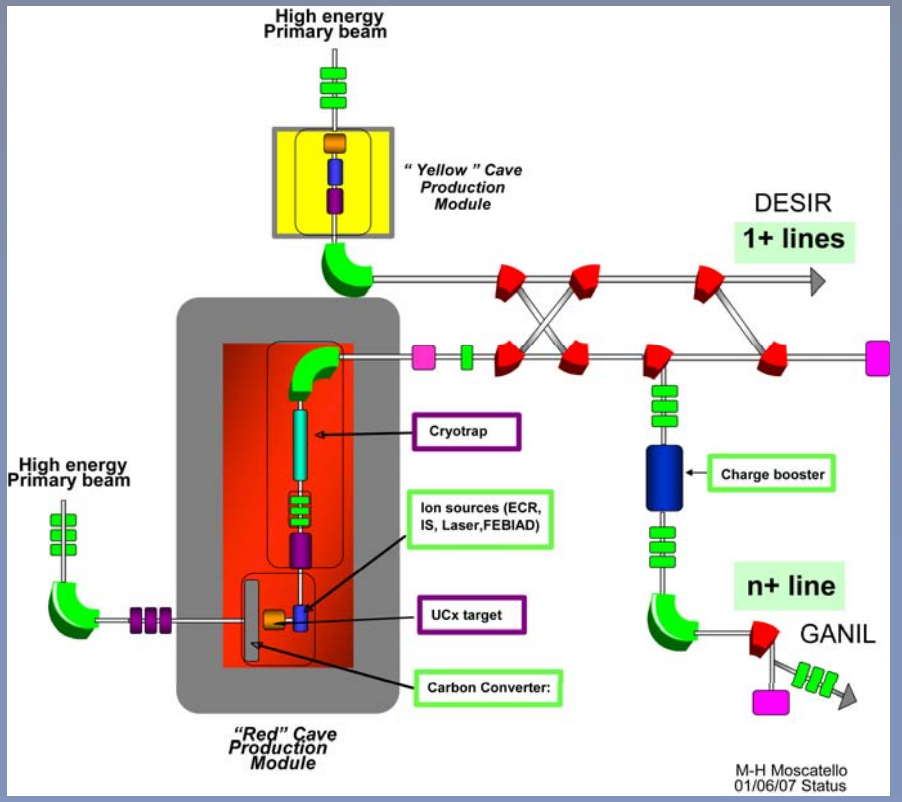
Expected yields: > 10^9 pps for ^{132}Sn

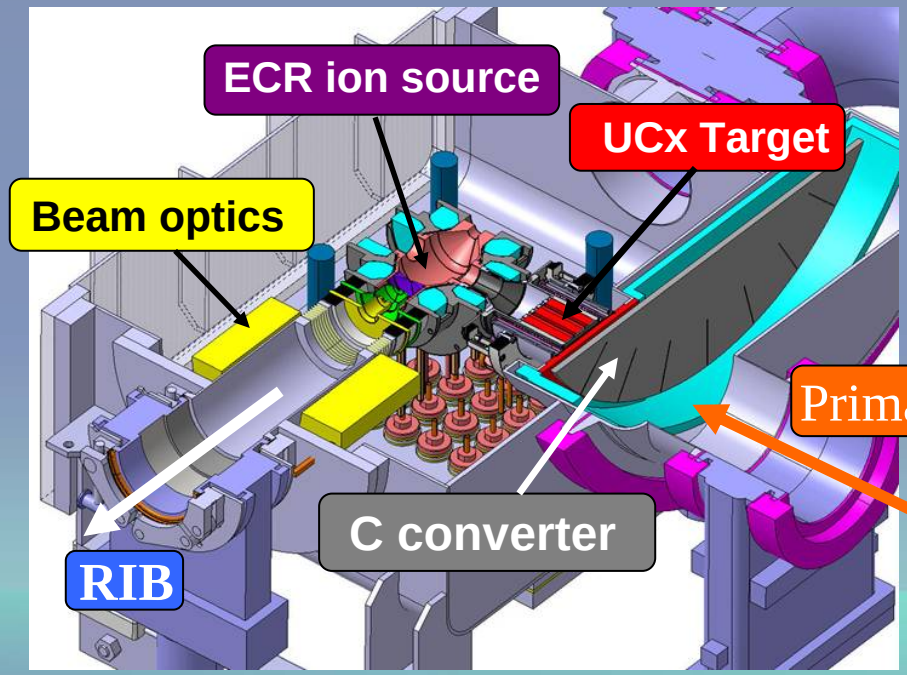
> 10^{10} pps for ^{92}Kr

- direct irradiation of the UCx target with deuteron beams for production of ^{3,4}He, ^{6,7}Li, or ^{12}C

RIB production systems







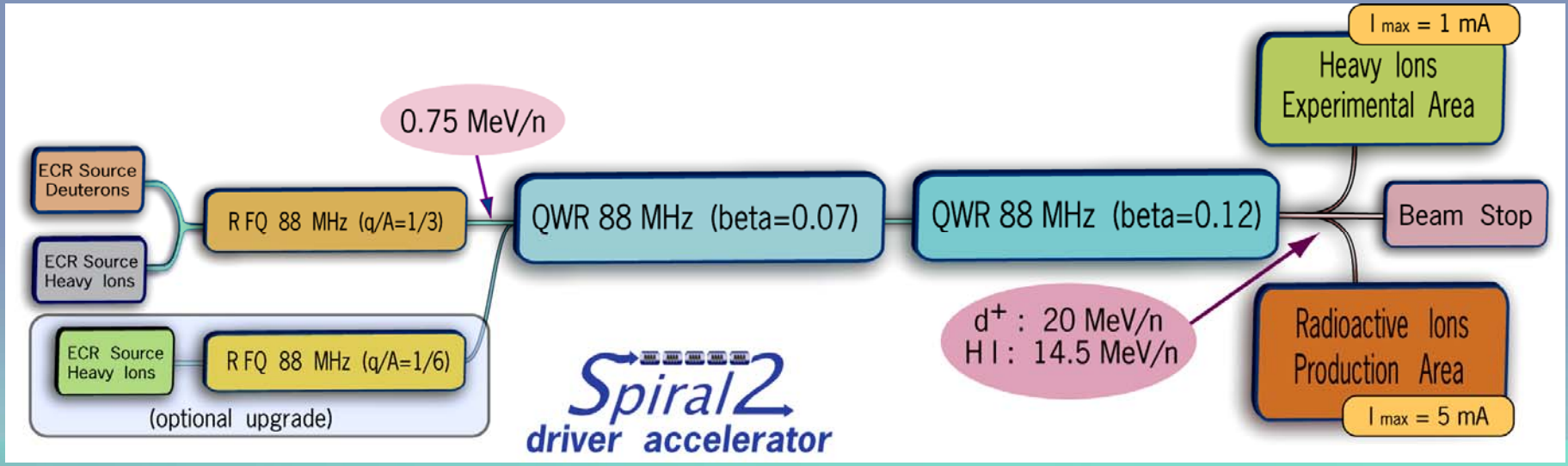
SPIRAL2 DRIVER ACCELERATOR

beam	p+	D+	ions	ions
Q/A	1	1/2	1/3	1/6
I (mA) max.	5	5	1	1
W_o min. (Mev/A)	2	2	2	2
W_o max. (Mev/A)	33	20	14.5	8.5
CW max. beam power (KW)	165	200	44	48

Total length: 65 m (without HE lines)

D^+ : ECR ion source
Heavy Ions: ECR Ion Source
Slow and Fast Chopper
RFQ (1/1, 1/2, 1/3) & 3 re-bunchers

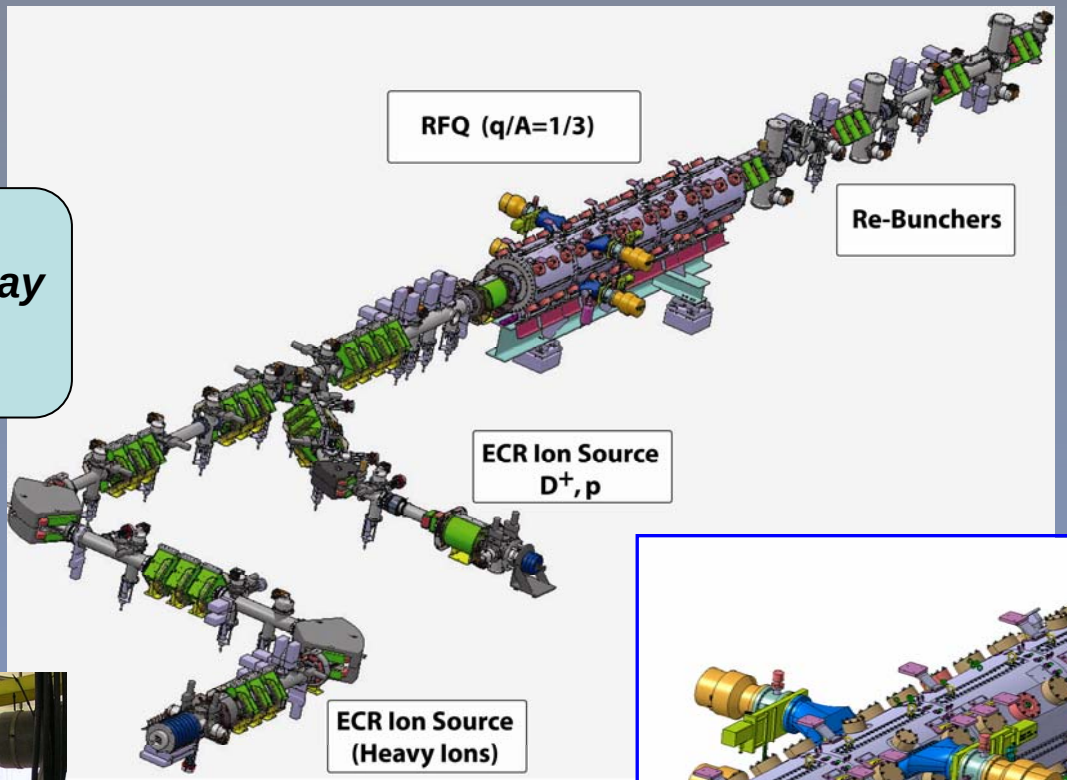
12 QWR beta 0.07 (12 cryomodules)
14 QWR beta 0.12 (7 cryomodules)
1 KW Helium Liquifier (4.2 K)
Room Temperature Q-poles
30 Solid State RF amplifiers (10 & 20 KW)



T. Junquera GANIL & IPNO, France

Spiral2
driver accelerator

Injector (Phase 1):
Task leader : CEA Saclay
Assembly & tests
Saclay 2009-2010

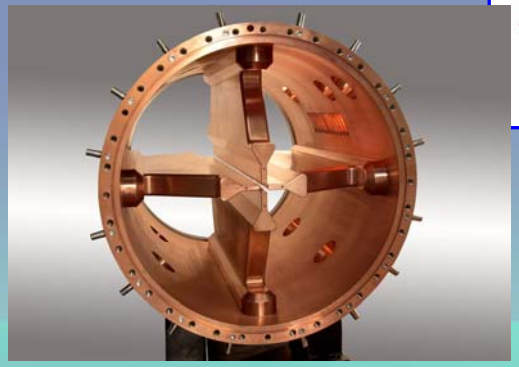


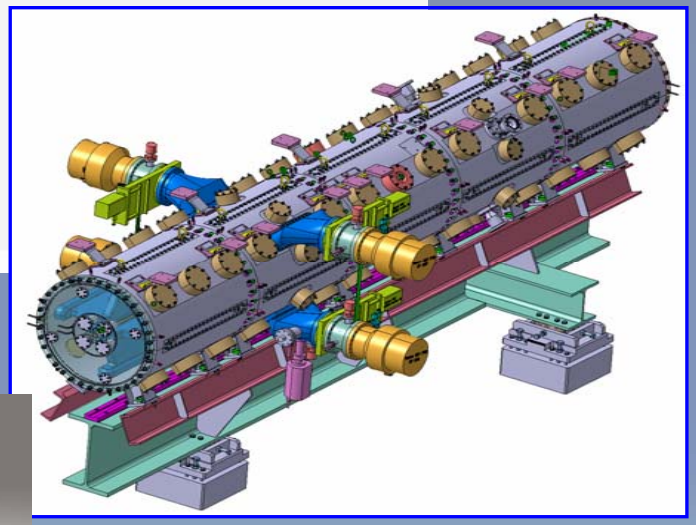
Heavy Ion Source

A-Phoenix

LPSC Grenoble

Test with LEB line 2008





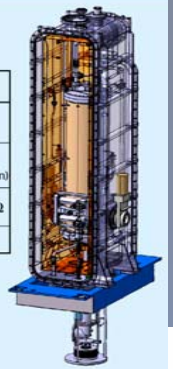
RFQ (q/A: 1, 1/2, 1/3)
88 MHz , length: 5 m
Prototype: tested at full power (2005-2006)

Spiral2
driver accelerator

SC Linac

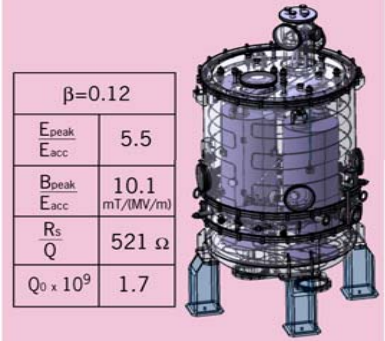
QWR (beta=0.07)
CEA/DSM/DAPNIA
(Saclay)

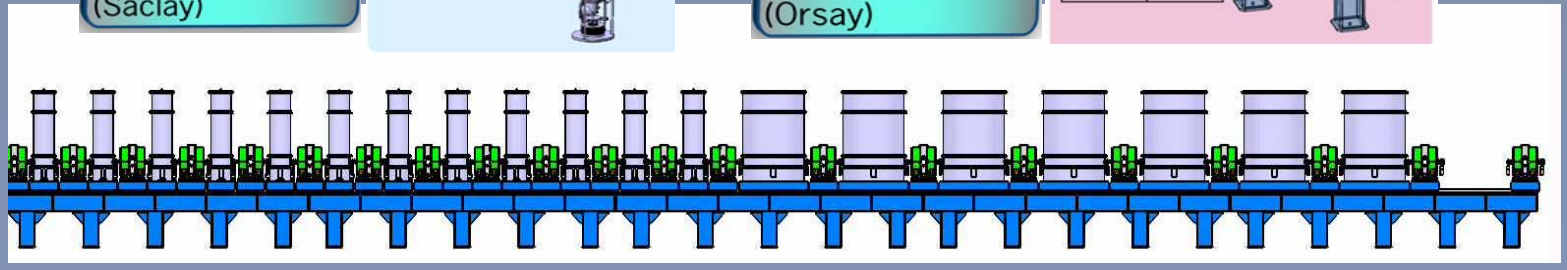
β = 0.07	
$\frac{E_{peak}}{E_{acc}}$	5.0
$\frac{B_{peak}}{E_{acc}}$	8.75 mT/(MV/m)
$\frac{R_s}{Q}$	632 Ω
$Q_0 \times 10^9$	2.2



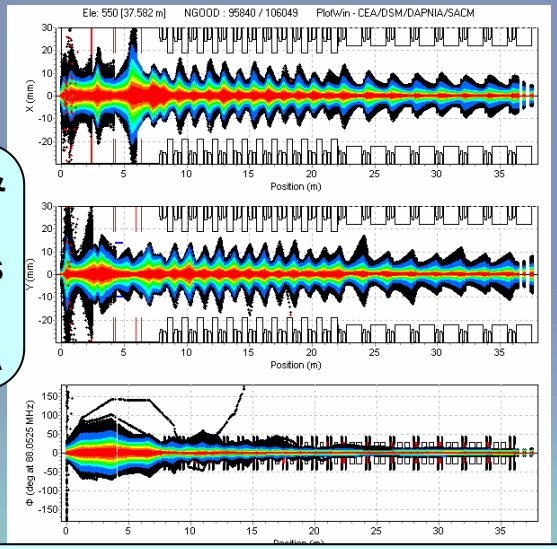
QWR (beta=0.12)
CNRS-IPN
(Orsay)

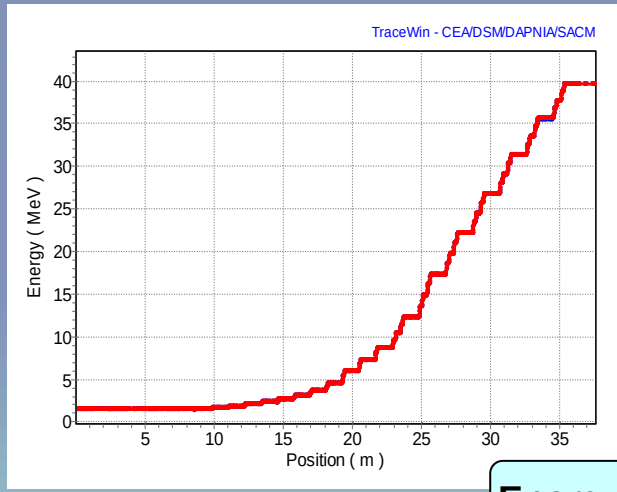
β=0.12	
$\frac{E_{peak}}{E_{acc}}$	5.5
$\frac{B_{peak}}{E_{acc}}$	10.1 mT/(MV/m)
$\frac{R_s}{Q}$	521 Ω
$Q_0 \times 10^9$	1.7





Transverse & Longitudinal Emmittances d+ 40 MeV,5 mA



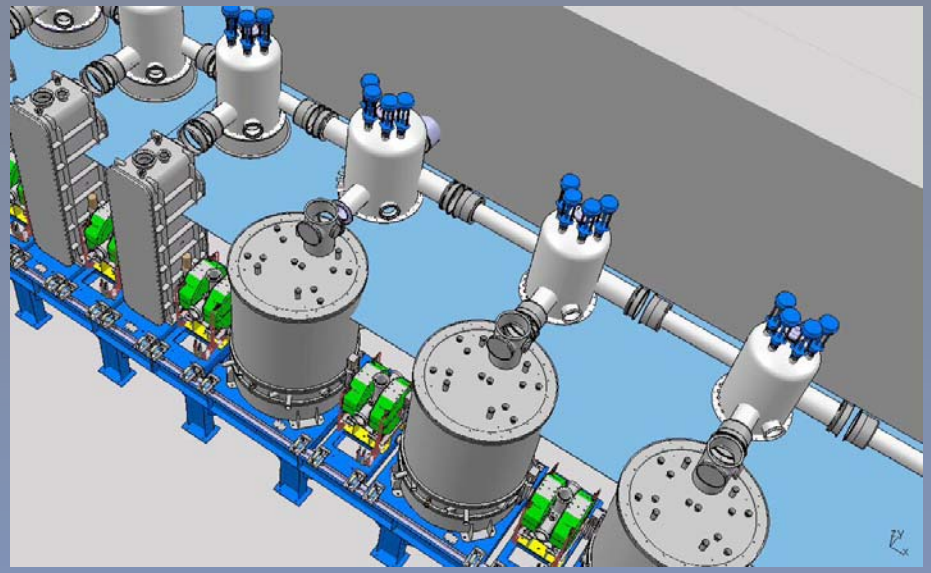


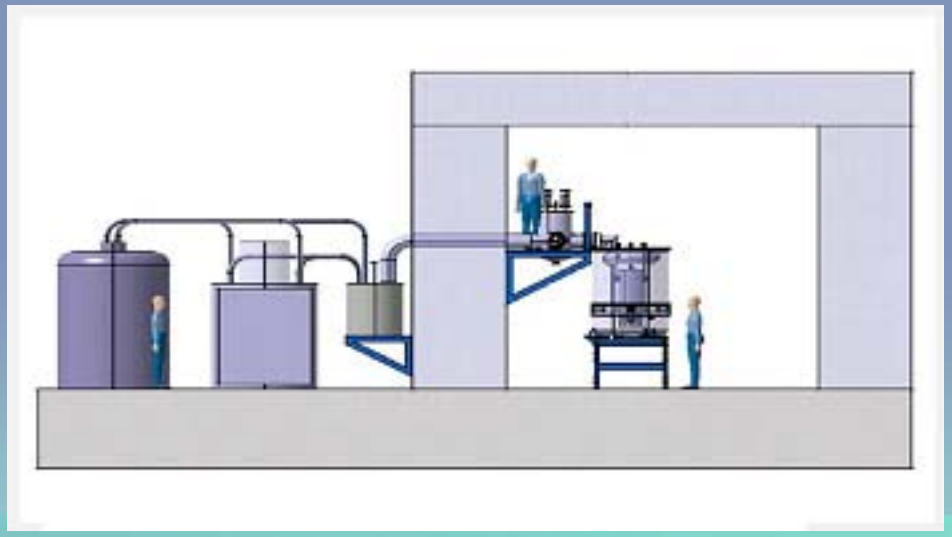
Energy Gain

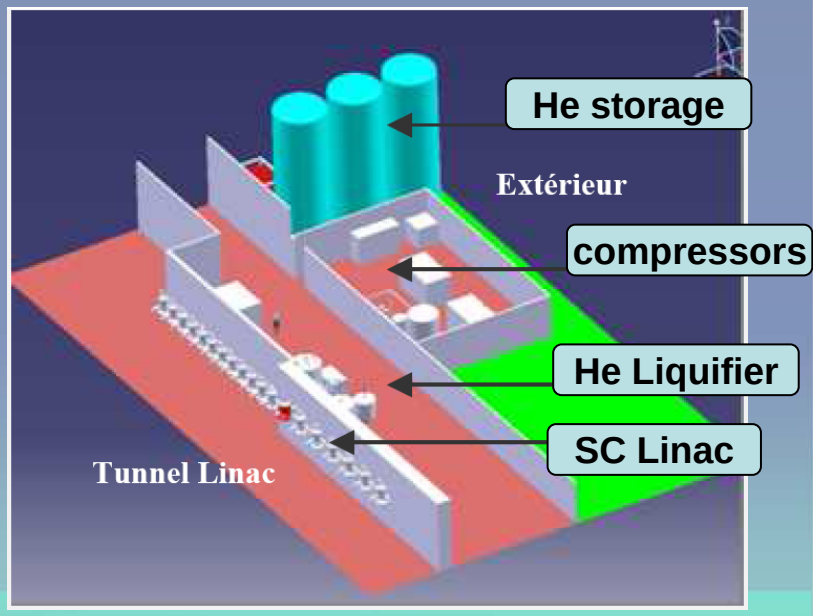
Beam Losses: d+: < 1 W/m

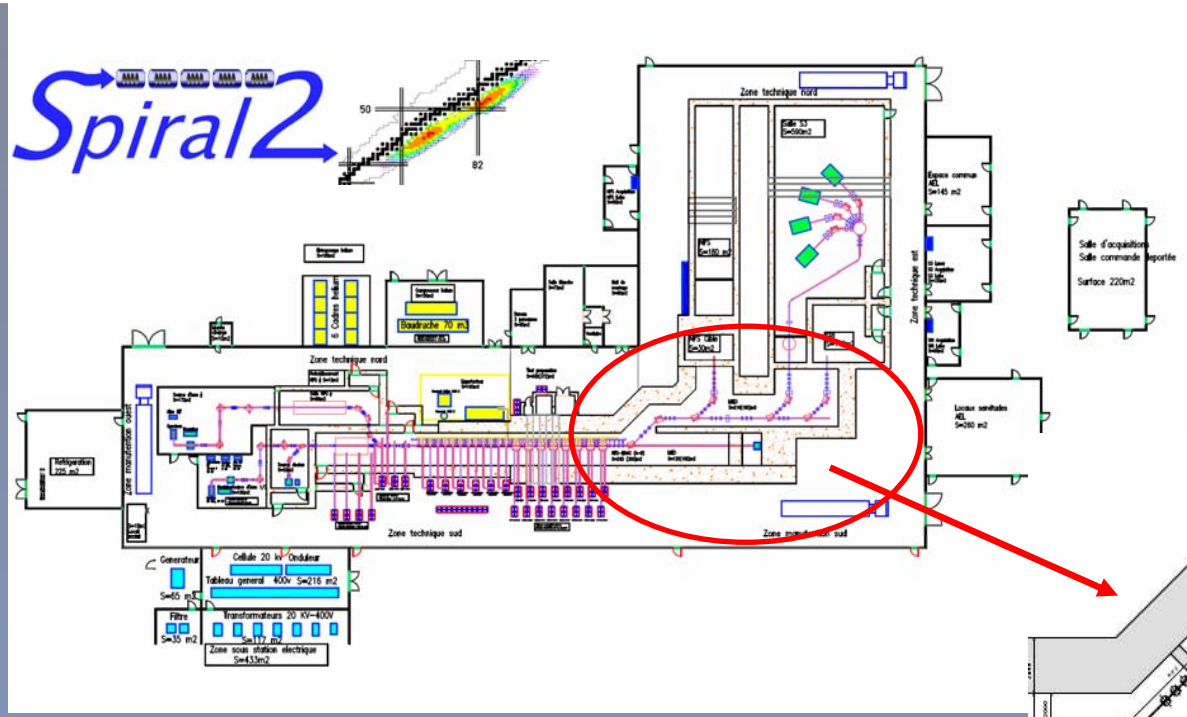
Spiral2
driver accelerator

Cryogenic Systems

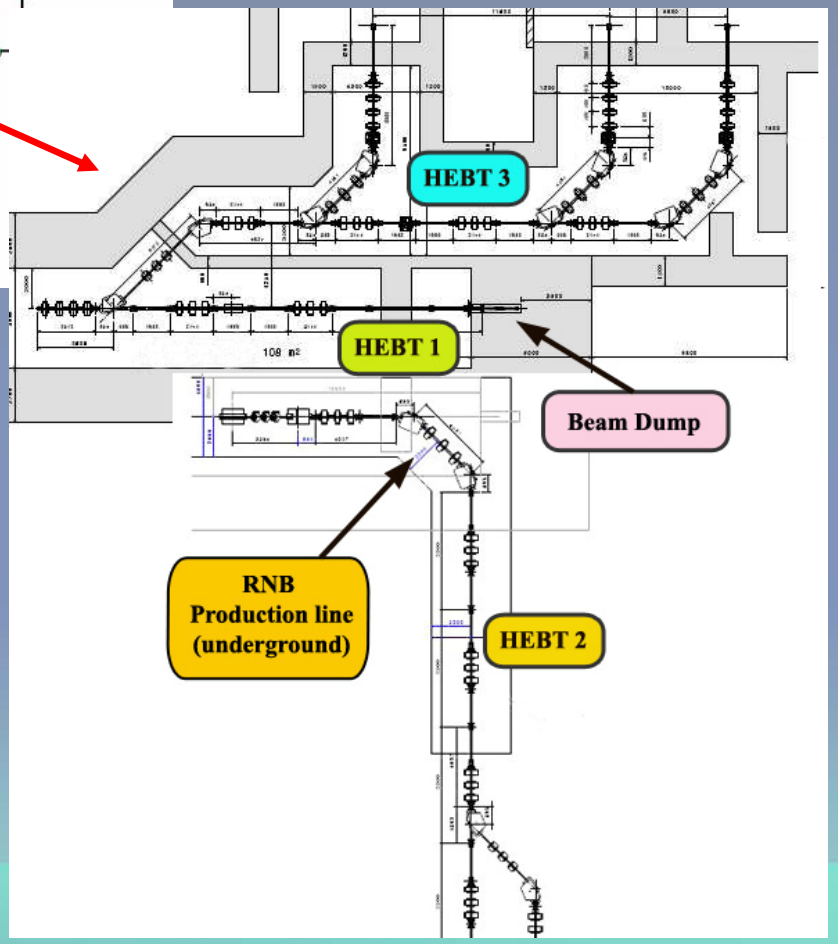








Driver Accelerator & Experimental Areas Building



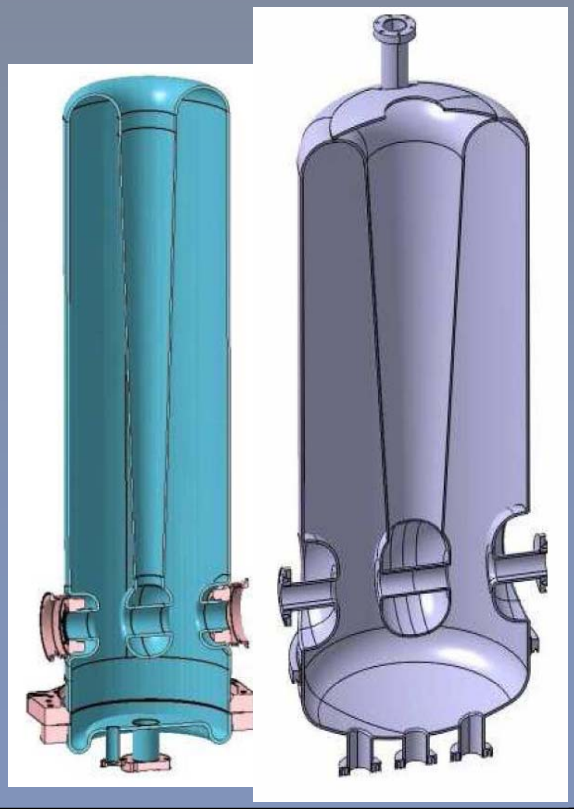
Experimental Areas

(heavy ions and neutrons)

1. S3 (high intensity stable beams)
2. NFS (neutrons for science)
   pulsed beam > 6.10^{12} n/s (14 MeV)
3. Atomic Physics, Condensed Matter, …

T. Junquera GANIL & IPNO, France

PROGRESS on the SUPERCONDUCTING LINAC Construction



QWR A β 0.07	QWR B β 0.12
Proto : 1	Proto : 1
Pre series: 1	Pre-series: 2

Poster: Guillaume Olry

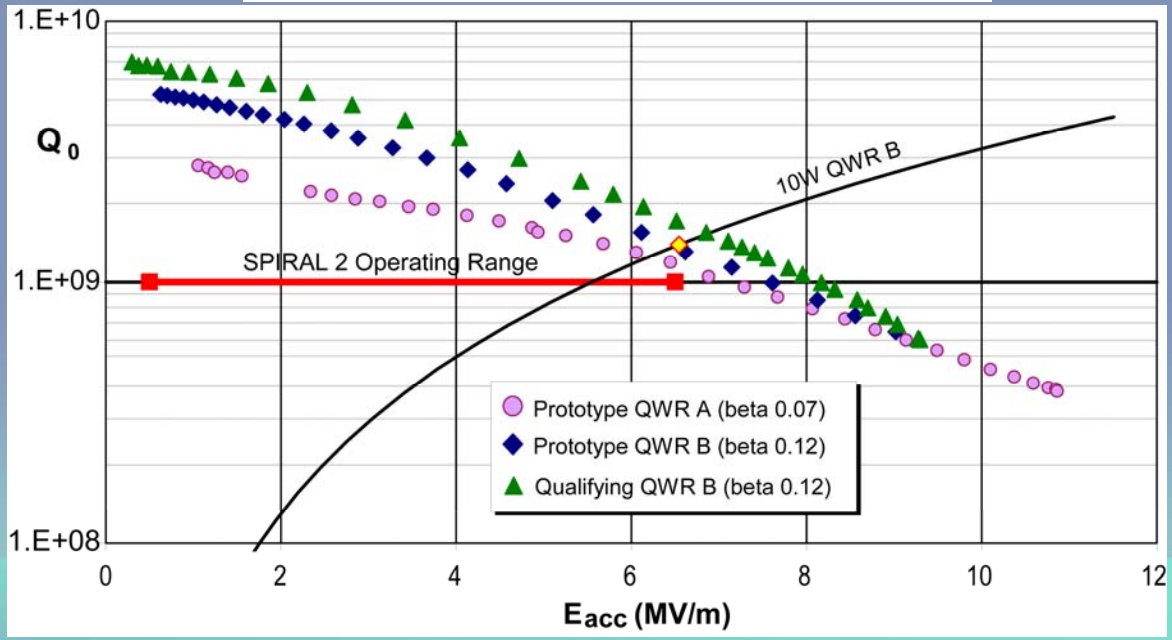
Evolution of the initial design

frequency [MHz]	88.05	88.05
β_{opt}	0.07	0.12
E_{pk}/E_{acc}	5.0	5.6
B_{pk}/E_{acc} [$\frac{mT}{MV/m}$]	8.9	10.2
r/Q [Ω]	632	518
V_{acc} at 6.5 MV/m, β_{opt} [MV]	1.54	2.65
G [Ω]	22.4	38
beam tube ϕ [mm]	30	36
cavity ext. ϕ [mm]	230	380
Q_{ext}	$6.6\ 10^5$	$1.1\ 10^6$

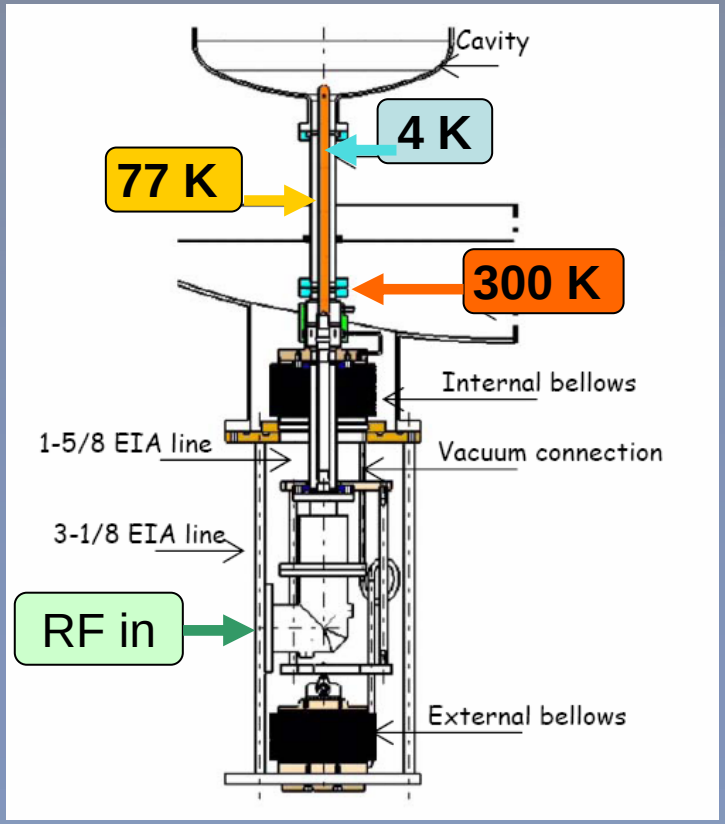
Table 1: characteristics of $\lambda/4$ cavities

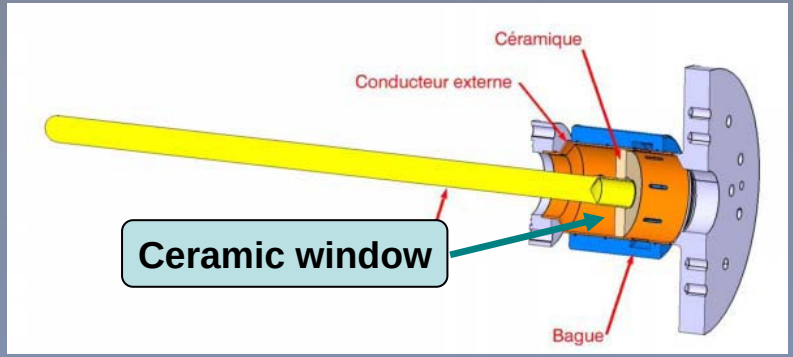
38

44

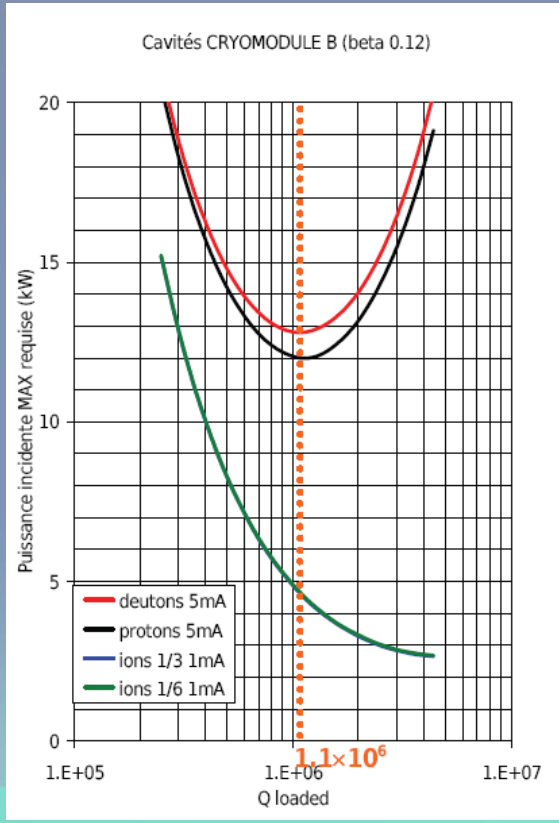


RF Power Couplers



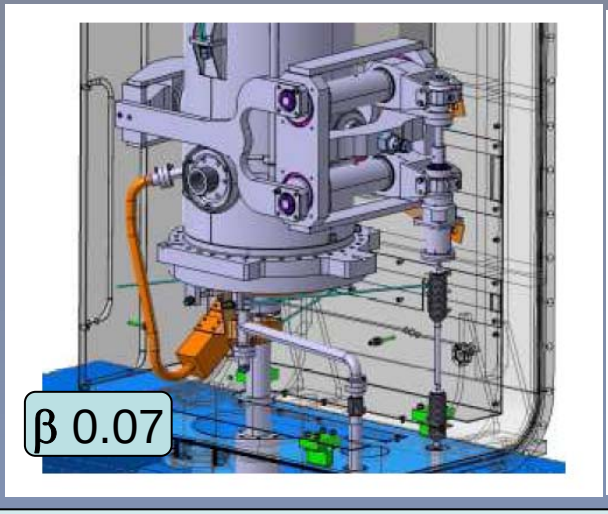


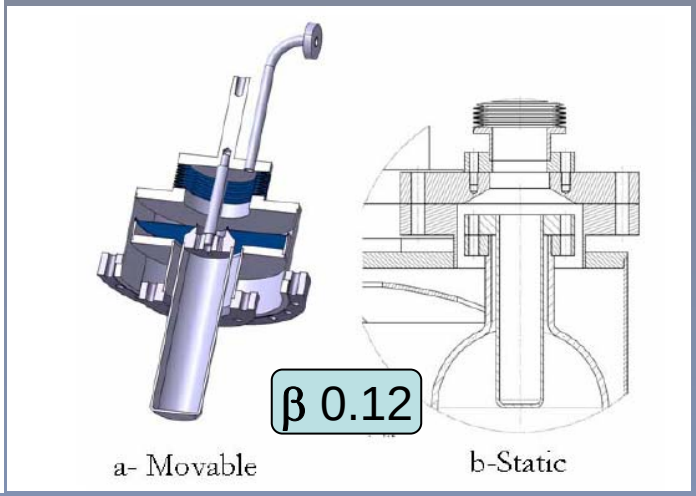
Nominal
RF power
for β 0.12
(5 mA D^+ beam)



details on Poster: Yolanda Gomez

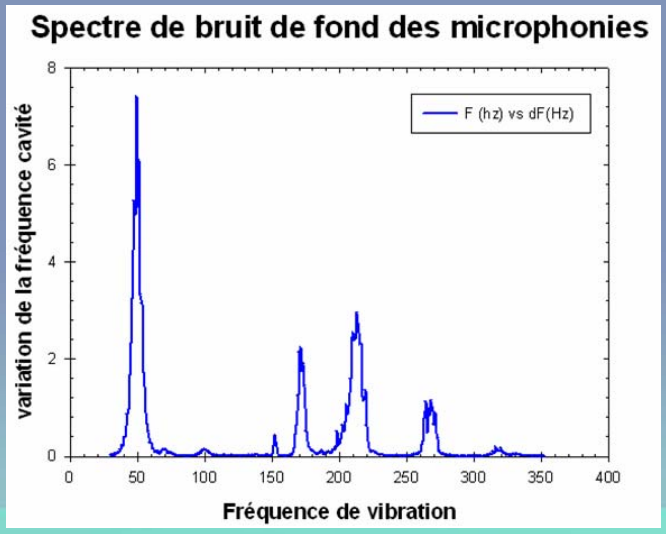
QWR Tuning



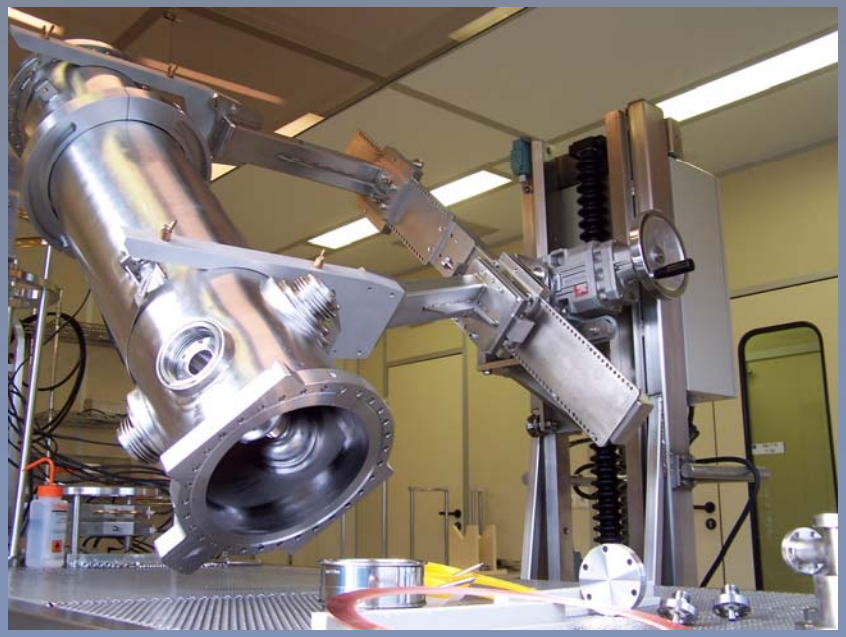


- **β 0.07 : mechanical tuner, QWR body deformation**
- **β 0.12 : plungers on QWR top volume (fixed and movable)**

Vibrations Measurements



Poster : Guillaume Martinet & David Longuevergne



Preparation of the first β 0.07 cryomodule

CEA Saclay

September 2007

Preparation of the first β 0.12 QWRs and couplers

(Clean room)

IPN Orsay

September 2007

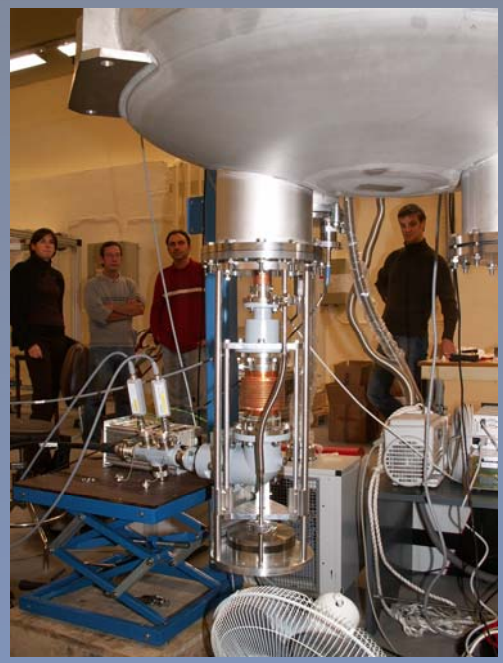
Assembly phases of the first β 0.12 Cryomodule

September 2007

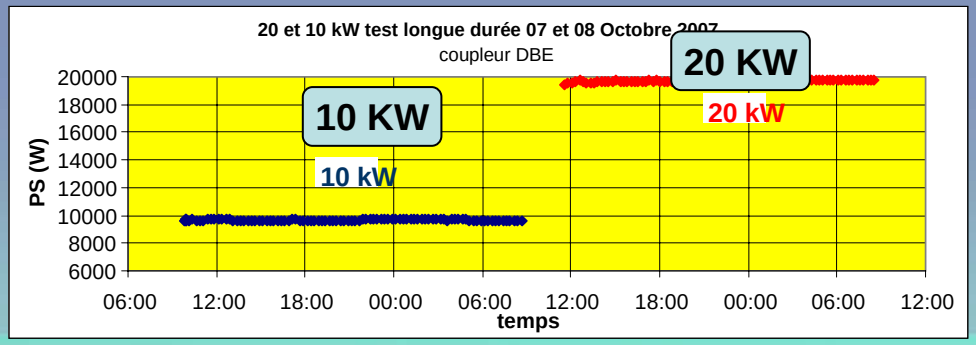
Tests with Cryomodule type B (beta 0.12)

Program for 4th Qr. 2007

1. Coupler at room temperatre (**Poster Yolanda Gomez**) — OK
2. Cryogenic test (transfer lines, valves and static losses)
3. RF tests at 4.2K (low power, high power)
4. Alignement, tuning, vibrations, …



RF Amplifiers Tests (**Poster Marco DiGiacomo**) — OK



… last week

Preparation of the cryomodule test site:

- cryogenic valve box
- alignment support

Tests: October & November 2007

Buildings Construction Phases