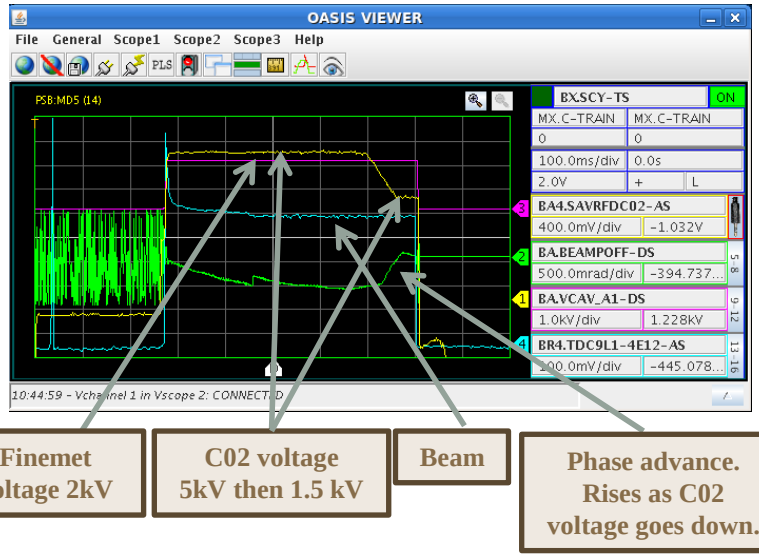
FINEMET® CAVITIES

Status and plan for PSB RF and PS damper during LS1

M. Paoluzzi – BE-RF - 12 April 2013

PSB TESTS in 2012



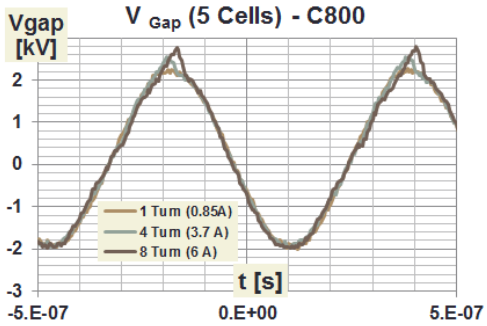
PSB beam acceleration tests:
8 turns injection :
4.6E12 protons – 6A

Finemet voltage 2kV

C02 voltage 5kV then 1.5 kV

Beam

Phase advance. Rises as C02 voltage goes down.



So far the beam did not seem to suffer from gap voltage distortion induced by wake fields.

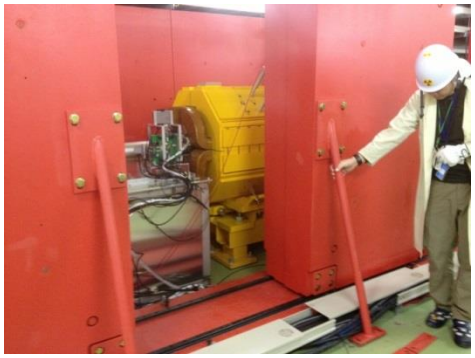
- **Excellent interaction with LL team.**
- **Excellent performances of the new digital LL electronics**
- **Promising results: 60% of maximum present beam current handled by prototype system.**

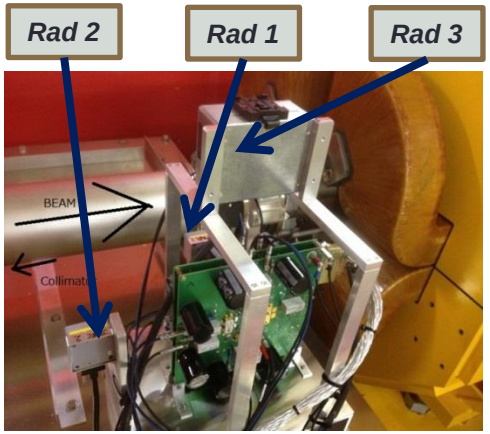
but…

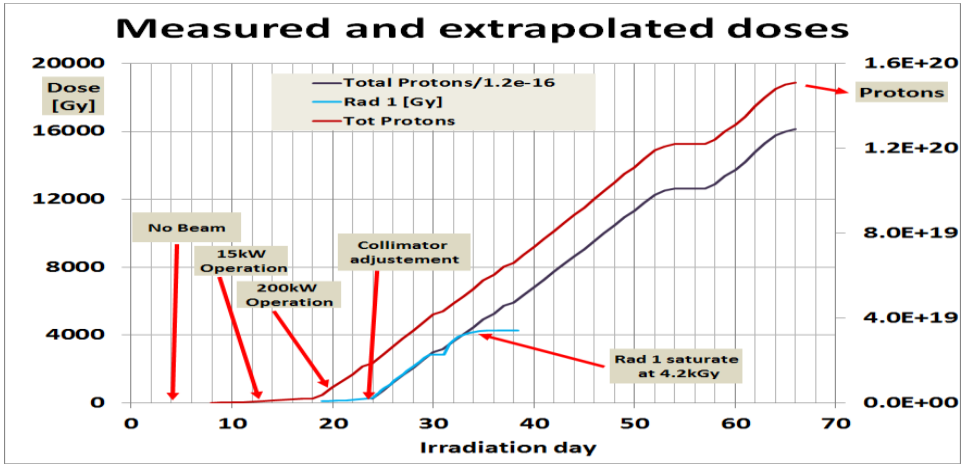
- **System becomes unstable due to coupling of radiation effects and excessive RF feedback loop gain.**
- **Insufficient system parameters monitoring.**
- **Actual achievable voltage limited by saturation effects.**

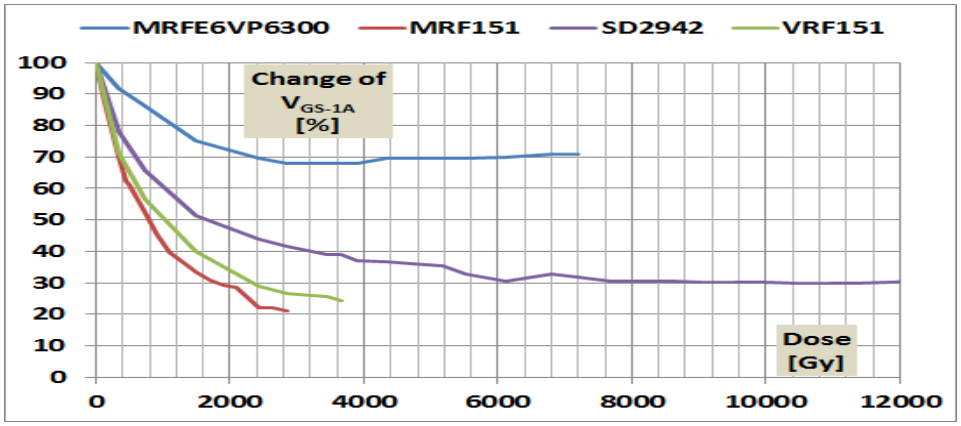
Radiation hardness issue: FETs characterization.

J-PARC MR Collimator









All survive ≈ 2kGy

2012 doses in PSB at Finemet cavities position: ≈ 250Gy

2012 doses in PSB at RF cavities positions: < 30Gy

2012 doses in PS SS2 (Longitudinal Damper): ≈ 1kGy

Second measure campaign at J-PARC in June to:

build up some statistics on VRF151 and MRFE6VP6300 and address single events sensitivity.

Goals for LS1

PSB

Upgrade the Finemet prototype system for full beam tests in 2014 in view of a final choice to be made in 2015 and to be implemented during LS2.

C02 : 0.6 to 1.8 MHz

C04 : 1.2 to 3.6 MHz

7-8 kV

Beam handling to ~10A

PS

Design, manufacture and install a Finemet based longitudinal damper in SS2. The system is expected to be operational at restart after LS1.

0.5 to 5 MHz

5 kV

Beam handling to ~ 30 A

Upgrade existing system to 10 cells.

Devise a compensation method to cope with radiation effects.

Cure weaknesses and improve performance of the amplifier.

Design the damper kicker.

Design a dedicated shielding for the amplifiers in the PS.

Amplifier: cures and improvements.

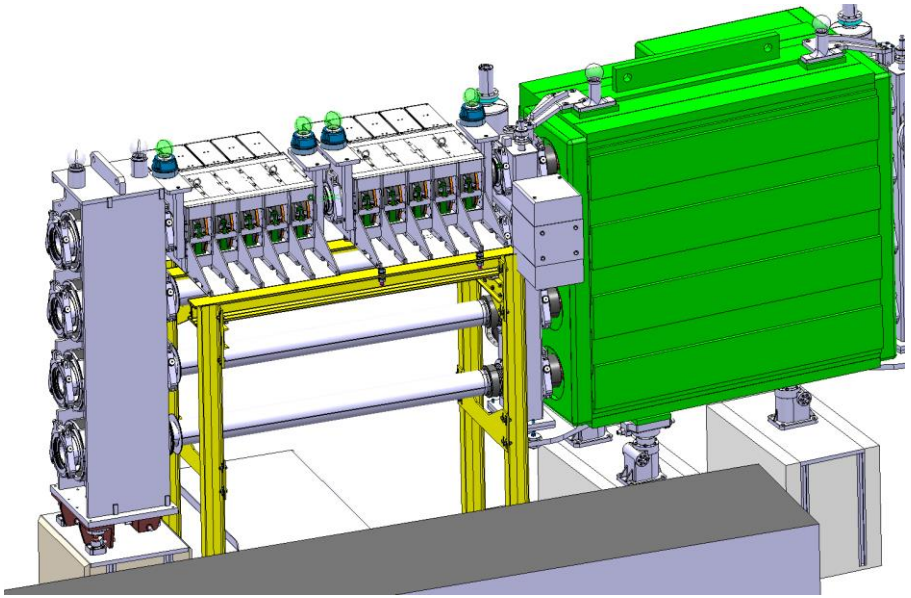
- **Second amplifier version with differential output (PSB) and:**
  - **Optimized supply to achieve nominal gap voltage (700 V 2x1.25 kW) .**
  - **Remote gate bias adjustment for compensation of bias point drifting effects due to radiation.**
  - **Reduced RF feedback loop gain to improve stability.**
  - **Cavity bandwidth limitation for a passive wake fields reduction.**
  - **New monitoring electronics for individual FET current observation.**

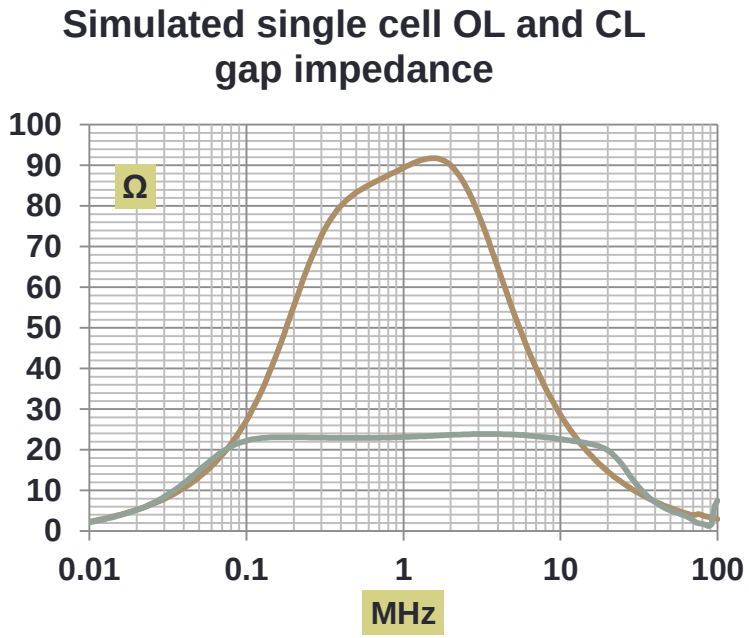
- **Third amplifier version with single ended output (PS) to:**
  - **Increase output voltage (800 V to 1kV) and power (2.5 kW).**
  - **Cavity cell driven by two amplifiers.**
  - **Remote gate bias adjustment for compensation of bias point drifting effects due to radiation.**
  - **Reduced RF feedback loop gain to improve stability.**
  - **Cavity bandwidth limitation for a passive wake fields reduction.**
  - **New monitoring electronics for individual FET current observation.**

PSB Cavity.

Second 5-cell system in construction after minor modifications.

System will be installed aside existing one on the same support.



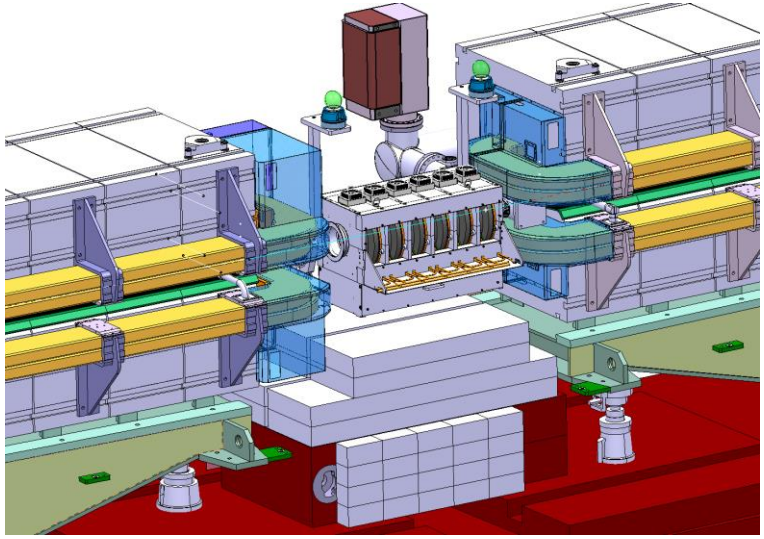


PS Longitudinal damper cavity.

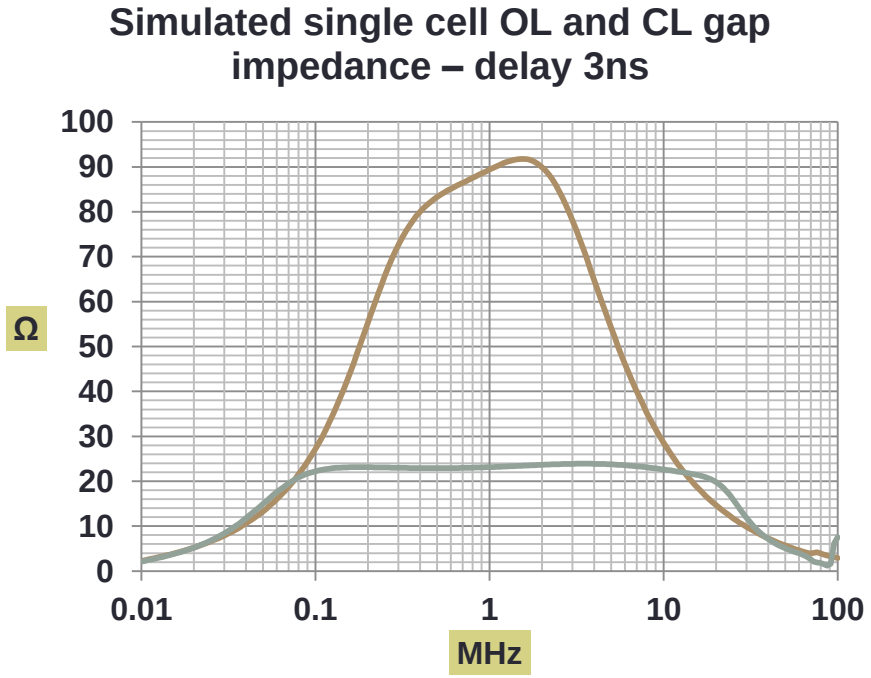
With the upgraded single ended amplifier, six cells are required to achieve 5 kV.

To extend FETs lifetime the received dose has to be limited by shielding.

40 cm of steel will reduce the dose by a factor >20 bringing the expected lifetime above 20 years.



Moving the amplifiers on the ground introduces about 3 ns delay. This has little influence on performance.



Status / Planning

The Finemet rings have been purchased.

- ***Delivery May.***

The second PSB cavity is in production.

- ***Delivery May.***
- ***Assembly and testing from summer.***

The PS longitudinal damper cavity has been designed and is in production.

- ***Delivery June.***
- ***Assembly and testing from summer.***

Amplifiers, ITL, ancillaries and cabling defined and on going.

- ***Amplifiers delivery from June.***
- ***Cabling from June.***

PS Longitudinal damper shielding designed.

- ***Approval from concerned services in discussion.***

Installation foreseen by end 2013.

Testing and running-in from January 2014.