

15th ESLS-RF Workshop
October 5-6
E.S.R.F.

Accelerator Upgrade

L. Farvacque
Accelerator & Source Division



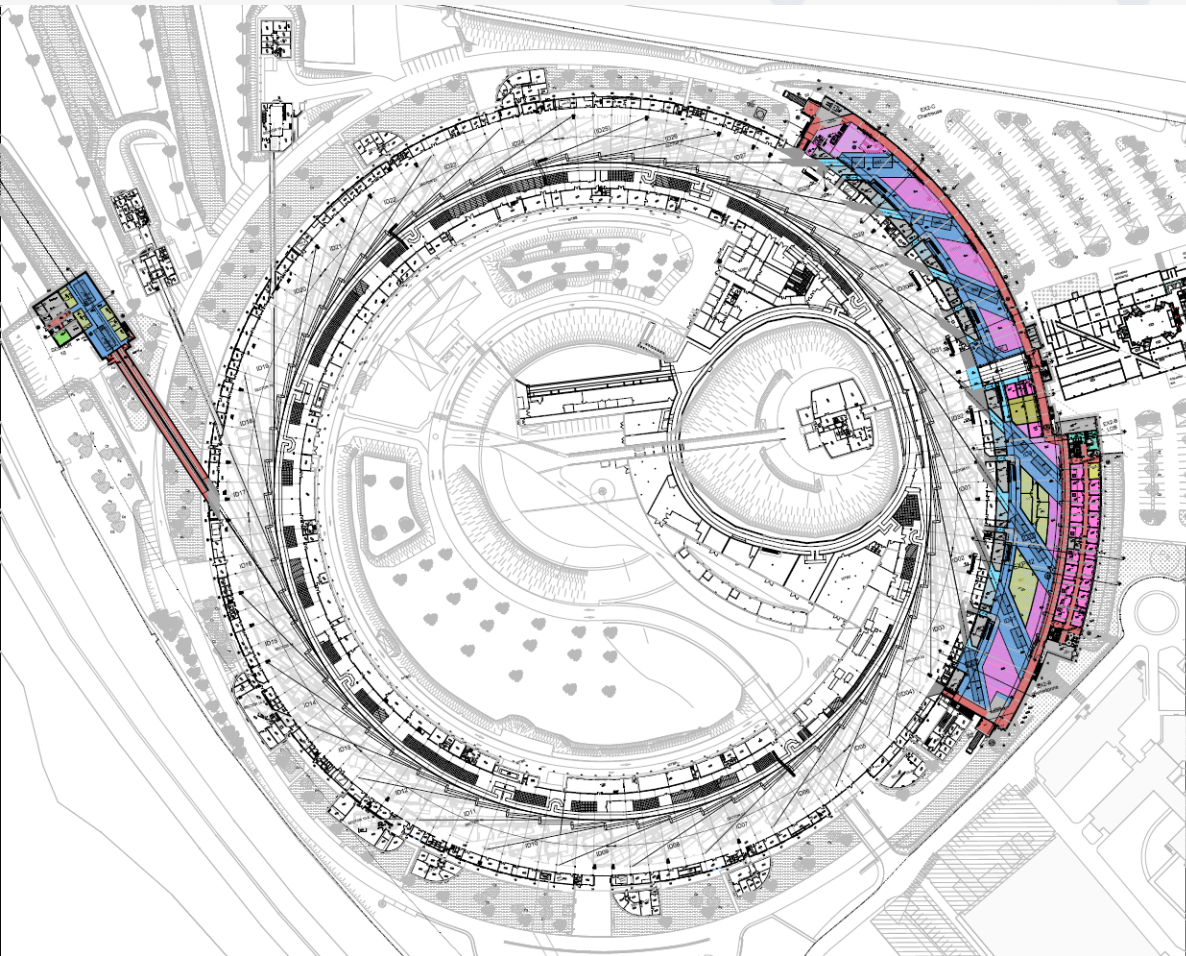
Pascal Elleaume

École Normale Supérieure de Physique (Ulm)

- 1984: Thesis : «Laser à électrons libres sur l'anneau de collision d'Orsay» (Y. Petroff, Y. Farge)
Design of the Super-ACO FEL
- 1986: ESRF: Head of the Insertion Device Group
- 2001 : ESRF: Director of the Accelerator & Sources Division
- 19/03/2011: Accidental death in the French Alps at 55

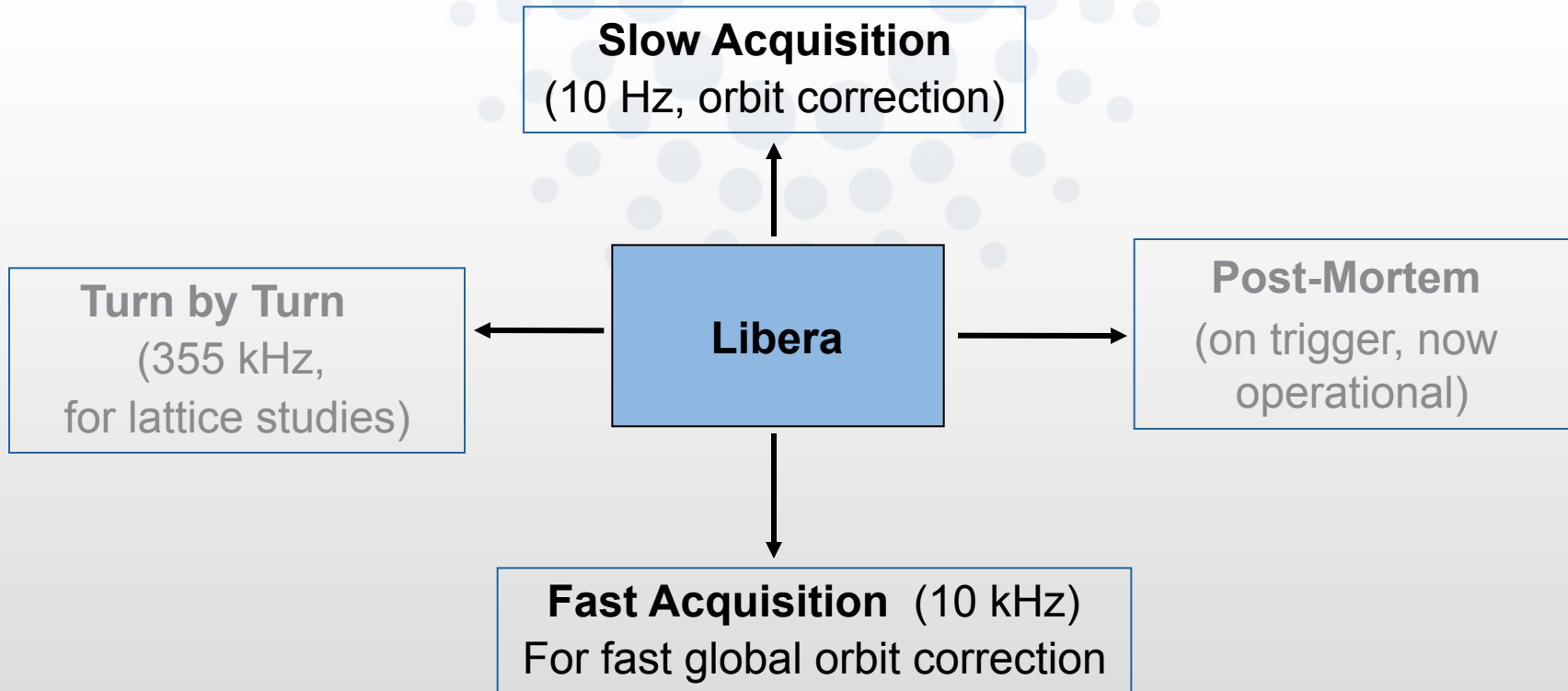
Pascal was the initiator of the accelerator upgrade

Longer beamlines
Increased capacity



Beginning of works:
October 2011

- Upgrade of BPM electronics
 - Improvement of the beam position stability
 - Coupling reduction
 - New position feedback
- 6 m long straight sections
 - No change in magnet lattice
 - Canted straight sections
- 7 m straight sections
 - Lattice symmetry breaking
 - New magnets necessary
- Cryogenic in-vacuum undulators
- Diagnostics developments
- New RF Transmitters
- New RF Cavities



Sum signal of the 4 buttons:

- Lifetime monitor
- Instant Fractional-Beamloss monitor

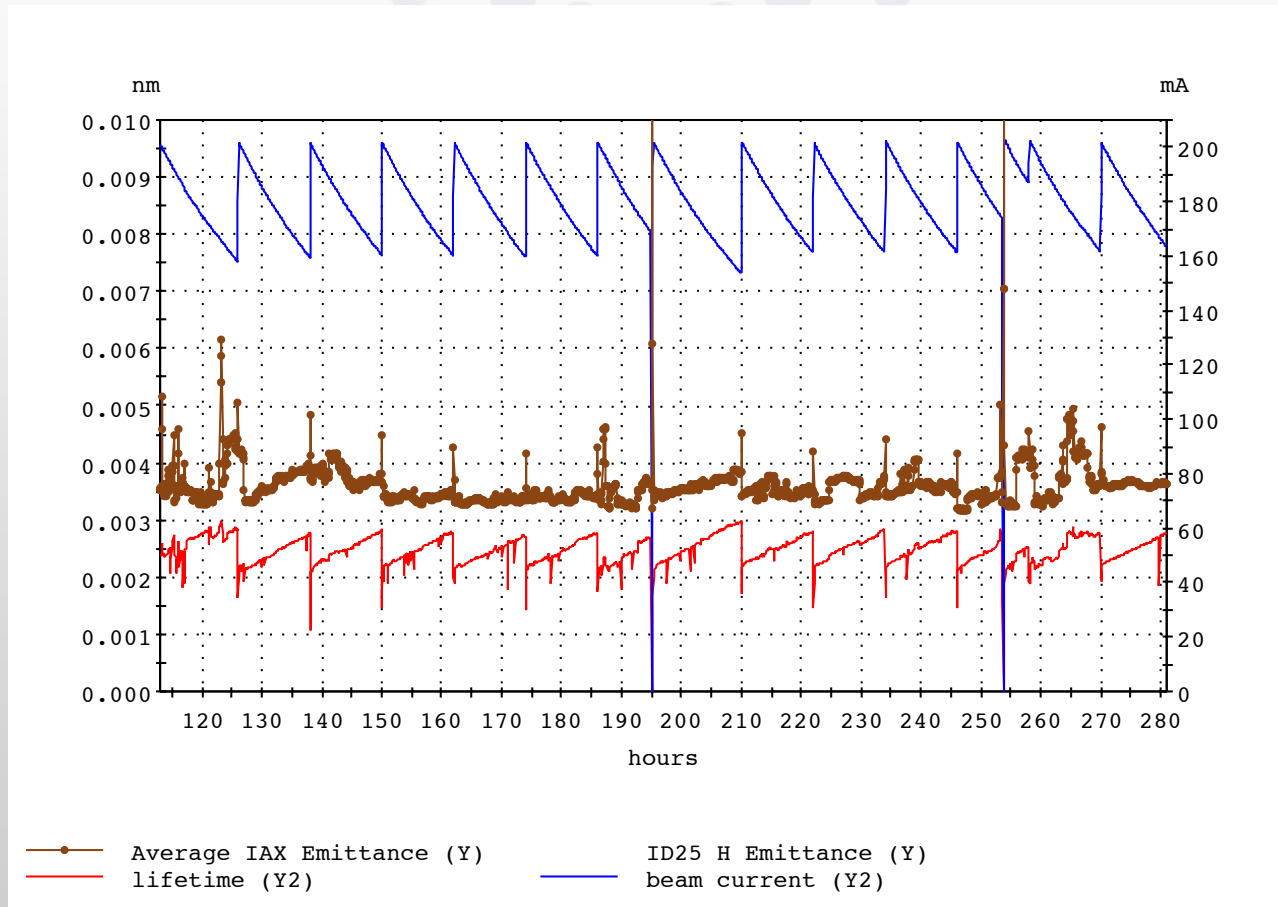
- Achieving lower coupling
 - Better resolution of the response matrices → better model
 - New correction method: minimization of Resonance Driving Terms
 - Increased number of skew quad correctors: 32 → 64

Down to 3.5 pm

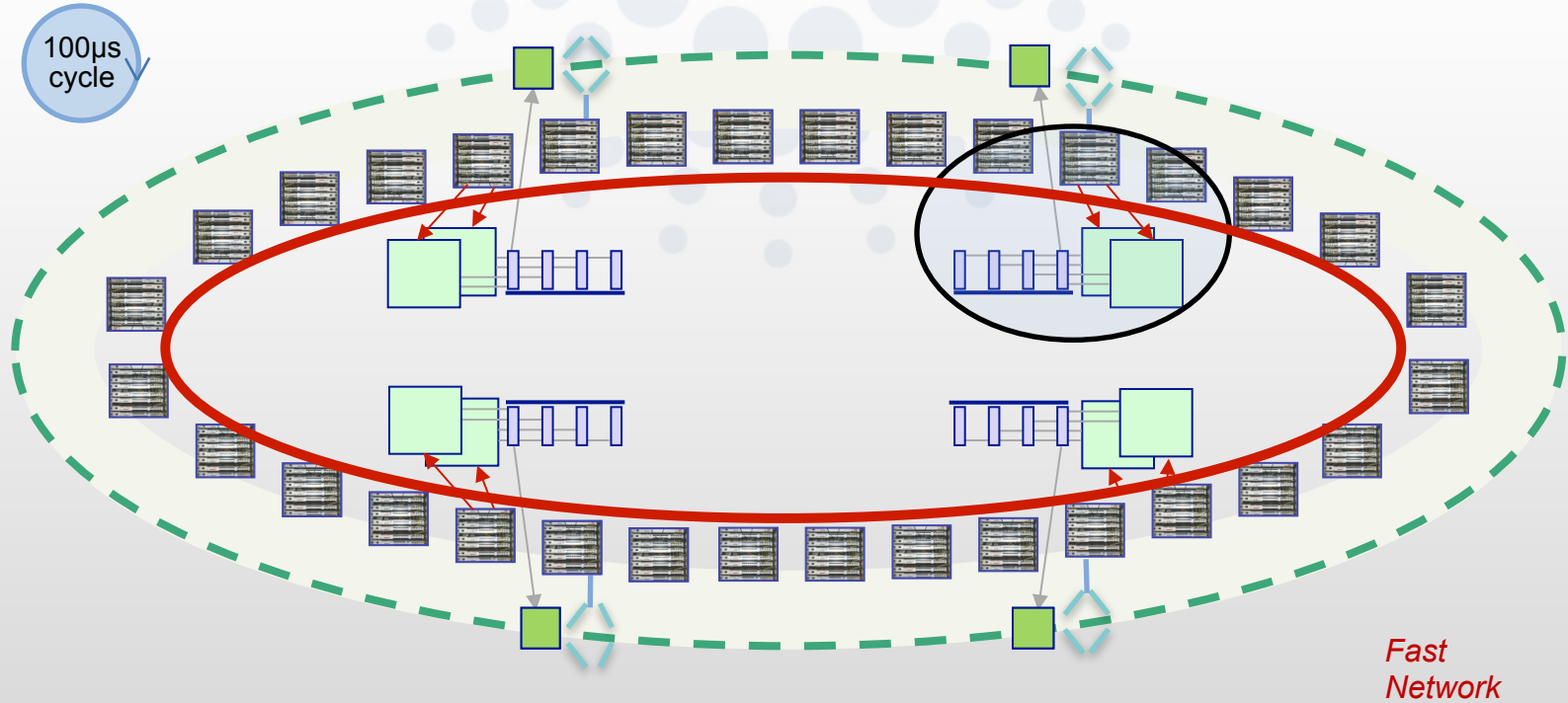
- Maintaining small coupling
 - ID gap variations with magnetic field errors induce varying contributions to coupling (in-vacuum undulators)
 - Local correction of ID magnetic field errors
 - 2 skew quad correctors, lookup table
 - Automatic periodic retuning of the correction

$4 \text{ pm} < \varepsilon_z < 5 \text{ pm}$ on medium term (1 week)

- Maintaining low emittance during USM: 1 week delivery



- Present
 - Slow feedback: 224 BPMs, 96 steerers, every 30 s
 - Fast feedback: 32 dedicated BPMs, 32 dedicated steerers
 - The fast feedback uses few monitors and steerers
 - The combination of 2 systems is delicate
- Future
 - Single system from DC to 200 Hz
 - All Libera BPMs
 - All the standard steerers (integrated in the sextupoles) up to 200 Hz
 - New power supplies
 - 10 kHz operation
 - Much better correction of the orbit distortion induced by IDs



 One of the 224 Beam Position Monitors

 Group of 7 Libera BPMs per cell

 4 cabinets each containing 18 corrector channels

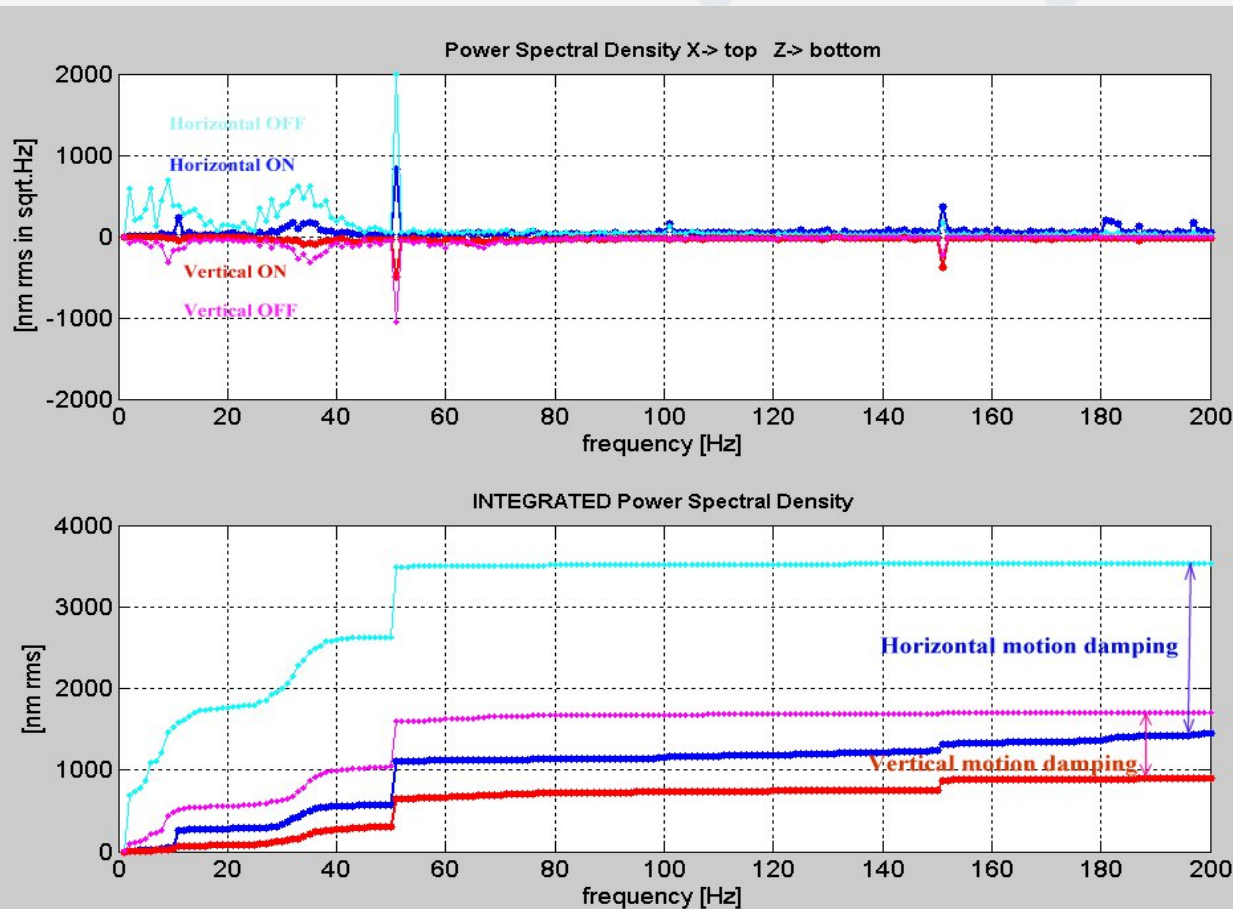
 One of the 8 Feedback Processors

 One of the 96 sextupoles housing the correctors

27/09/2011

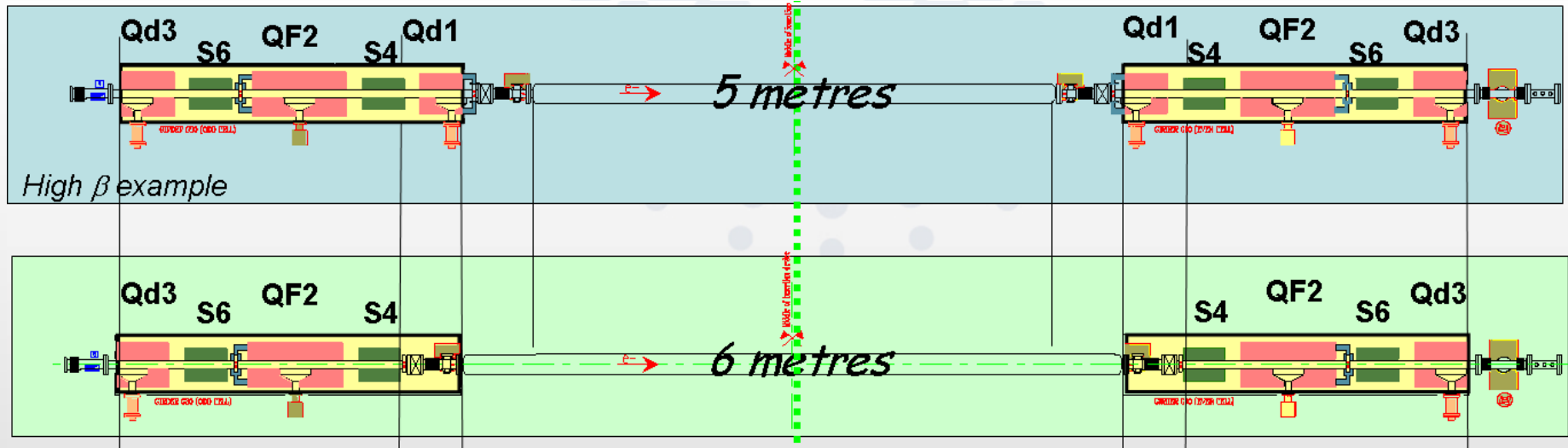
224 BPMs / 96 steerers

Average over 224 BPMs



Horizontal OFF

Vertical OFF
Horizontal ON
Vertical ON

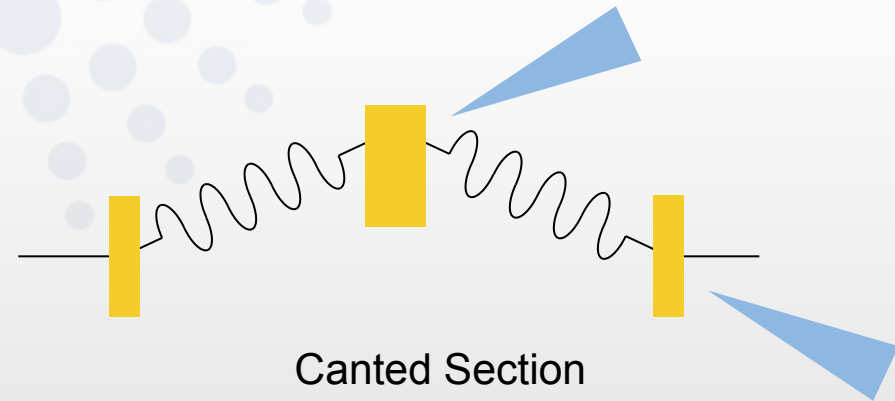


No change in optics
New vacuum chambers

- 6 m section no canting
 - **Standard**
 - ID18, ID24 , ID20 , ID14
 - **With 2.5 m in-vacuum undulator**
 - ID6
- 6 m Large Angle canting
 - ID30 (± 2.2 mrad)
 - ID16 (± 2.7 mrad)

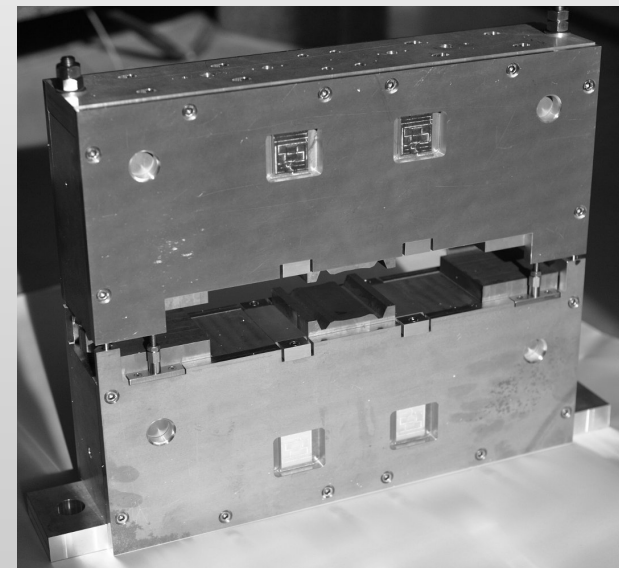
Permanent Magnet Steerers

- Homogeneous field integral
- Low fringe field
- 11 Steerers manufactured
- Magnetic measurements

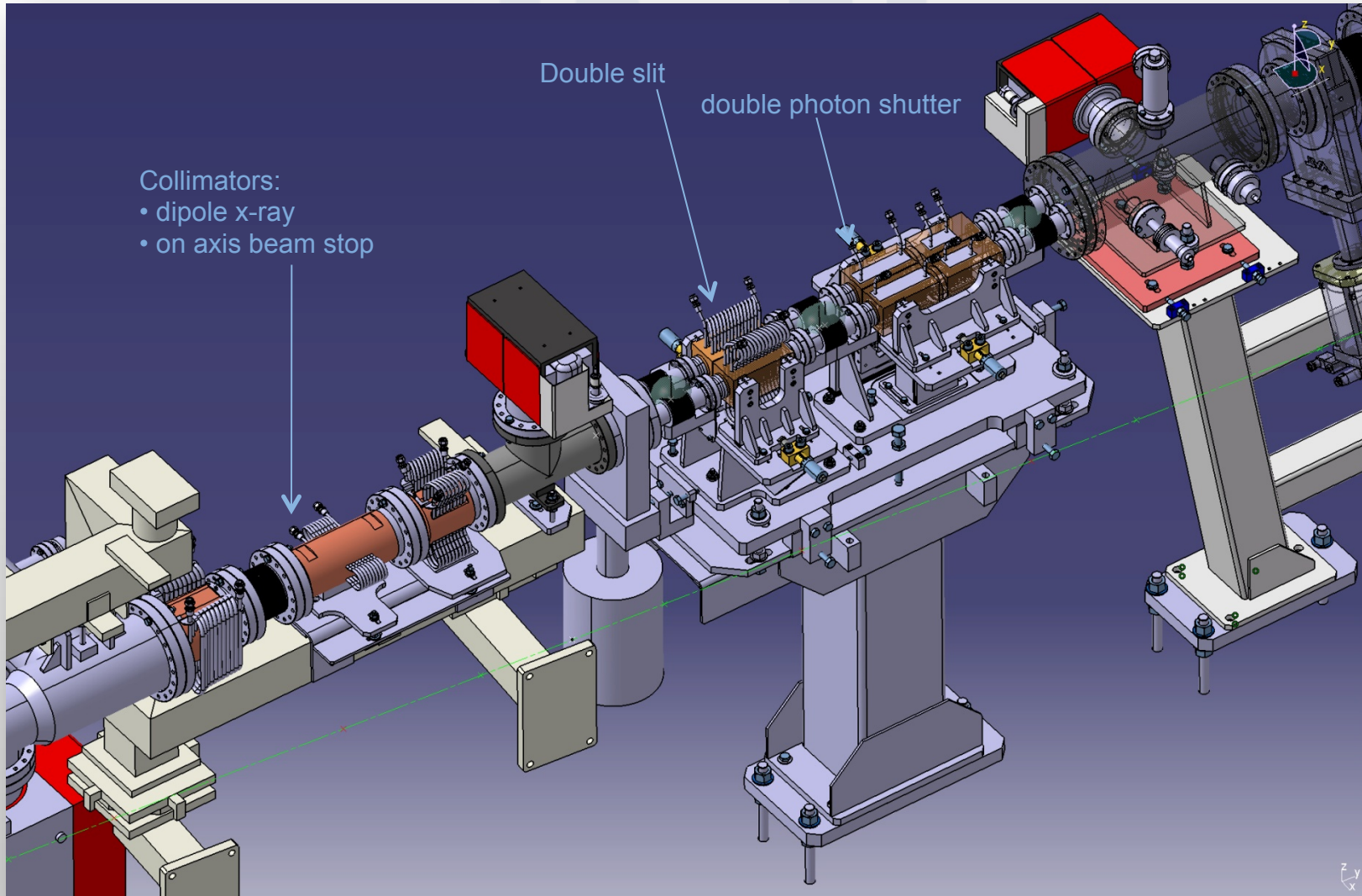


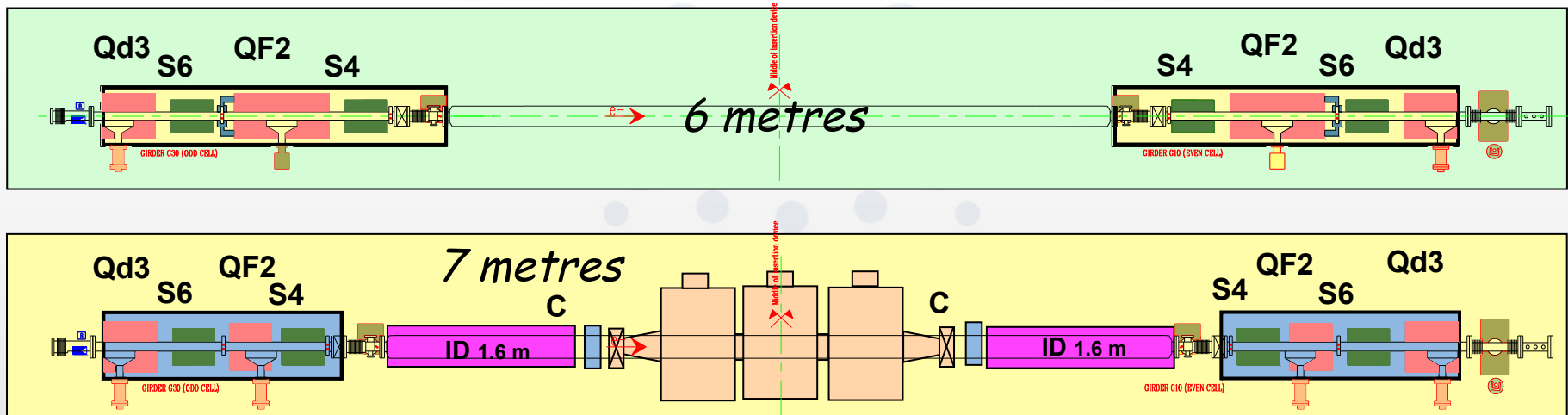
Steering angles in [mrad]

| | | | |
|------|-------|------|-------|
| ID16 | -2.70 | 5.40 | -2.70 |
| ID18 | -1.2 | 2.71 | -1.51 |
| ID23 | -0.75 | 1.5 | -0.75 |
| ID30 | -2.2 | 4.4 | -2.2 |



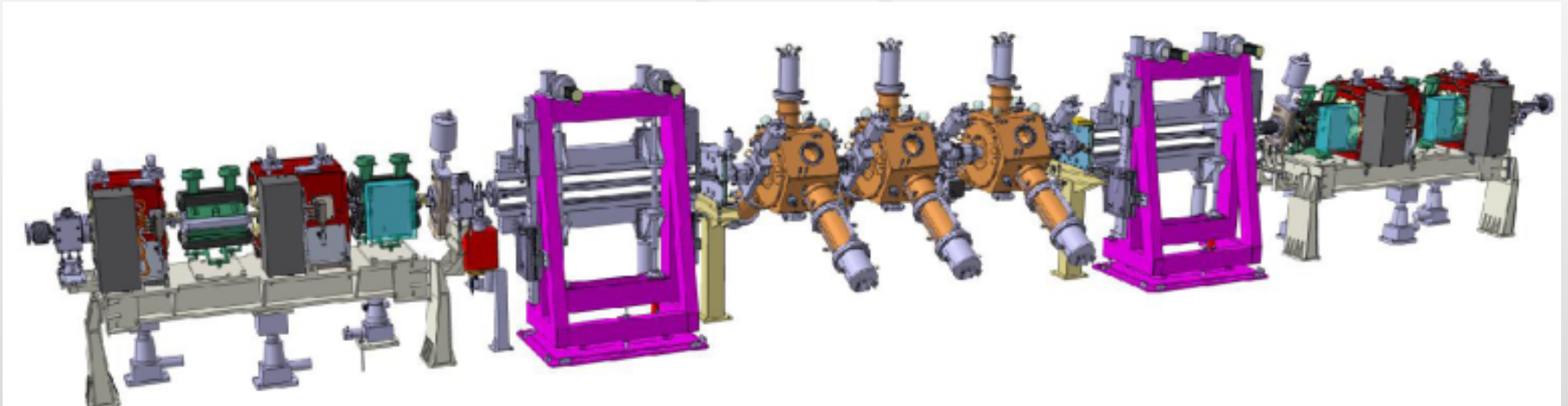
2.70 mrad End Steerer

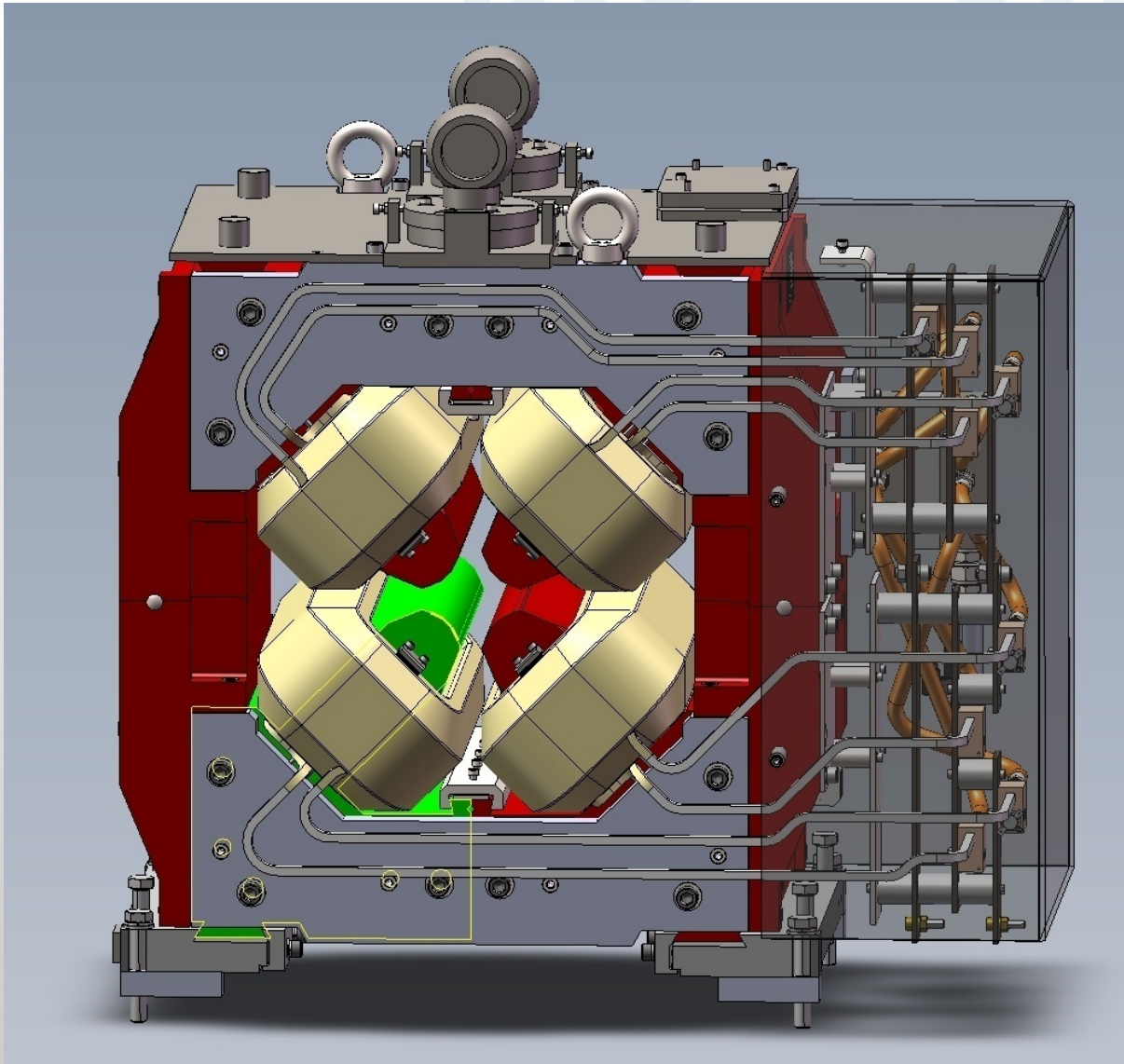




- New girders
- New quadrupoles
- Individual power supplies
- New vacuum chambers
- 1st symmetry breaking

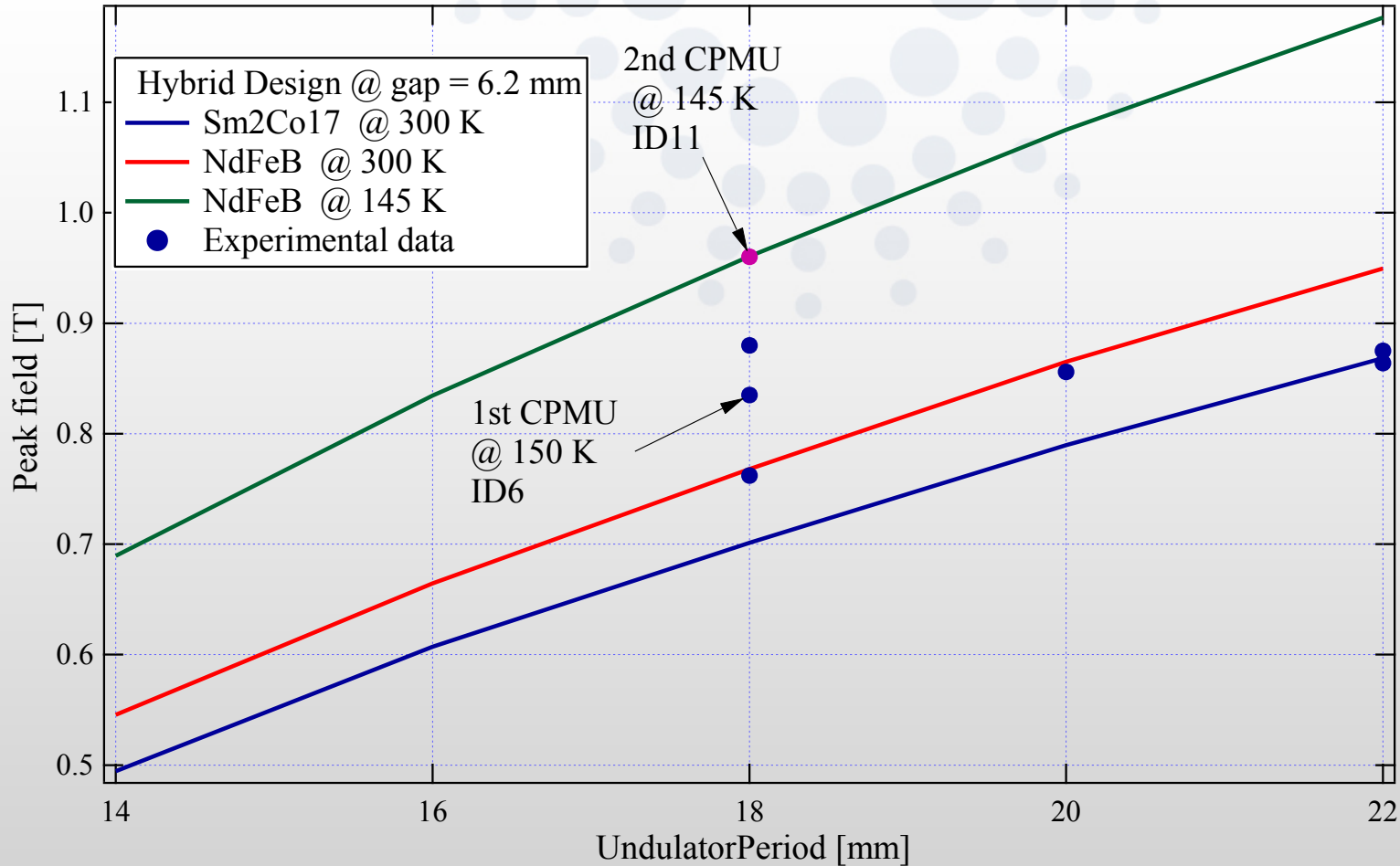
Goal:
Redistribute RF cavities to gain
useful straight sections





- 12 units manufactured by ANTEC
- Needed for 7 m straight sections
- Gradient 26 T/m
- Diameter 66 mm

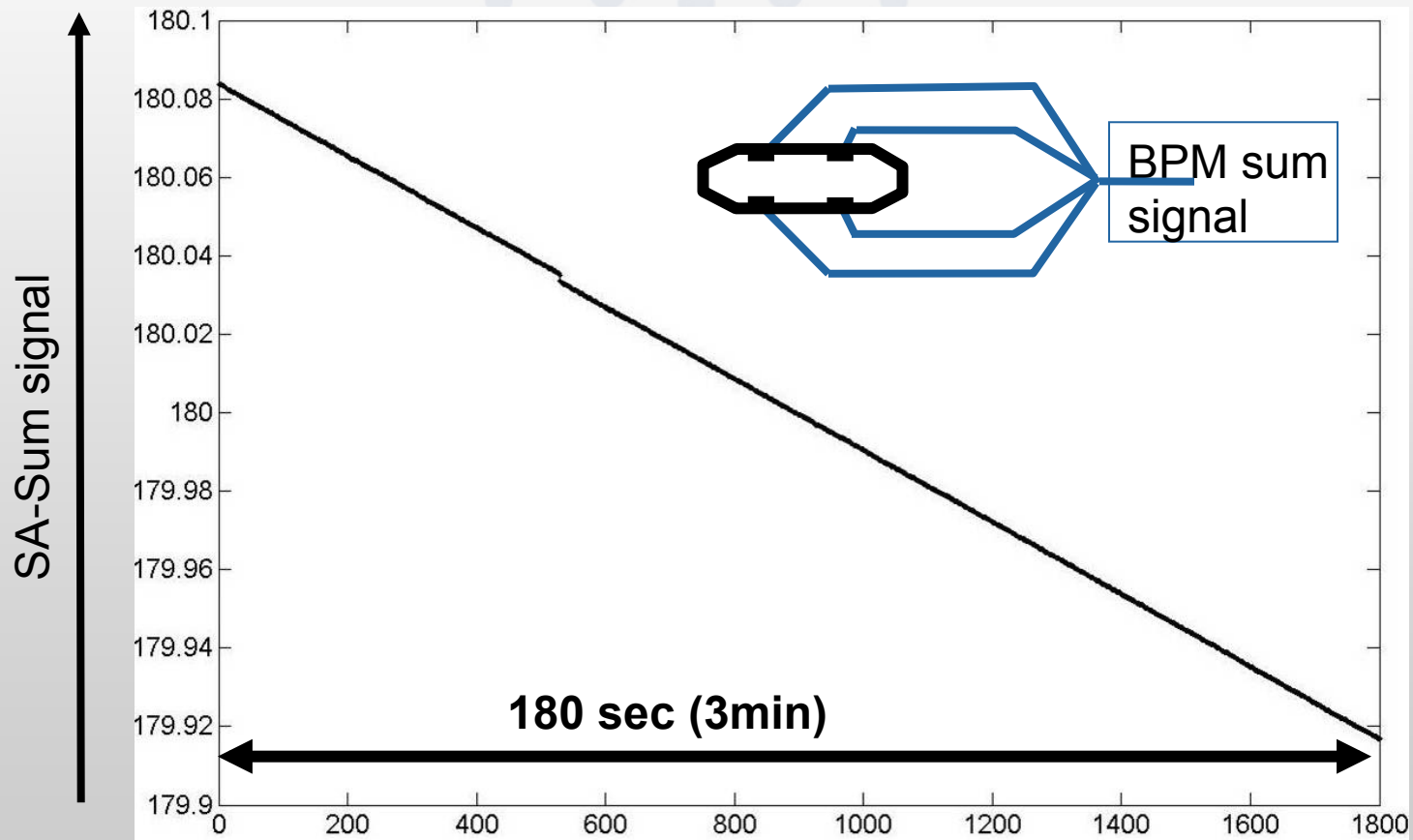
- Delivered
- Magnetic measurement at ESRF

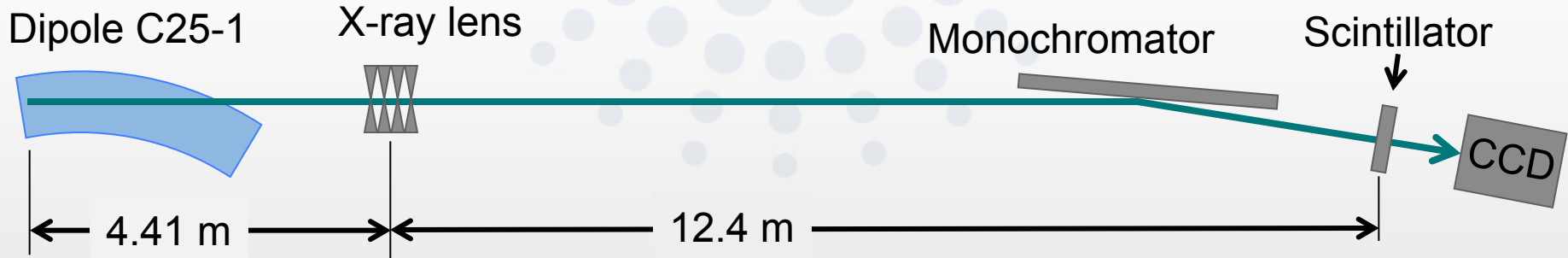


25 % Field Increase at given gap and period
 => Higher brilliance on high energy undulators

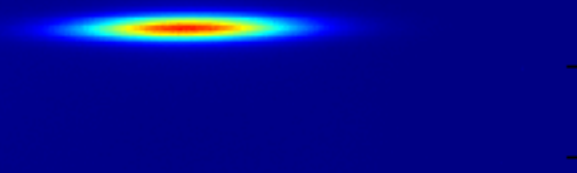
SUM signal : Instant-Partial-Beam-Losses

The sum of the 4 electrodes of an individual BPM is proportional to the beam current.
 → SA-Sum signal of all Liberass → precise and fast lifetime measurements





ID25-XRL



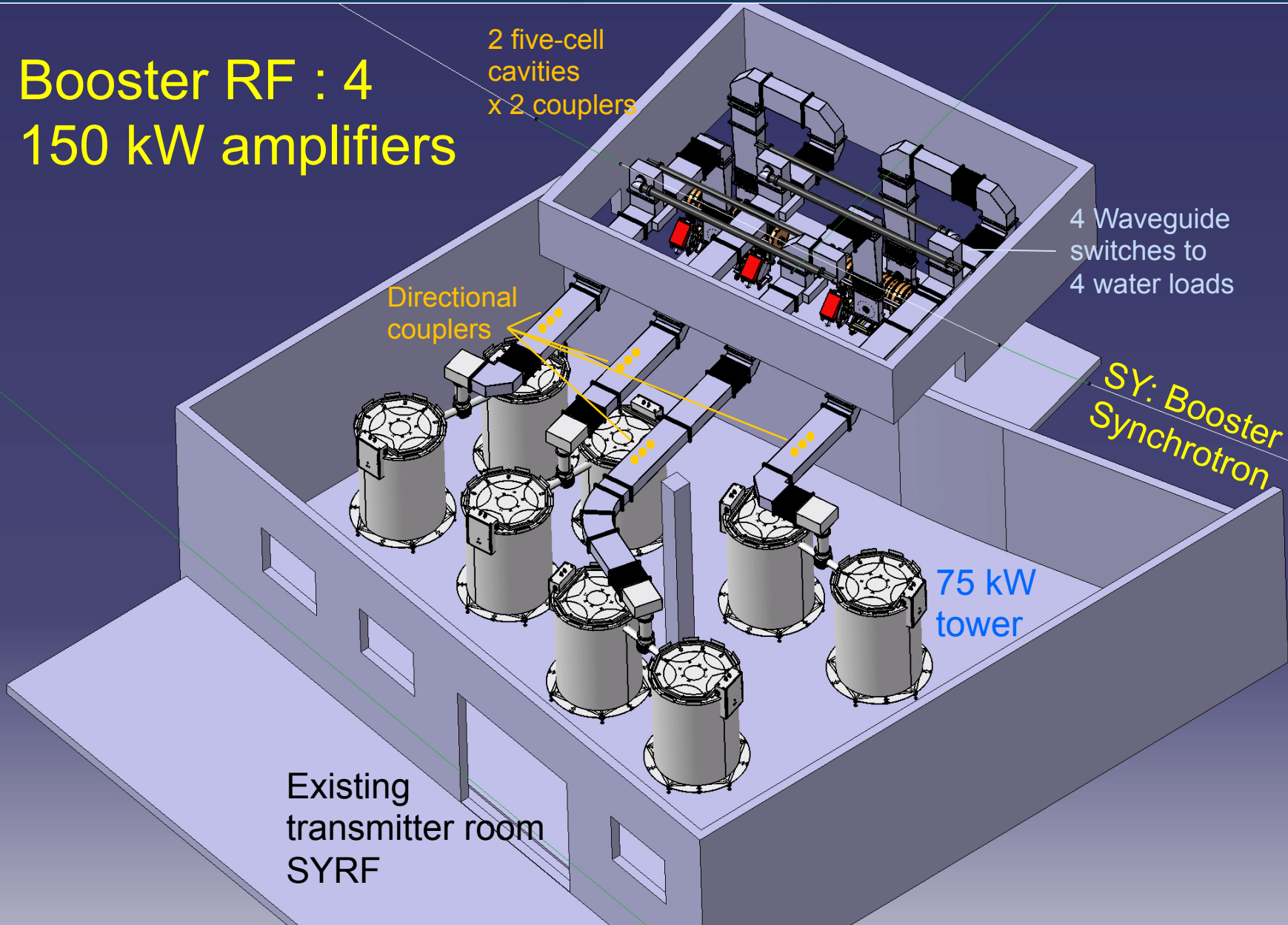
02/Feb/2011
 USM (7/8 +1)
 32 skew correctors

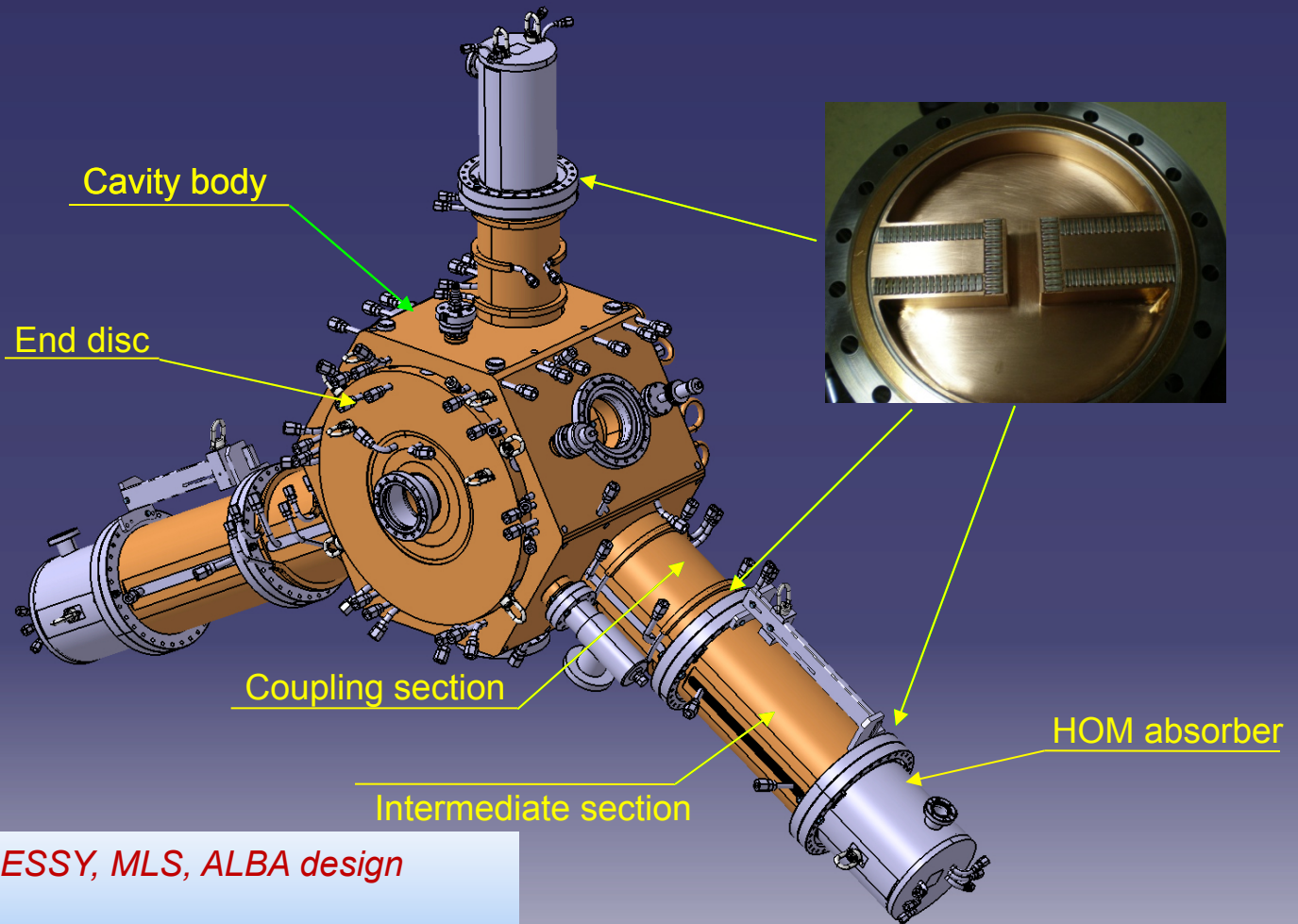
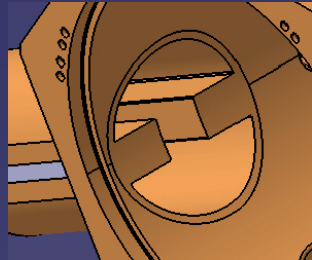
ID25-b : 6.6 pm
ID25-xrl : 6.2 pm
 IAX : 6.4 pm

01/Feb/2011
 MDT (7/8 +0)
 64 skew correctors

ID25-b : 3.6 pm
ID25-xrl : 3.7 pm
 IAX : 4.2 pm

**Booster RF : 4
150 kW amplifiers**





The priority is still the machine operation:

