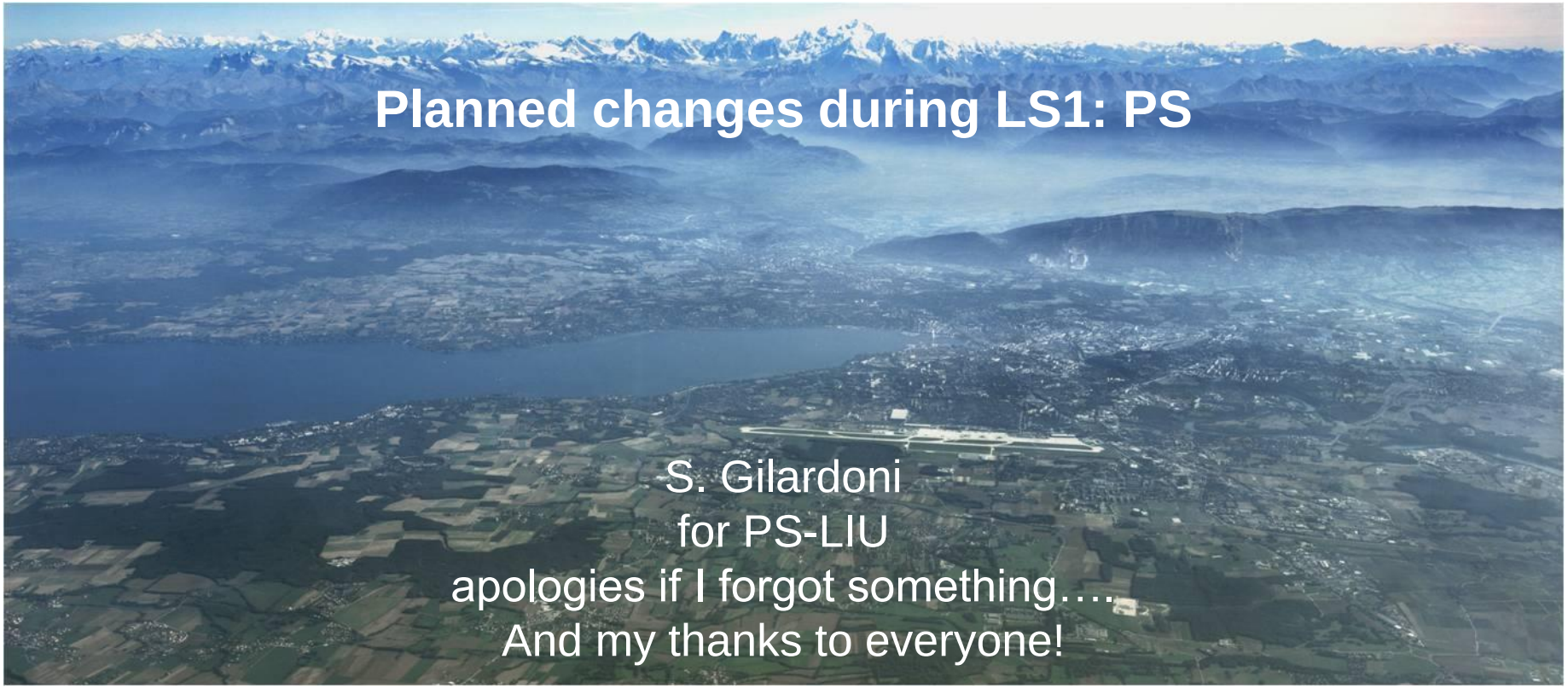
LHC Injectors Upgrade

CERN

LHC Injectors Upgrade



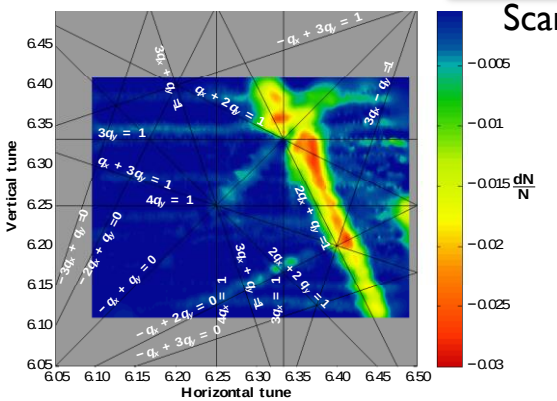
Planned changes during LS1: PS

S. Gilardoni
for PS-LIU
apologies if I forgot something….
And my thanks to everyone!

Skew sextupoles

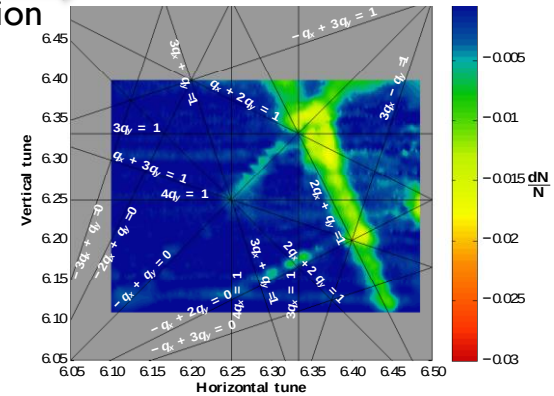
Resonance compensation successfully applied with 4 sextupoles in SS02 SS72 SS14 SS52

Scan direction

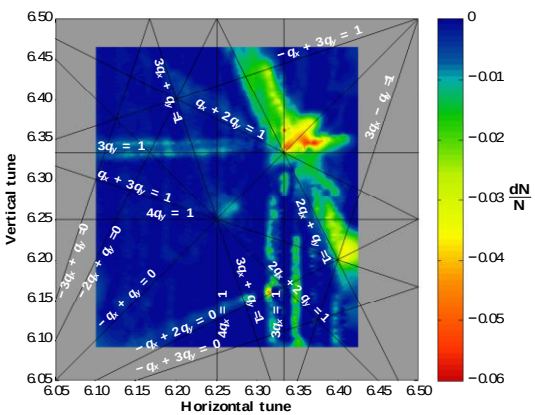


(e) Tune scan conducted from left to right without compensation.

A. Huschauer

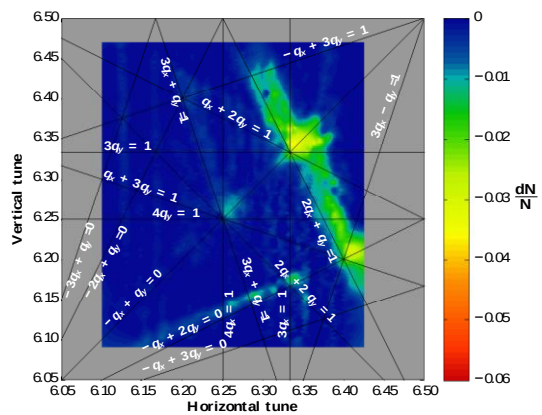


(f) Basis of this plot is a scan in the same direction as in (e), but this time four skew sextupoles were independently powered in order to reduce the resonance $3q_y = 1$. Additionally, a decrease in the strength of $2q_x + q_y = 1$ is visible.



(g) Tune scan conducted from top to bottom without compensation (the two lines close to $3q_x = 1$ are interpolation artifacts).

Scan direction



(h) Basis of this plot is a scan in the same direction as in (g), again with active skew sextupoles for compensation. The resonance $3q_y = 1$ seems to be completely suppressed and the beneficial influence on $2q_x + q_y = 1$ is also visible.

SS02 and SS72 taken by:

- New Finmet cavity
- New PU for tune meas.

Identified two new SS

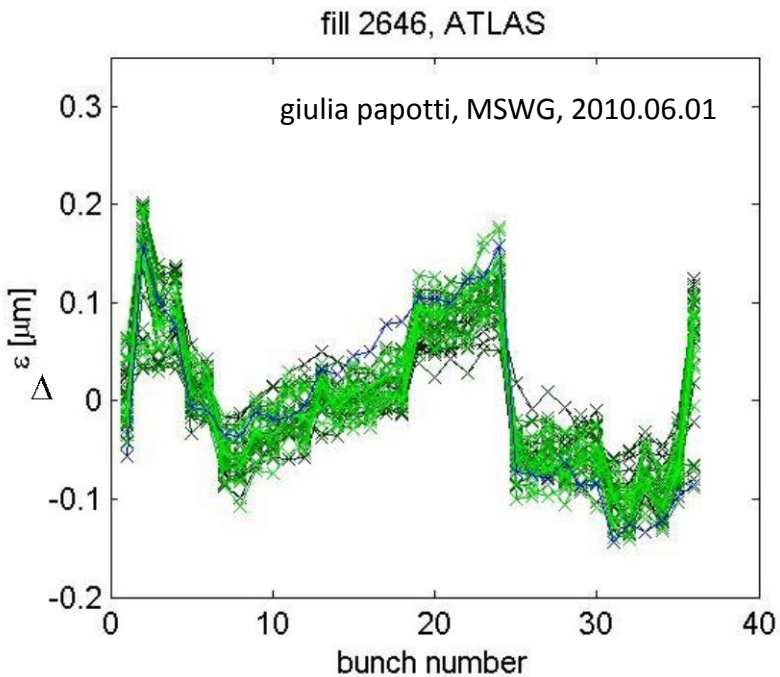
- SS58
- SS10

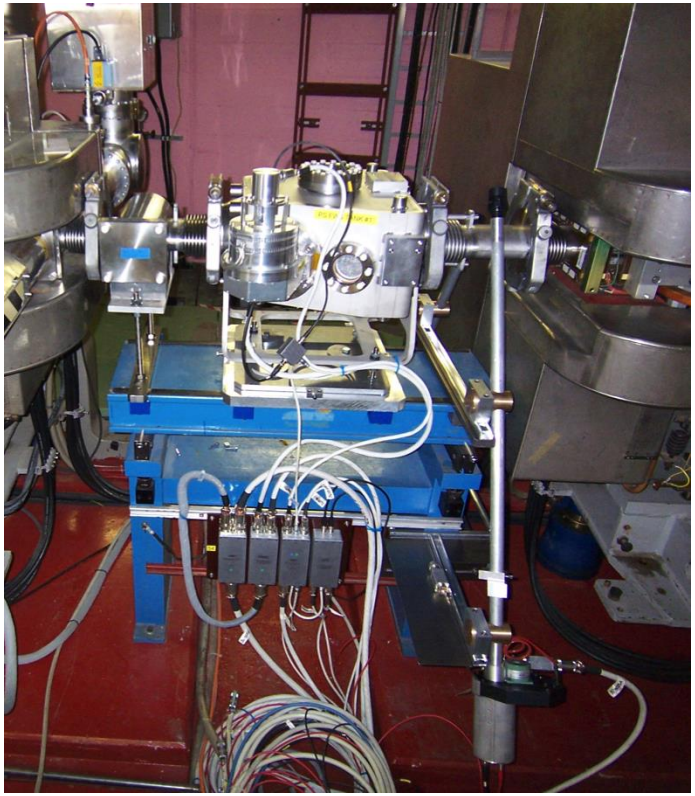
for skew sextupoles

Beam instrumentation: emittance measurement

New cables and electronics to test bunch-by-bunch emittance measurement at injection and extraction.

- Tests to reconstruct emittance from different PBS ring or 1st and 2nd injection

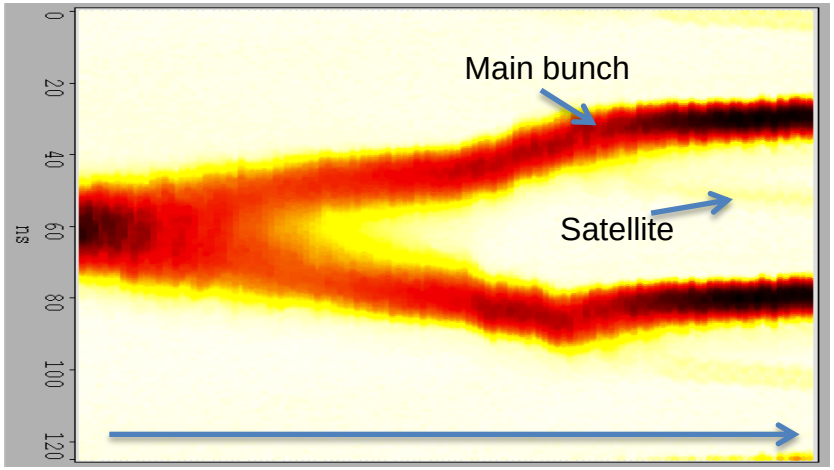




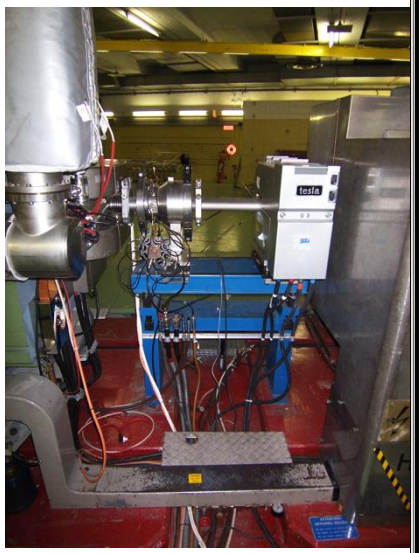
Beam instrumentation: fast signals

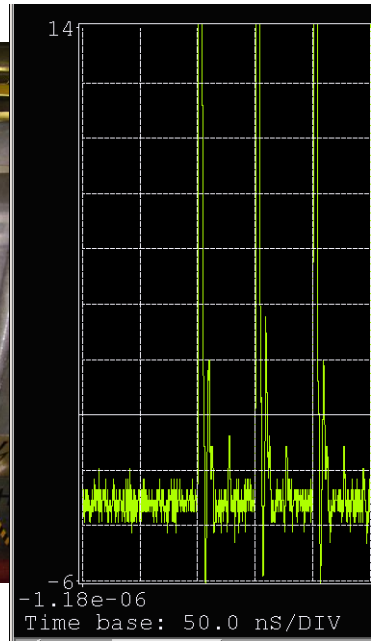
New wall current monitor installed in SS03 to:

- log last turn longitudinal profiles
- Improve detection of “satellites”



Time

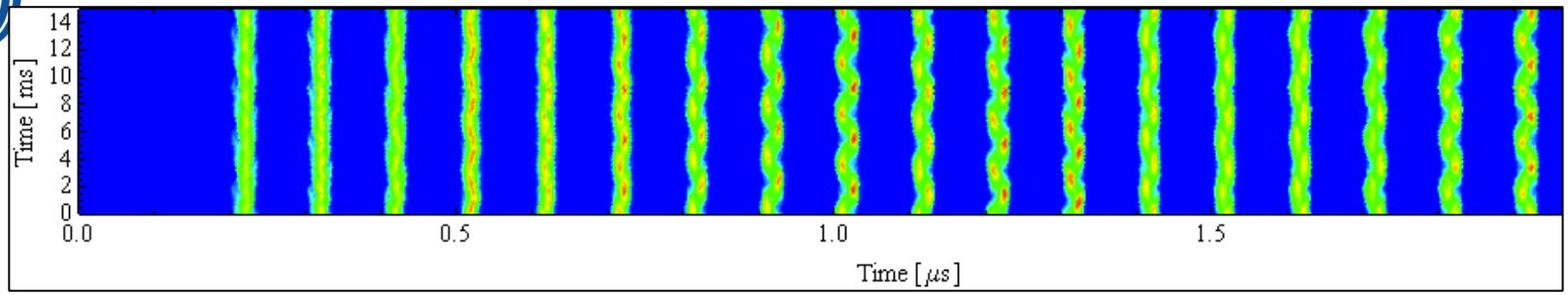




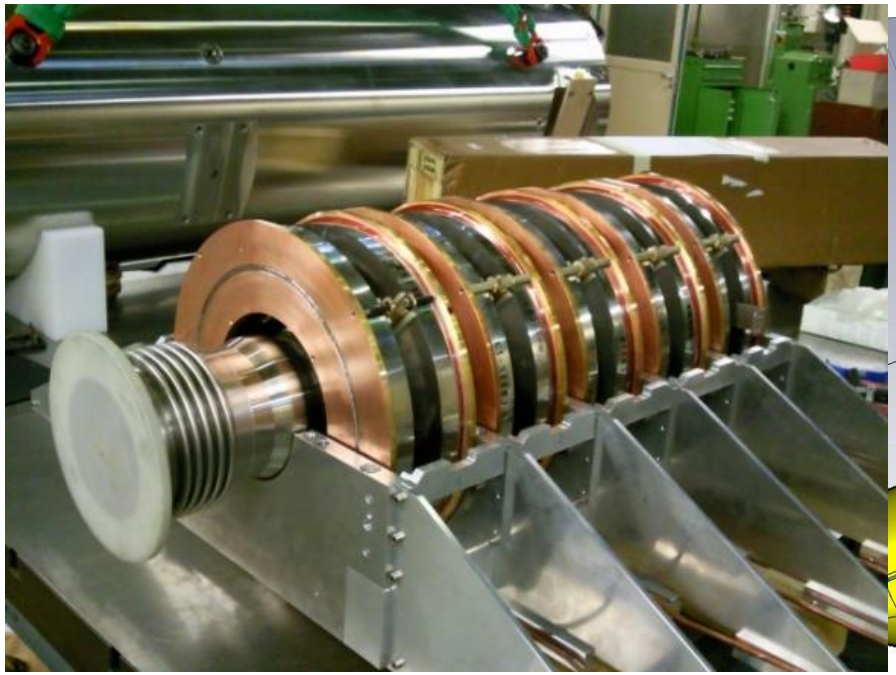
New pickup at beginning of TT2 to:

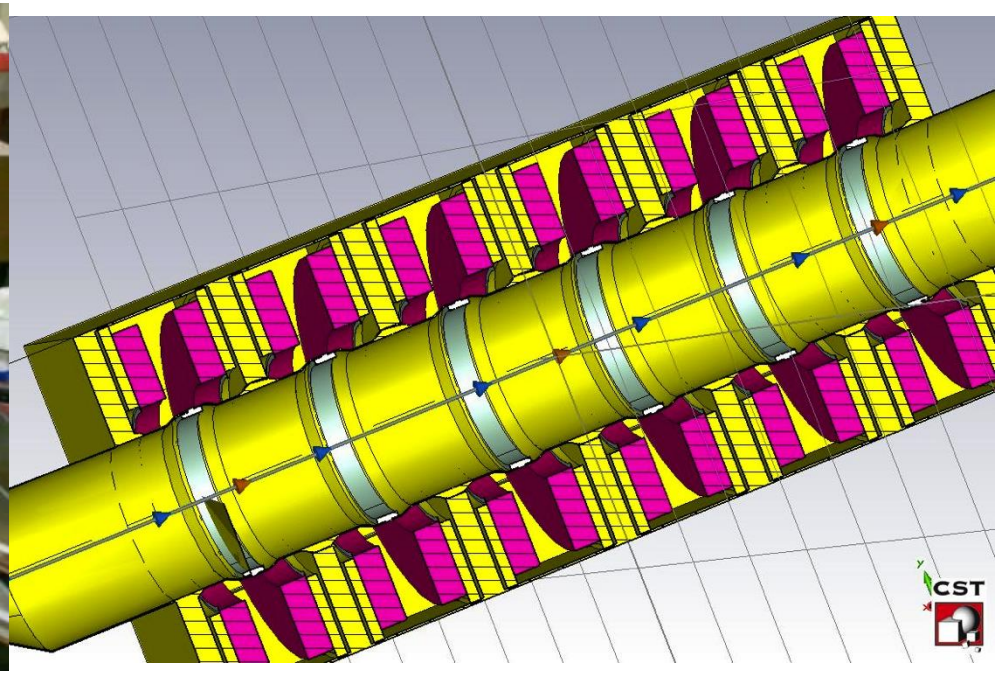
- Improve extraction trajectories
- Improve trajectories in TT2

Finemet® cavity development as longit. kicker



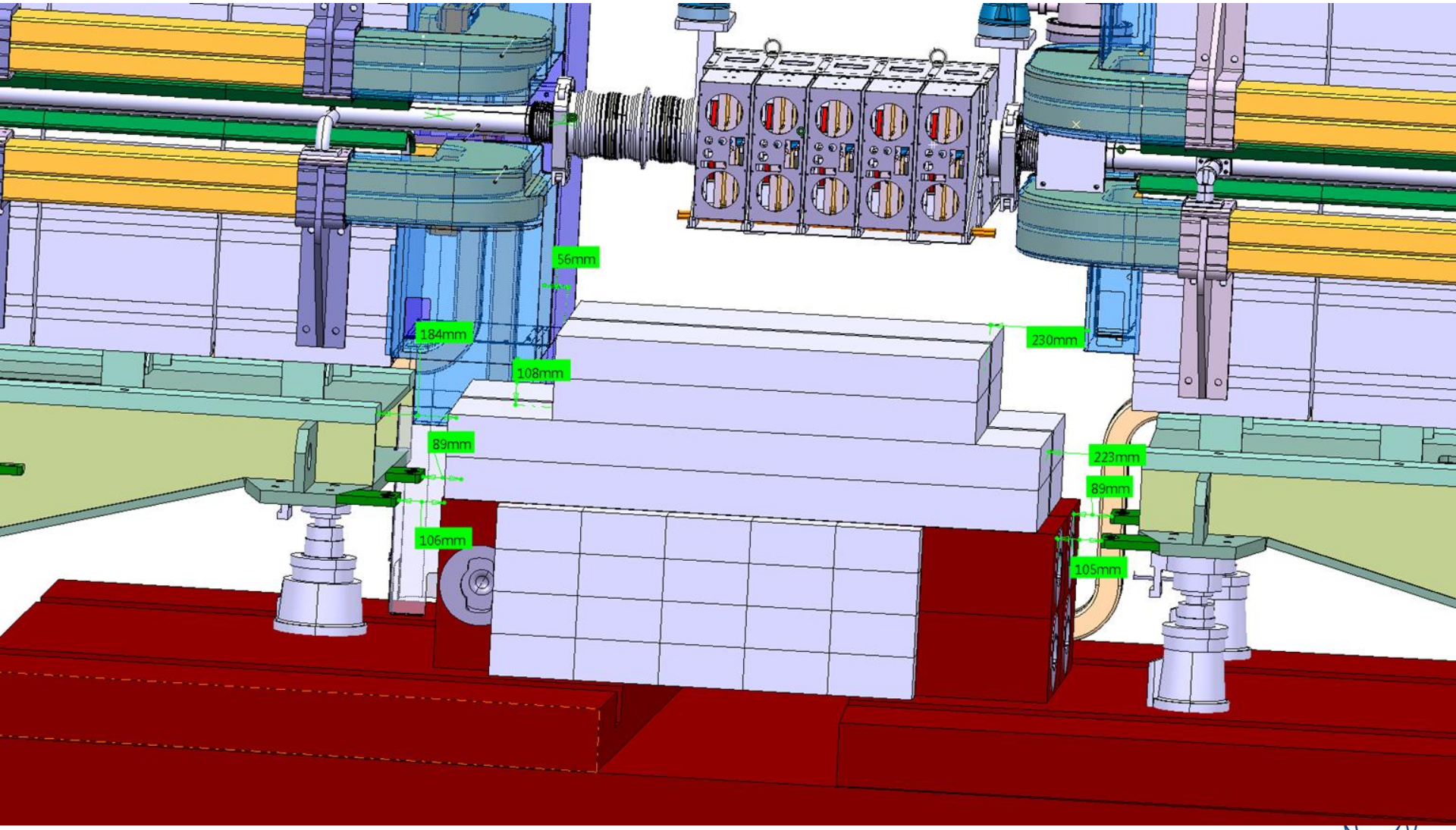
Finemet® wideband cavity (as longit. damper) design based on PSB design (M. Paoluzzi)





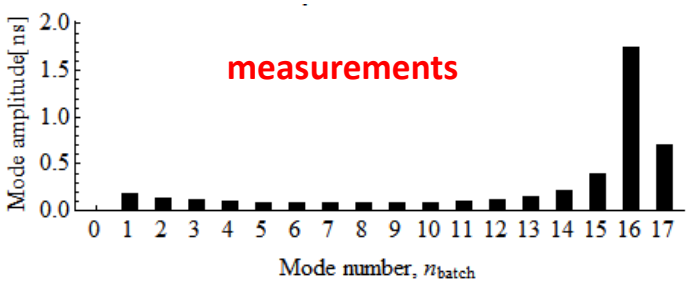
- Impedance model (CST® studio) being developed
- Simulation progressing to asses the performances as feedback

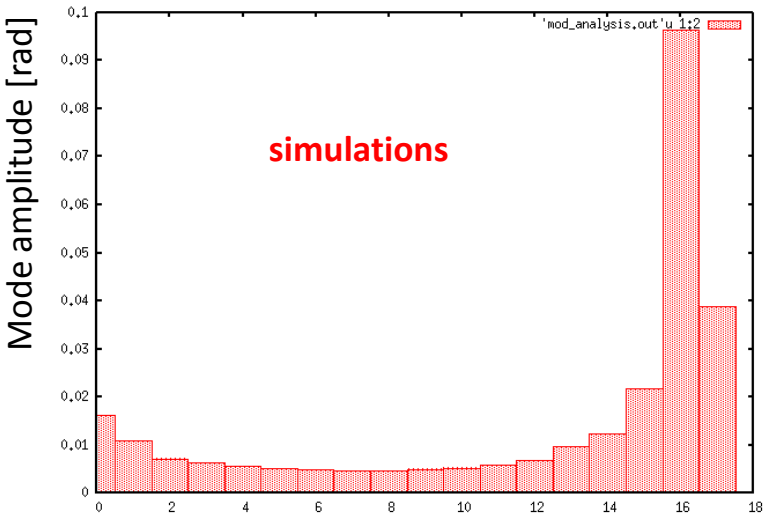
Finemet® cavity: shielding the amplifiers



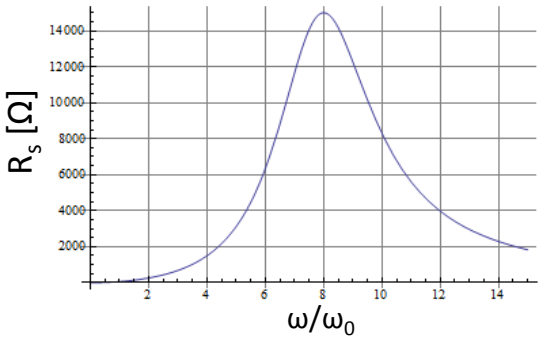
Simulation of coupled bunch: developments during LS1

Comparison with external excitation





Comparison with 10 MHz RF system mode



Quality factor	2
Shunt impedance (Ω)	1.5×10^3
Total beam intensity (ppb)	9×10^{12}

simulations:

$\omega_r = 5\omega_0 \ldots 9\omega_0$ ⇒ **rise time** ⇒ $\approx 340 \div 500$ ms

Measurement results			
Mode Number	1	2	3
Rise time	400ms	333ms	1s

FRPMN069 Proceedings of PAC07, Albuquerque, New Mexico, USA

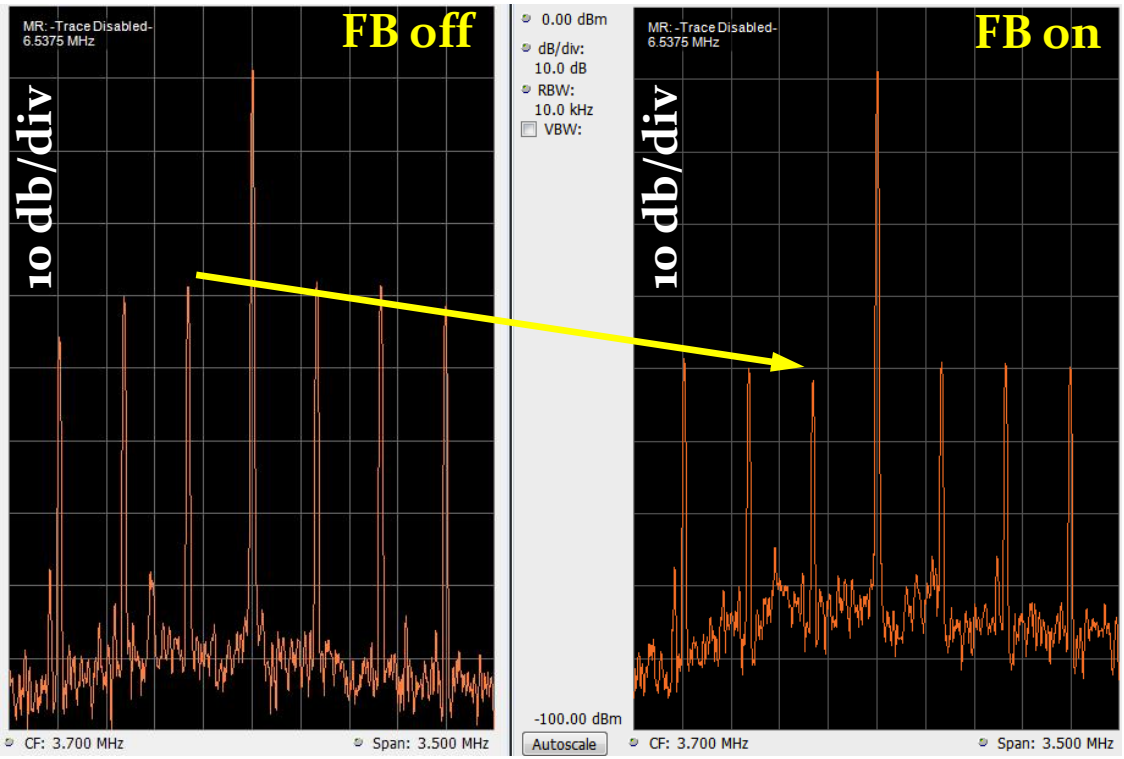
LONGITUDINAL COUPLED-BUNCH INSTABILITIES IN THE CERN PS

H. Damerau*, S. Hancock, C. Rossi, E. Shaposhnikova, J. Tuckmantel, J.-L. Vallet,
CERN, Geneva, Switzerland
M. Mehler, GSI, Darmstadt, Germany

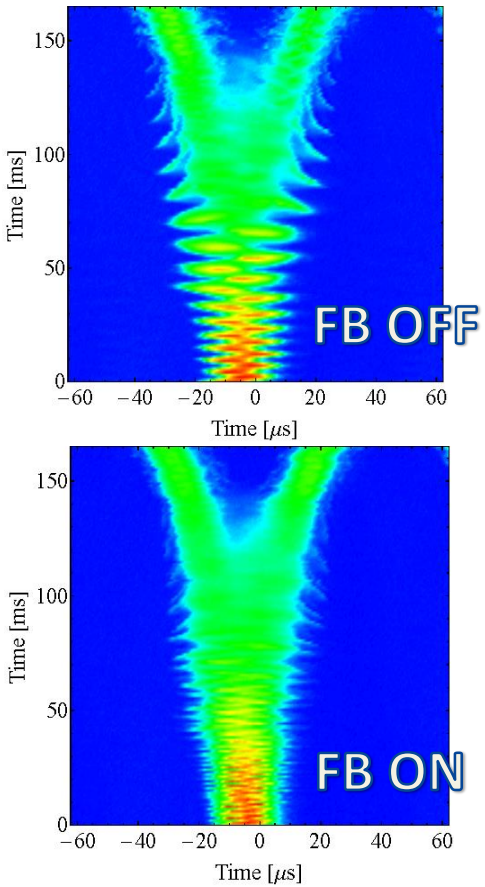
New digital 1-turn feedback implementation

Successful proof-of-principle test of new 1-turn feedback on one 10 MHz cavity

Beam induced spectrum on cavity return signal cycle



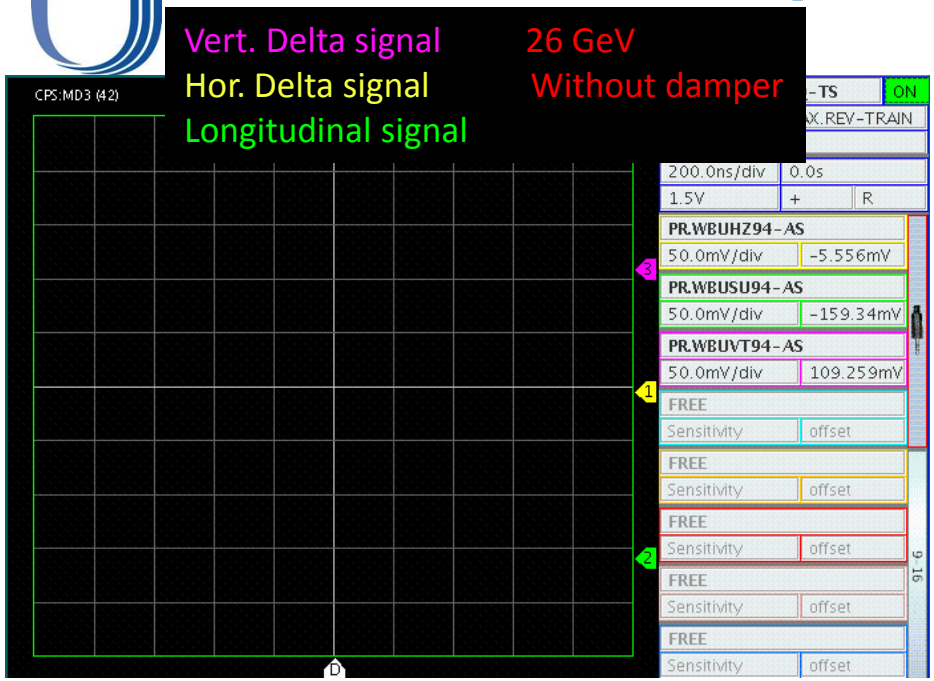
LHC50ns, splitting on flat-top

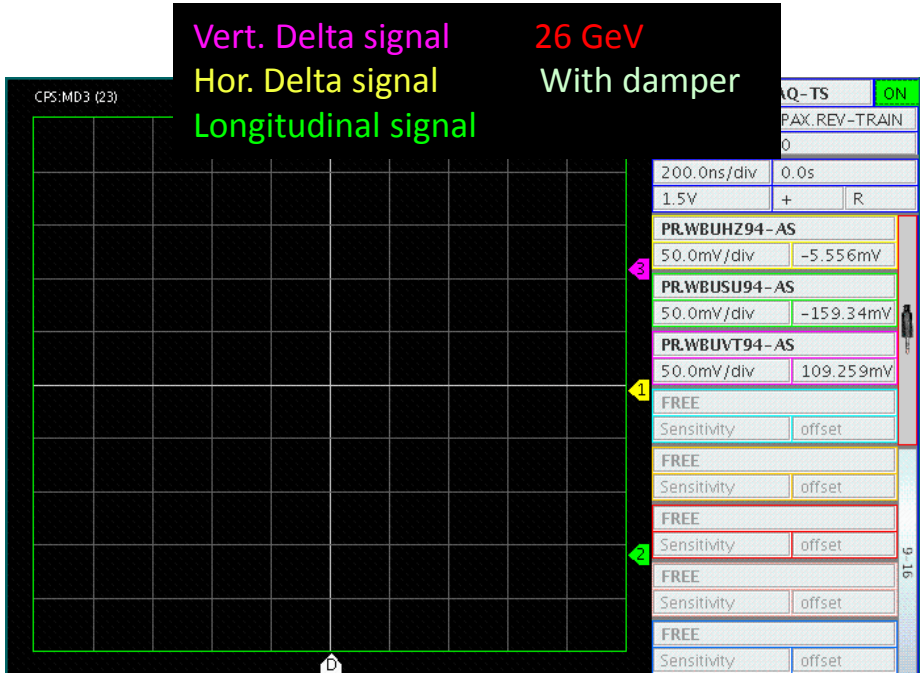


→ **Fully digital**

→ **Much more flexible and higher gain than operational system**

Transverse damper



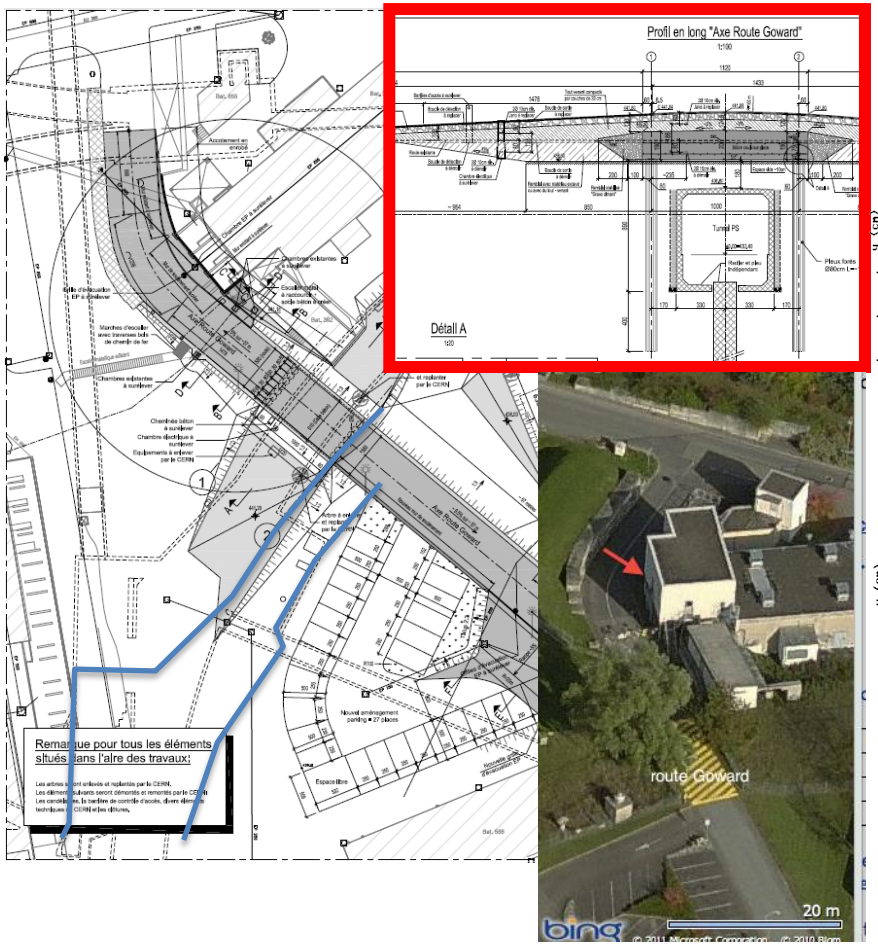


BW bottleneck today is the power amplifier (23 MHz bandwidth at -3 dB).

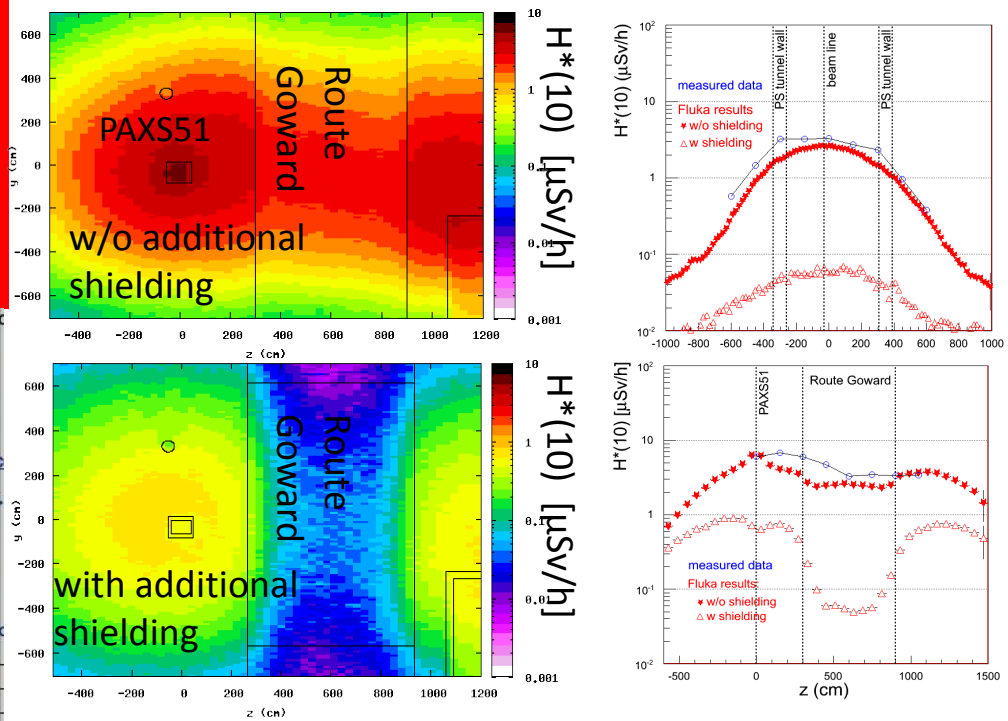
During the LS1 period the specification for the update will be defined from the beam physics requirements. **The present specifications are 100 MHz (-3 dB) and 5 kW CW (output matched)** per plate (instead of 23 MHz at 800 W CW) **which should be fulfilled before the restart of the LHC**.

To fully exploit the 100 MHz frequency one could use more DSPU per plane and increase the BW of the PU…

Additional shielding above PS injection region



Improvements of Radiation Level verified by FLUKA



Attenuation by a factor of ~50 reached at the crossing of Route Goward / PS Tunnel

Proposed shielding reduces dose to 0.6 µSv/h for the future upgrades of PSB intensity and energy

→ Future classification of Route Goward as Non-designated area

Works already started.

Rte Goward CERN works when started

Rte Goward works started, first with removal of two transformers

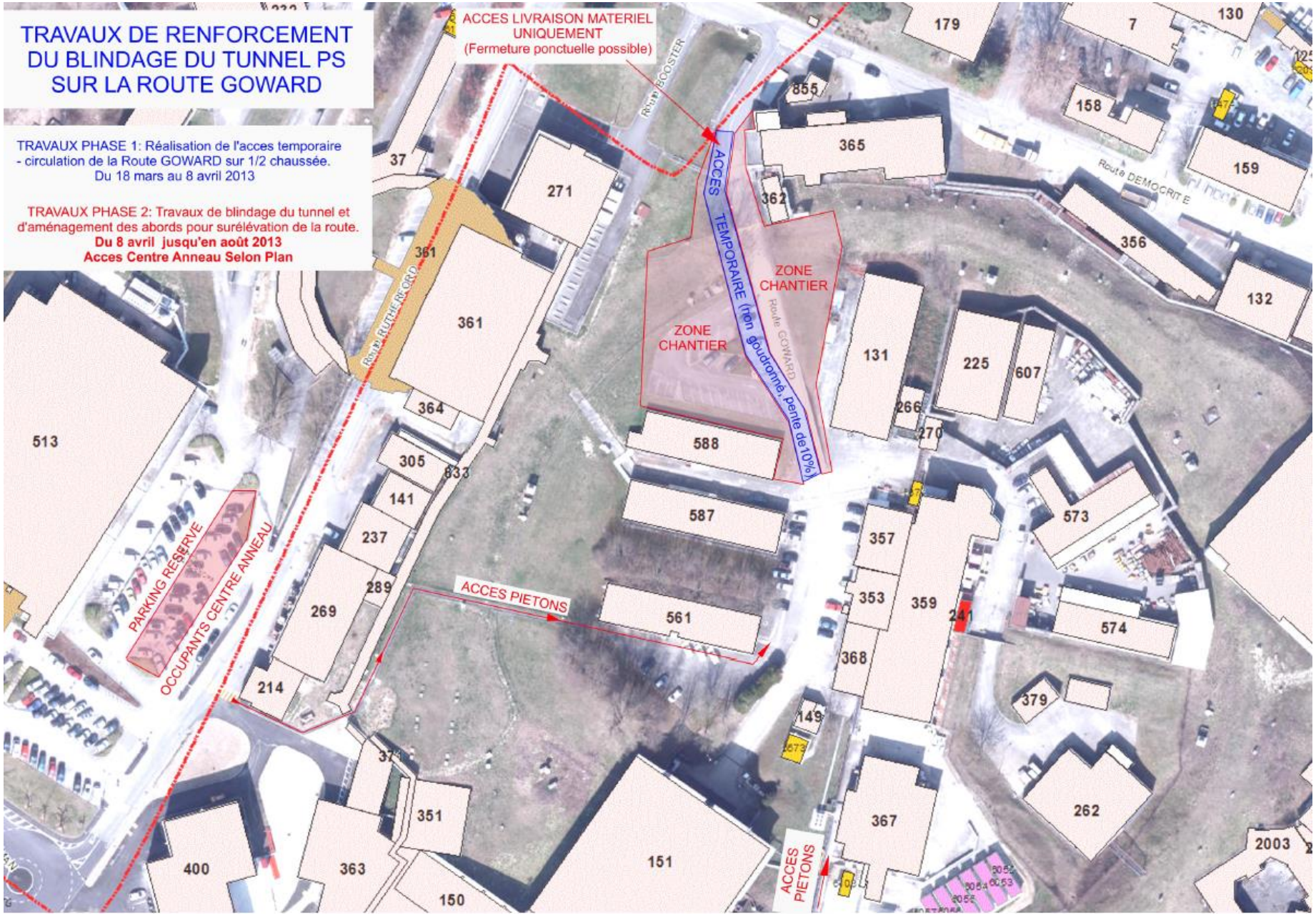
First traffic jams, even if intervention announced well in advance …

Rte Goward: transformer displacement

TRAVAUX DE RENFORCEMENT DU BLINDAGE DU TUNNEL PS SUR LA ROUTE GOWARD

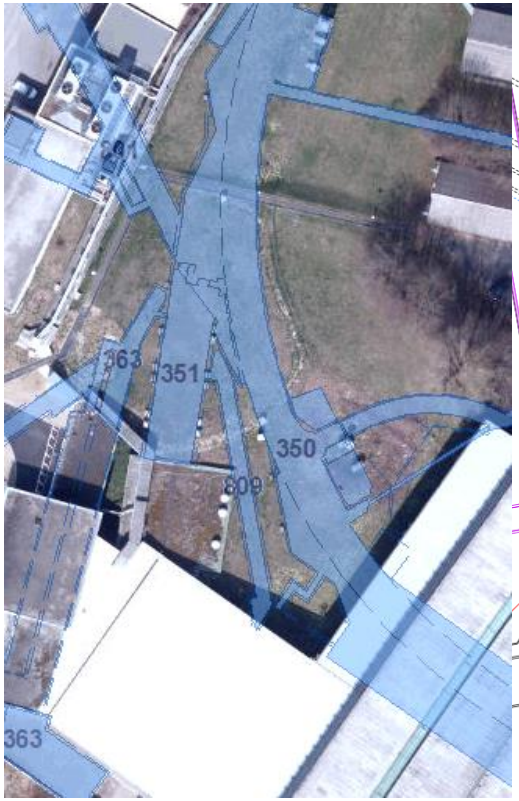
TRAVAUX PHASE 1: Réalisation de l'acces temporaire
- circulation de la Route GOWARD sur 1/2 chaussée.
Du 18 mars au 8 avril 2013

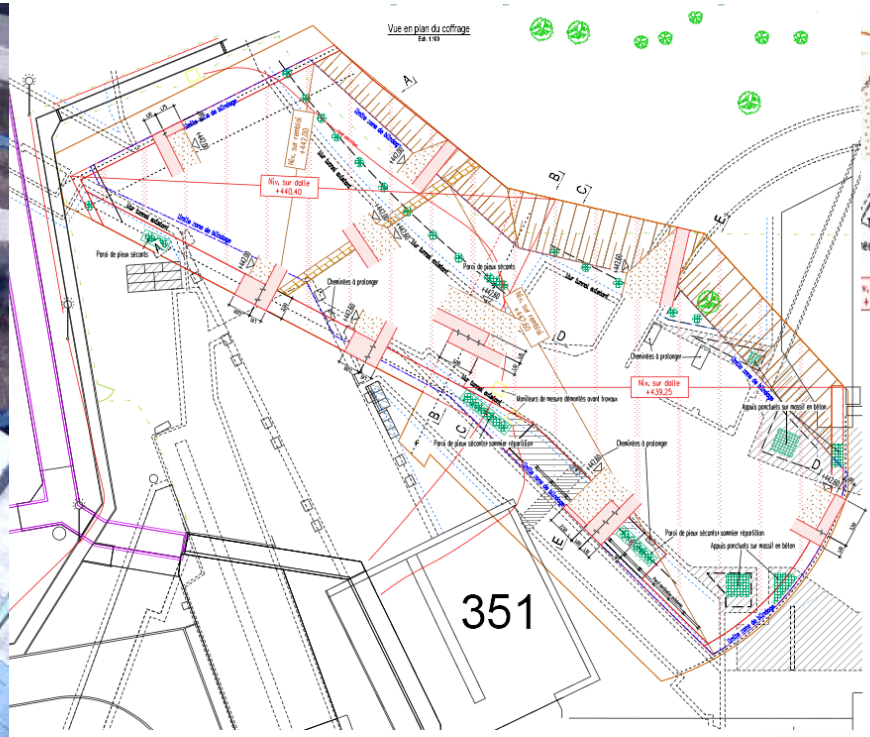
TRAVAUX PHASE 2: Travaux de blindage du tunnel et d'aménagement des abords pour surélévation de la route.
Du 8 avril jusqu'en août 2013
Acces Centre Anneau Selon Plan

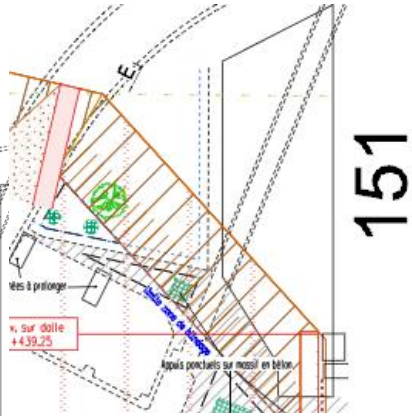


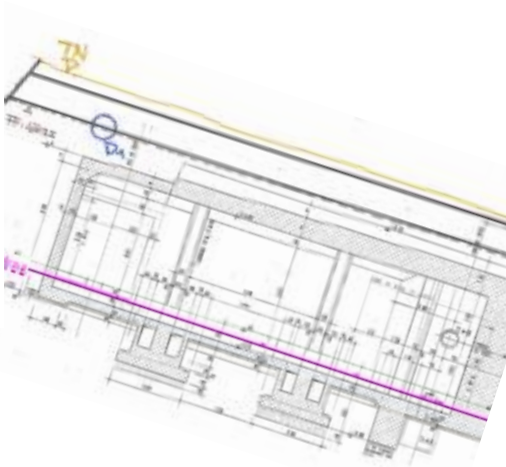
Rte Goward Worksite

Extraction septum shielding increase







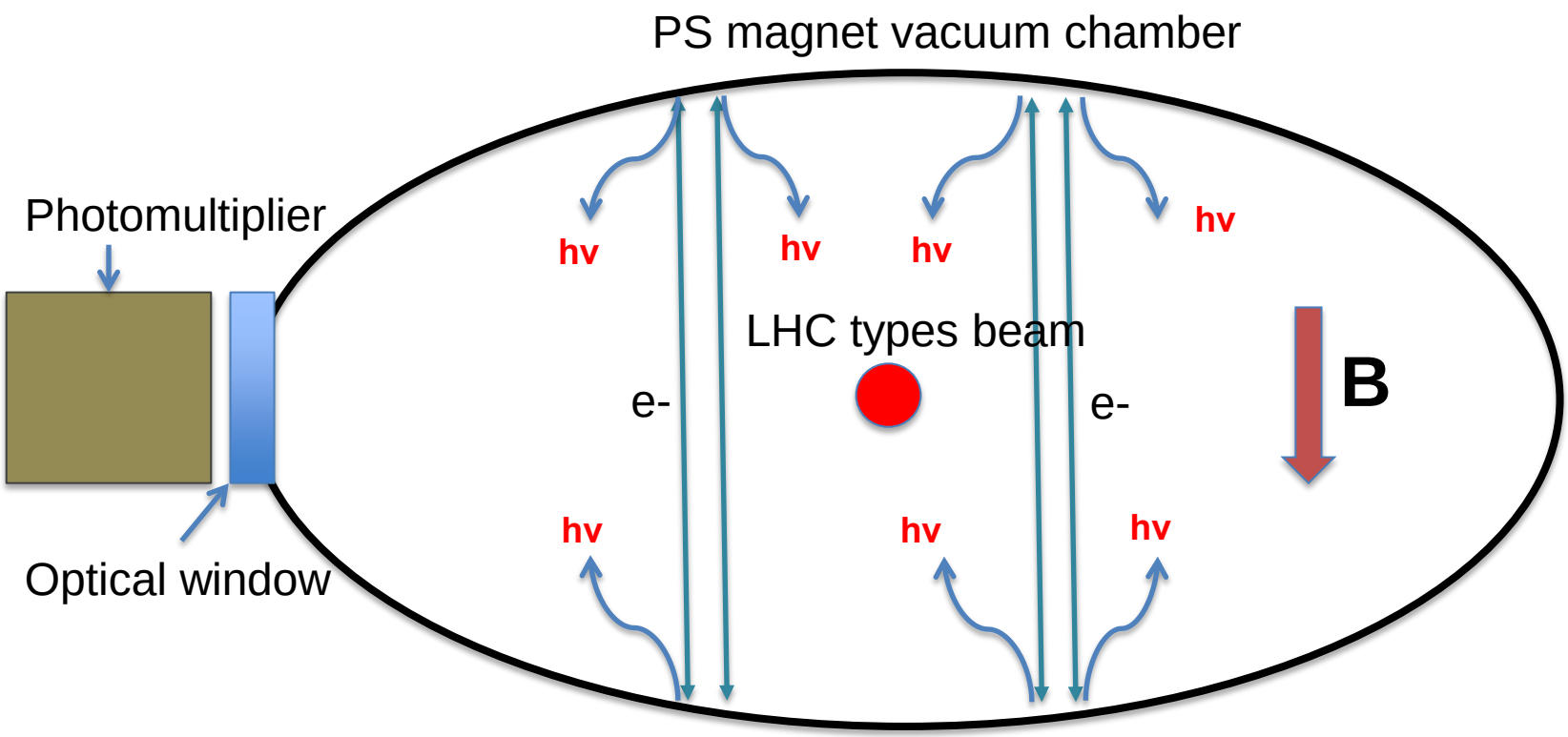


- → Extraction septum shielding increase: technology chosen
  - → Pillars around the tunnel plus single concrete slab (1.1 m thick)
- → Increase of safety margin wrt original project (2-3) by additional factor of 2
- → Reduce risk of large stresses on existing structures
  - → **Carottage under tunnel showed weakness of molasse excluding other solutions**

Electron cloud measurement via electron-photon emission

Electron-photon emission:

The emission of photons from metals bombarded by low-energy electrons



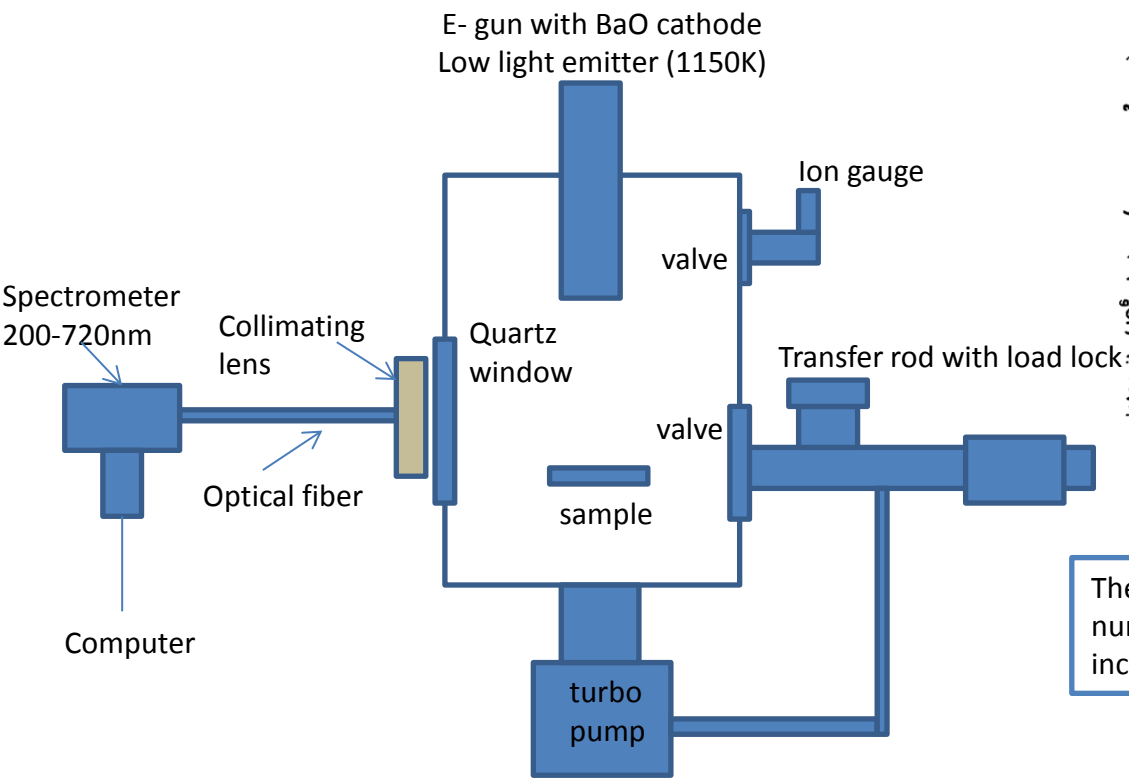
- Electrons in EC has a relatively low energy (~300eV).
- Expected photon wavelength with 300eV electrons: 200nm (UV) – 700nm (visible).
- Expected photon energies: 2eV – 5eV.
- Expected radiation yield: 10^6 photons/sec.nm.mm^2.A

New ecloud monitor in main magnet unit

Principle: detection of photons generated by electrons

Test stand: Build a complete new permanent system to study Cathodoluminescence of different metals in the lab.

J. Phys. Chem. Solids, 1976, Vol. 37, pp. 403-409



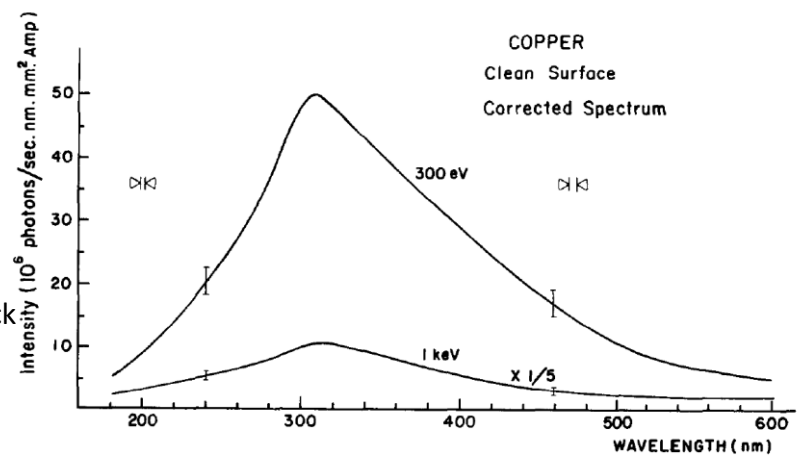
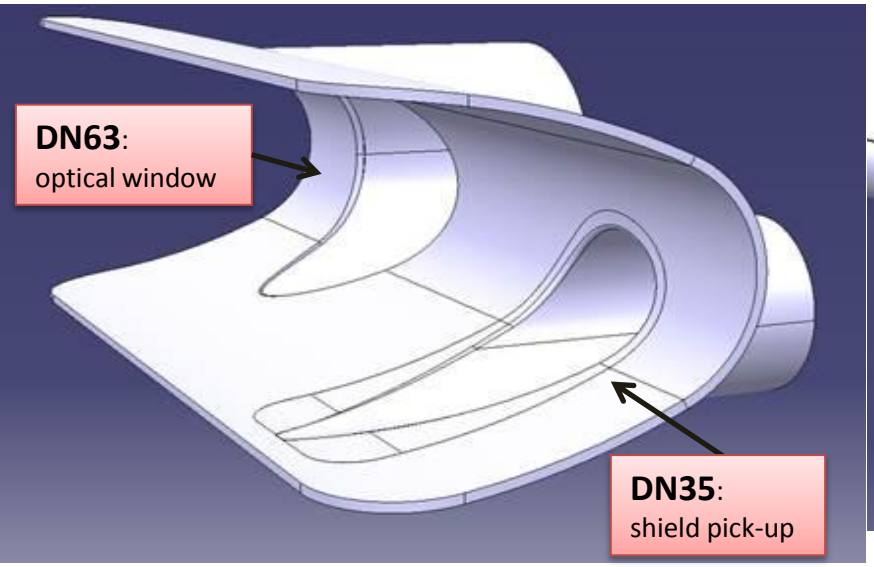


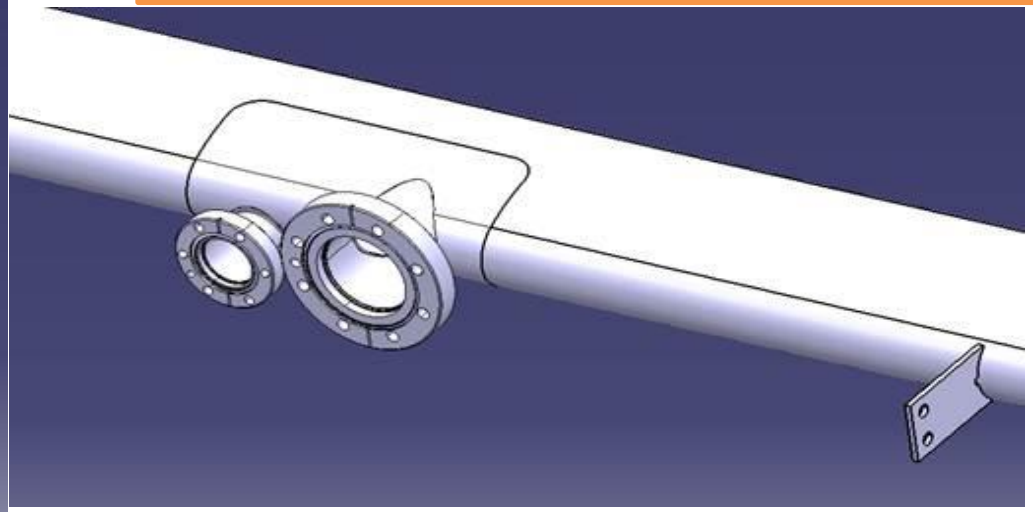
Fig. 3. Corrected cathodoluminescence spectra of clean Cu at electron energies 300 eV and 1 keV.

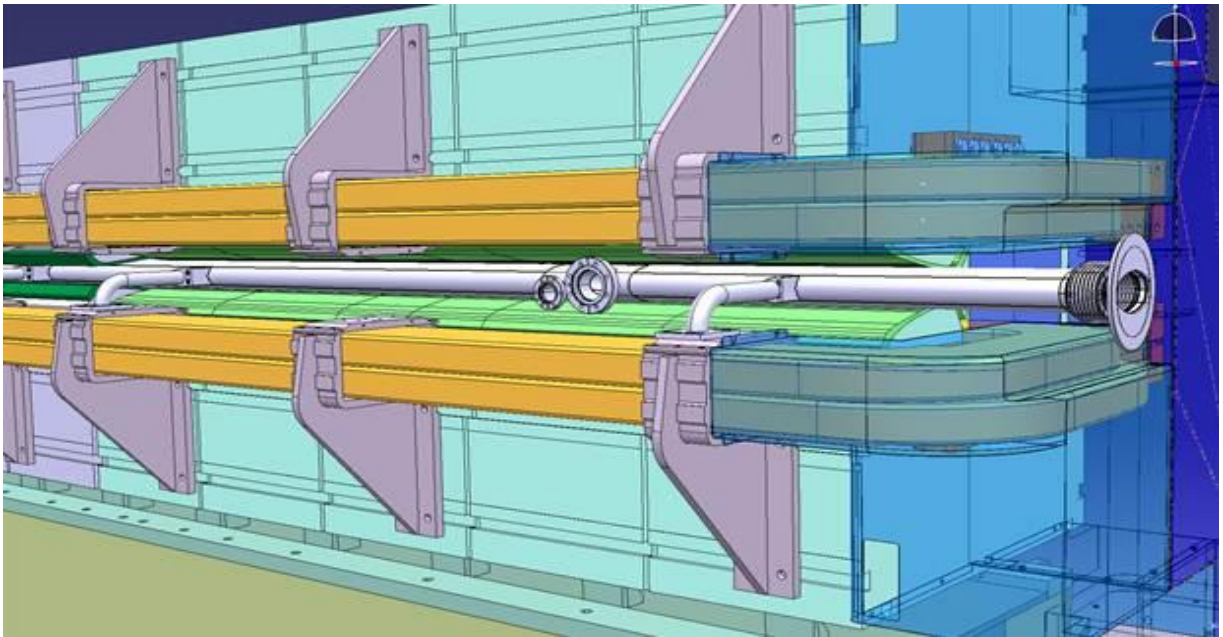
The measured luminescence intensity is expressed in: number of photons/mm2 per sec per nm per Ampere of incident electron beam at a distance of 30 cm from the target.

Implementation in the PS vacuum chamber

Modification of vacuum chamber: 1st version







[By Teddy Capelli EN/MME]

Conclusions

Thanks to everyone for the impressive 2012

and for all the LS1 activities!

I think we really deserve another vodka bottle….