Installation of the CLIC Stripline Kicker at the ALBA Storage Ring for its beam characterisation

2017 CLIC Workshop

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Outline

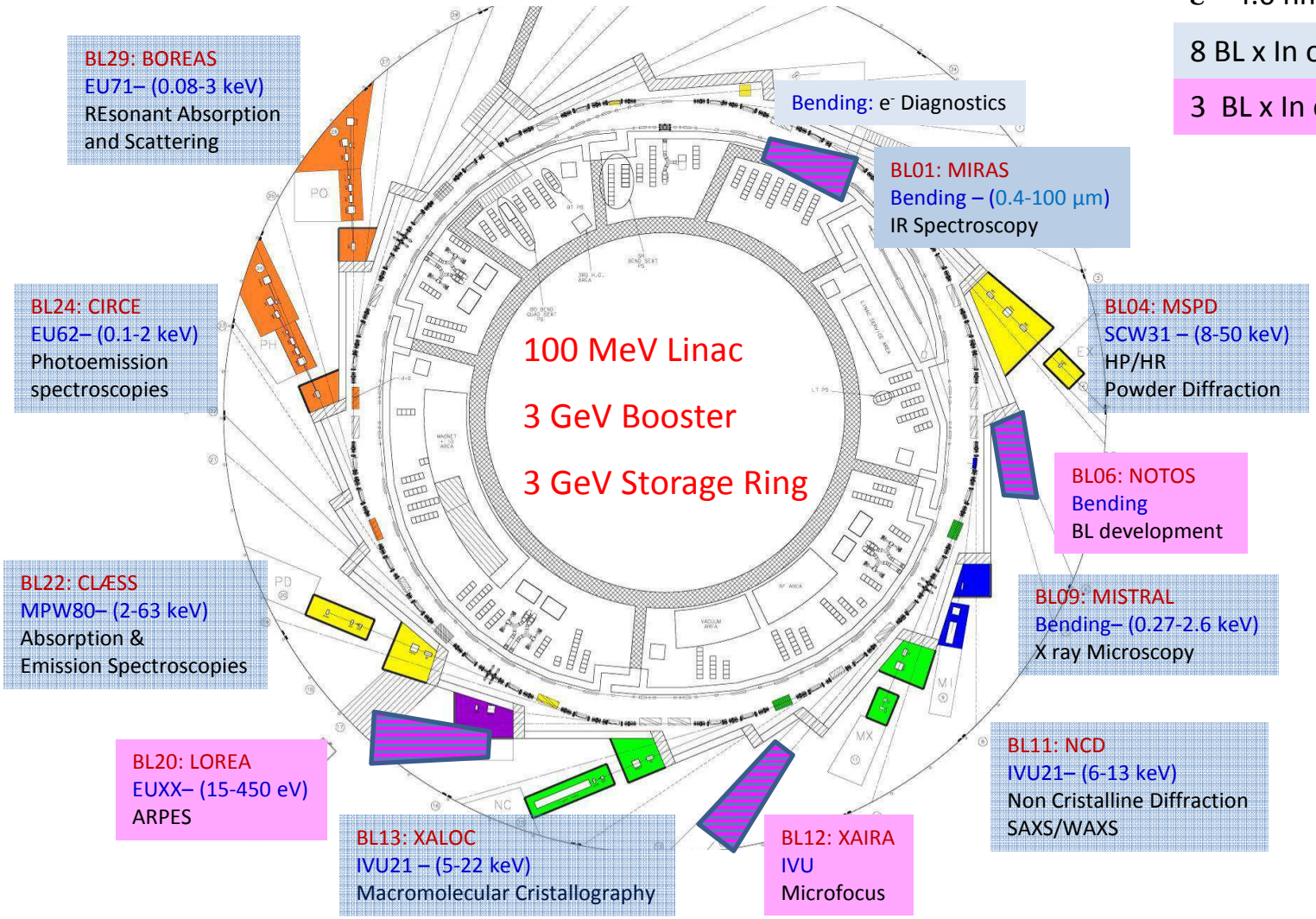
1. Introduction
2. Design issues
3. Installation
4. Conditioning
5. Beam characterisation

Introduction to ALBA

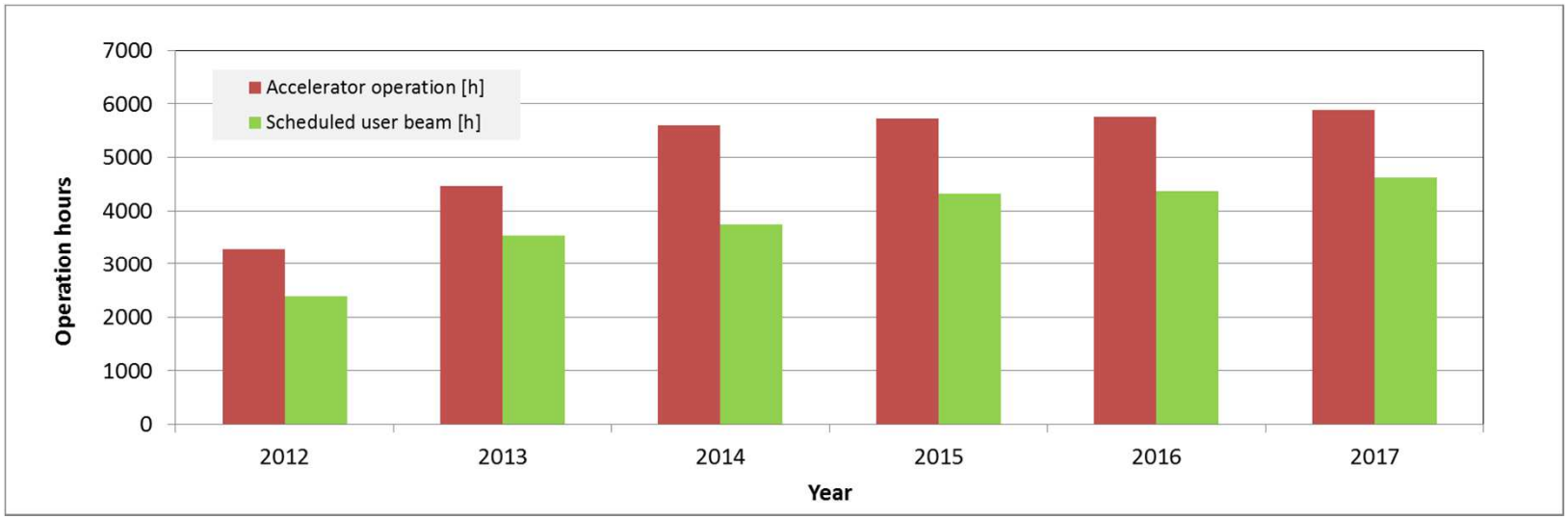
E = 3.0 GeV
C = 268.8 m
ε = 4.0 nm·rad

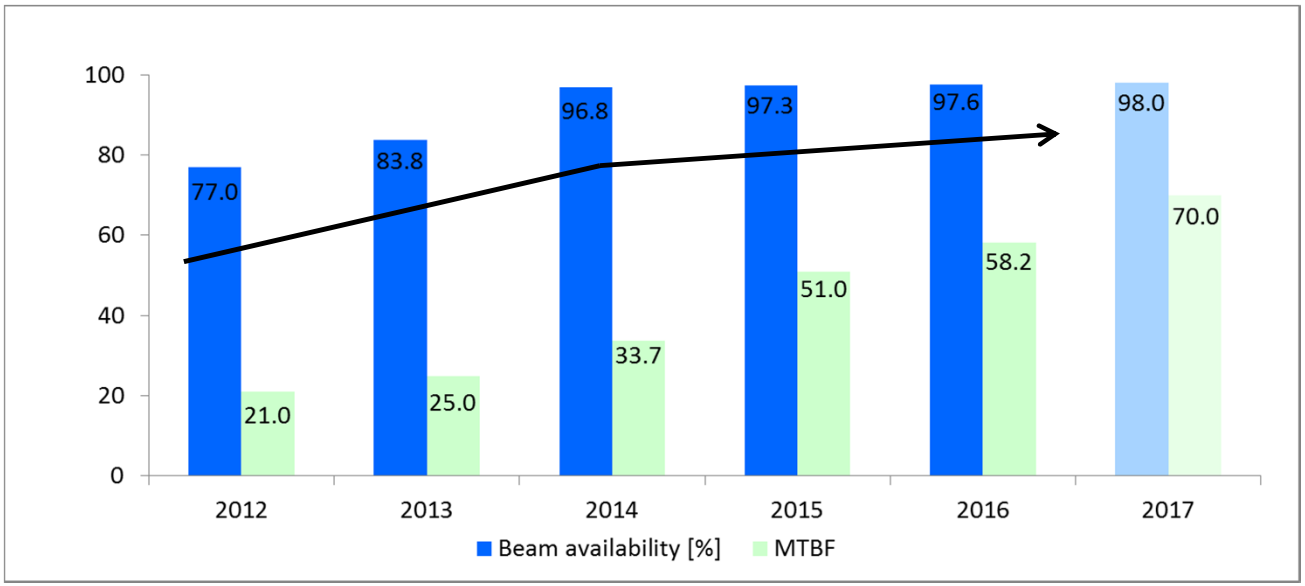
8 BL x In operation

3 BL x In construction



Introduction to ALBA

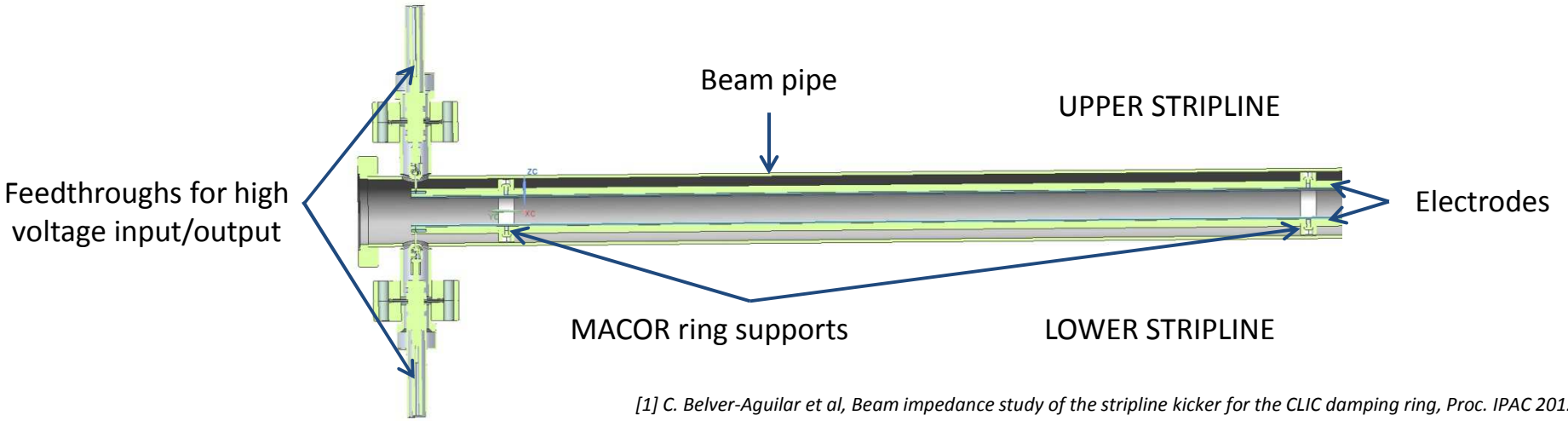




Design issues

STRIPLINE KICKER

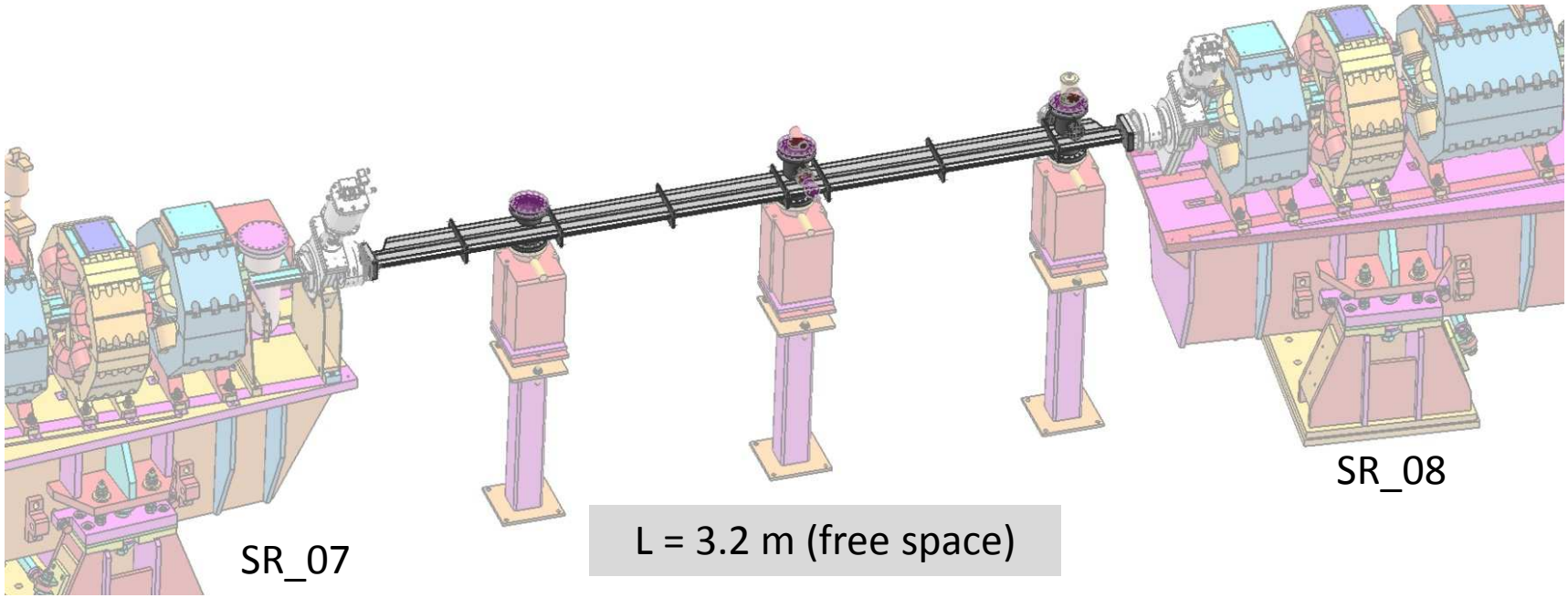
- Beam pipe of 40.50mm ID
- Total length 1.7 m
- Al electrodes hold in position by MACOR rings (28.8 mm ID)
- Distance between electrodes 20 mm



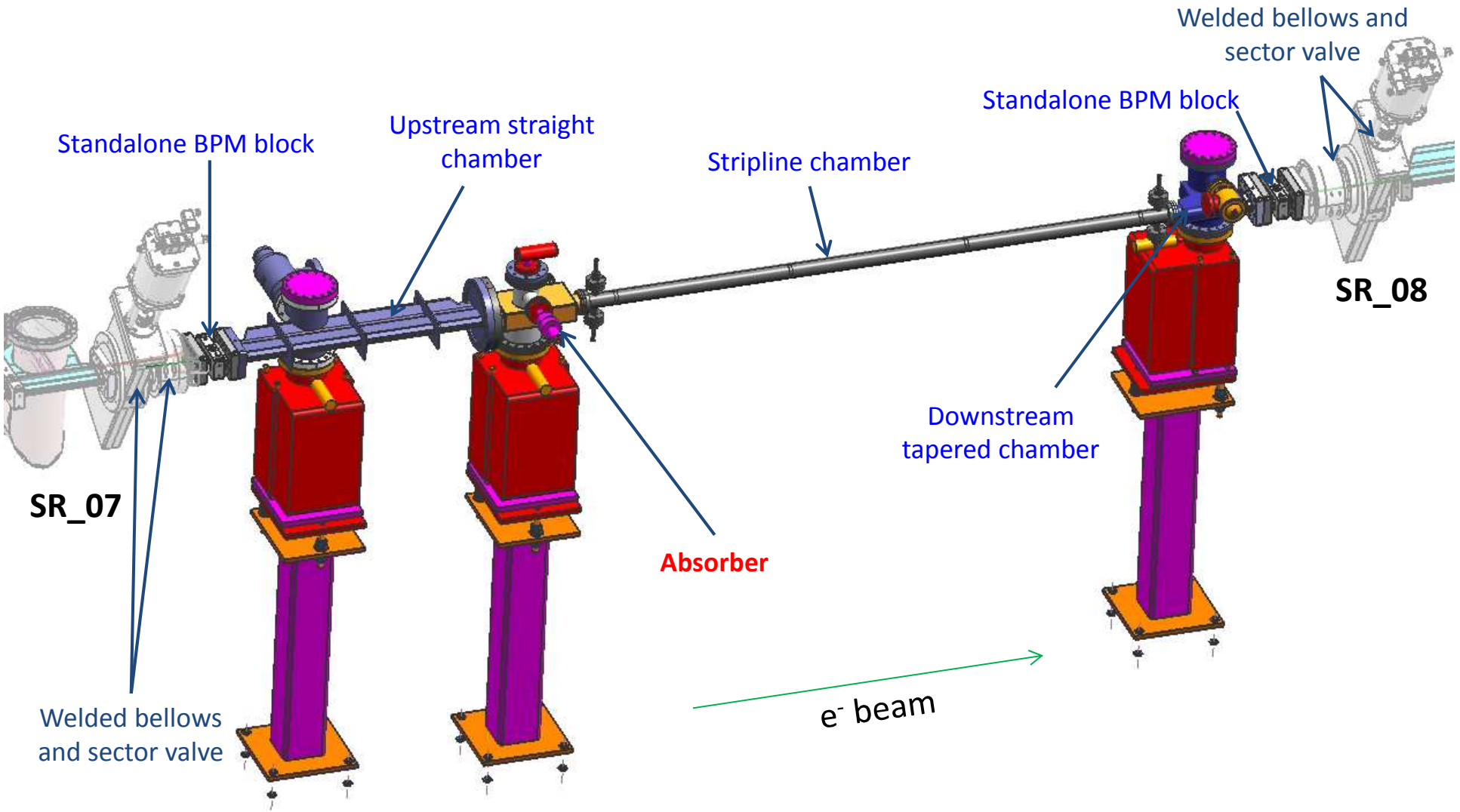
[1] C. Belver-Aguilar et al, Beam impedance study of the stripline kicker for the CLIC damping ring, Proc. IPAC 2012

Design issues

CLIC stripline installed in a medium straight section of the SR



Design issues

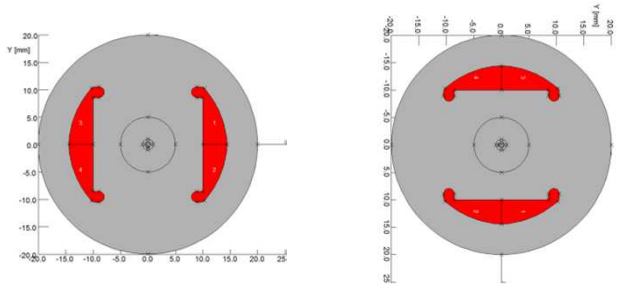


Design issues

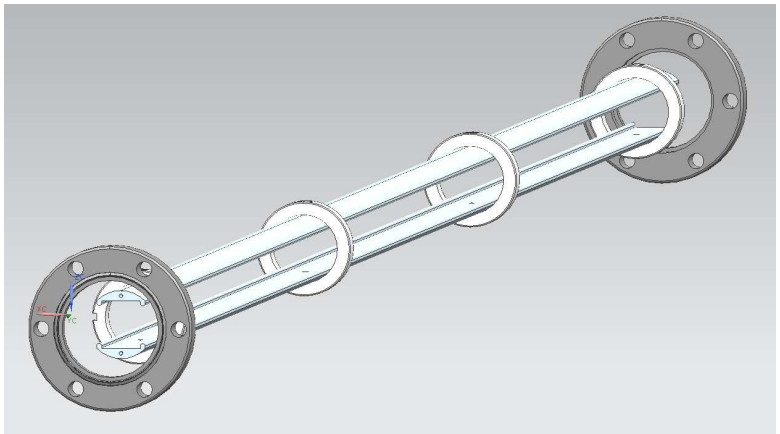
Absorber design is critical:

- should protect stripline from SR
- but shoud not limit the hor aperture of the SR

1) Rotate the stripline by 90º



2) But still MACOR rings

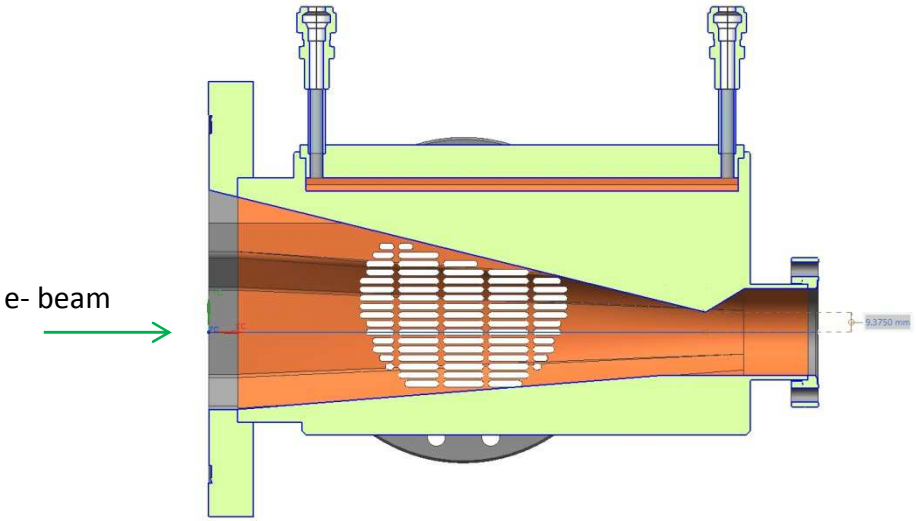


Design issues

Absorber design is critical:

- should protect stripline from SR
- but shoud not limit the hor aperture of the SR

3) Reduce safety margin: Only 1 mm between SR fan and last MACOR ring



4) Distance: tip absorber – beam

9.4 mm

comparable to SR limiting aperture

Installation

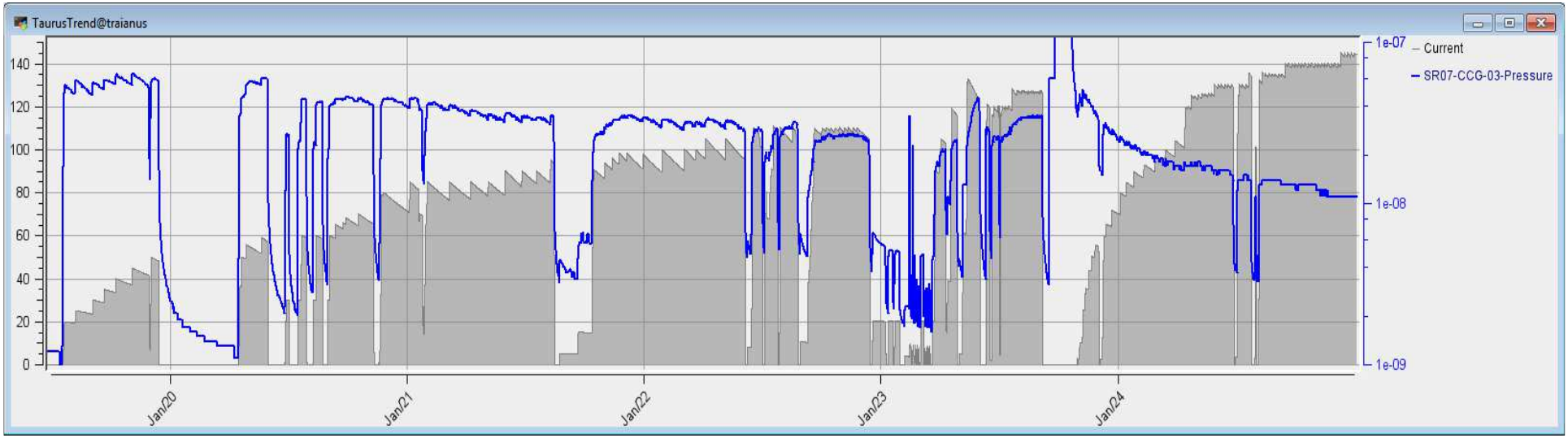
- TCs installed at the outer side of electrodes and at the chamber
- RGA installed 10 m upstream from stripline
- Work with open ended stripline

  Calculations by C.Belver indicated that the T at the electrodes could reached 80ºC, which seemed acceptable.

Conditioning_1

Pressure

Since the nominal conditions for beam for users were not achieved, the stripline was replaced

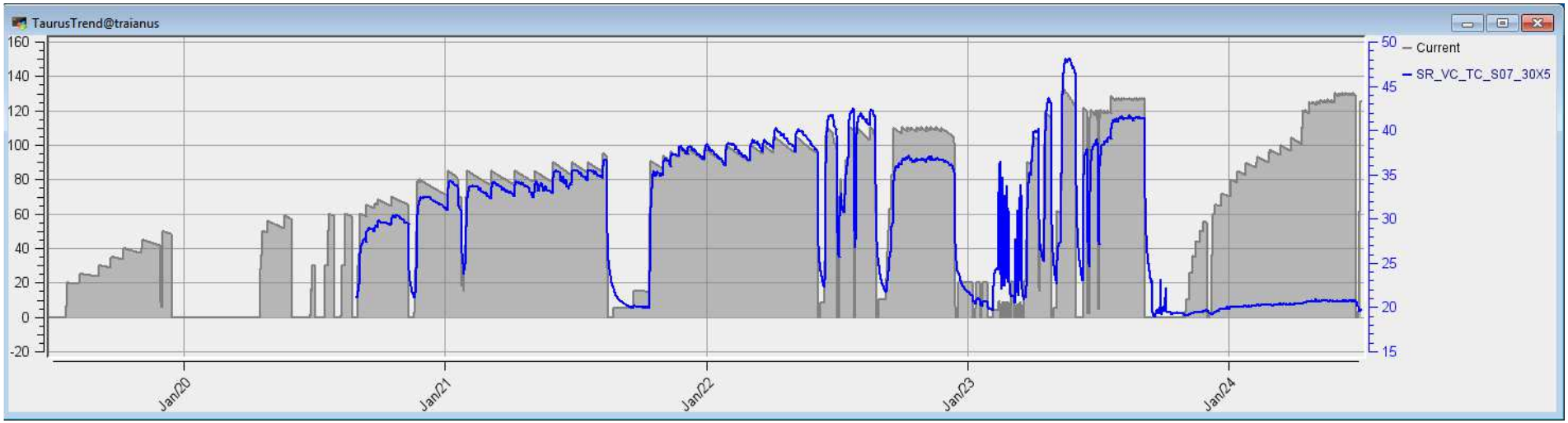


- For I<110 mA pressure is slowly decreasing, OK
- For I>110 mA the behaviour is not explained, NOK
- RGA (placed 10 m ustream) shows a clean spectra

Conditioning_1

Temperature

Since the nominal conditions for beam for users were not achieved, the stripline was replaced



- Reached 45ºC in the outer side of the connector
- Temp reached on the electrode?

Conditioning_1

SOURCES OF HEAT INSIDE THE STRIPLINE

1) Because the stripline is not terminated, beam image currents flow and stay on the electrodes

   >33W/4 feedthrough = >8 W/feedthrough

   $T_{electrode}$ = 80ºC

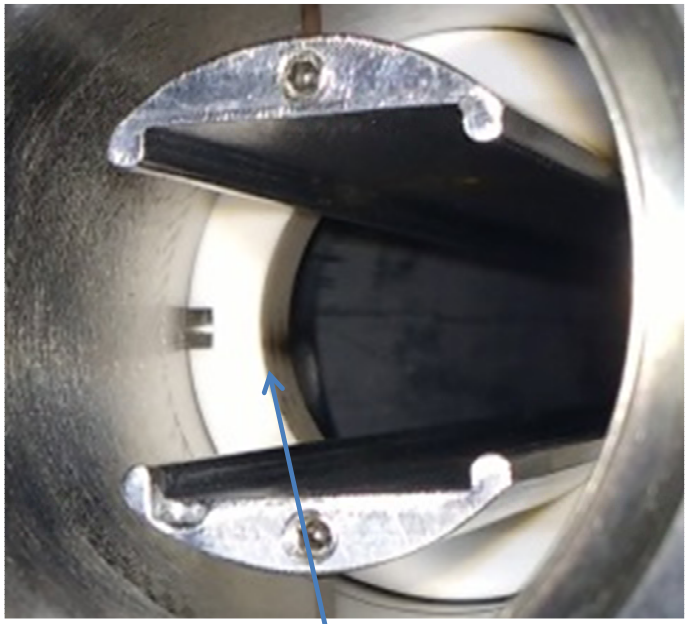
2) Synchrotron radiation impinging on the MACOR rings.

SOURCES OF PRESSURE INCREASE INSIDE THE STRIPLINE

3) Photodesorption due to SR on the absorber
4) Thermal desorption

Conditioning_1

Zoom in at stripline exit, last MACOR ring



SR hitting the MACOR rings

- What happens to MACOR under radiation?
- RGA indicates a clean scan but is it close enough?

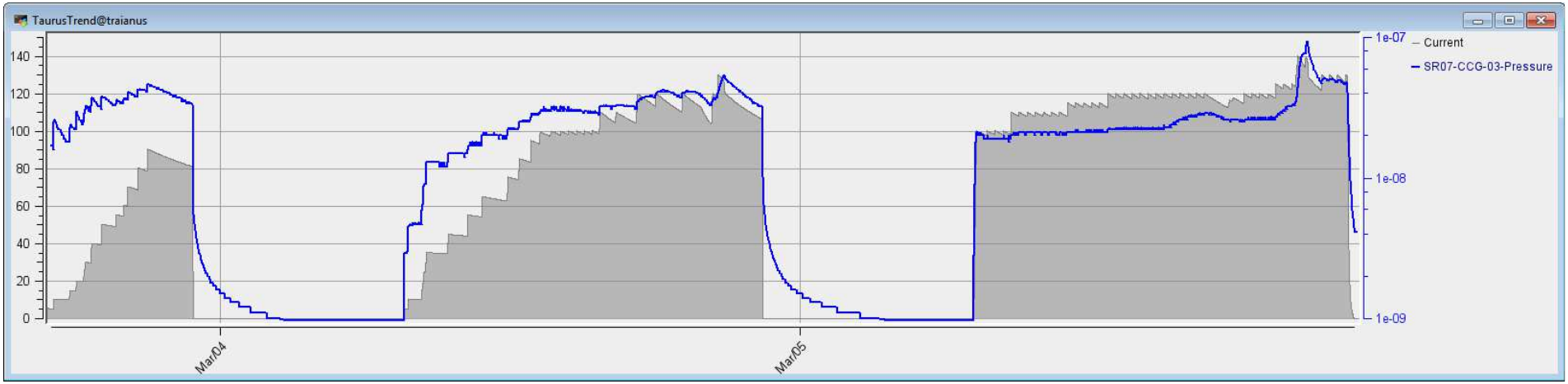
Conditioning_2

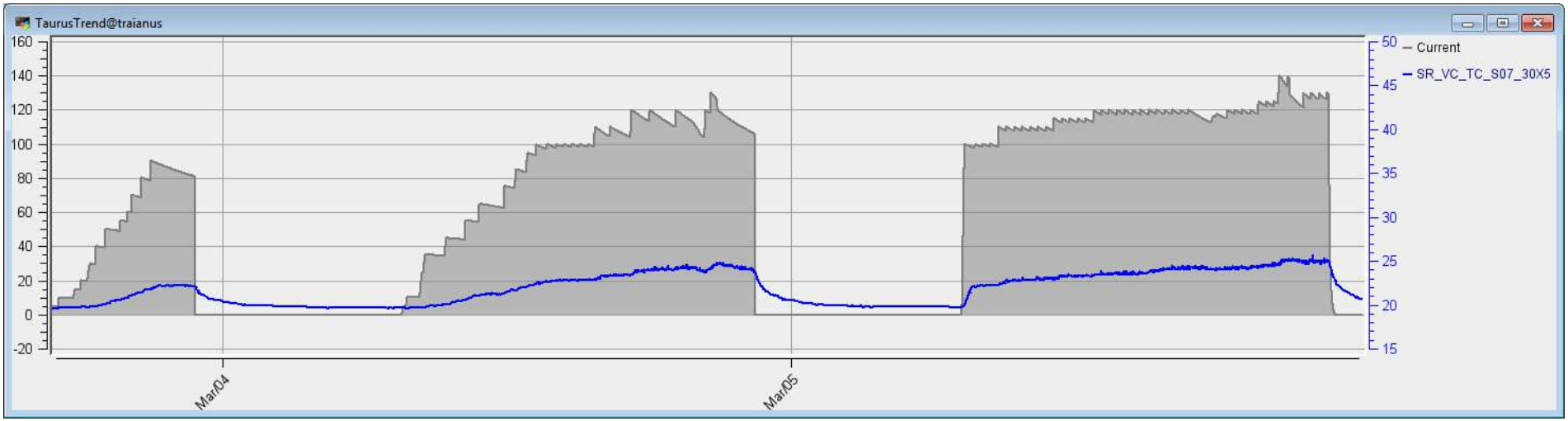
- Re-aligned Stripline
- Stripline connected to loads to avoid T increase
- RGA installed next to the stripline

4 x 100W loads
from DICONEX

RGA

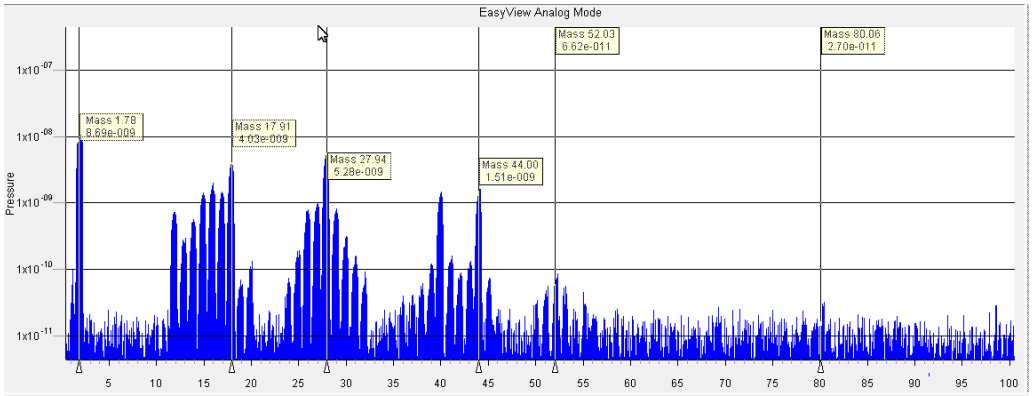
Conditioning_2



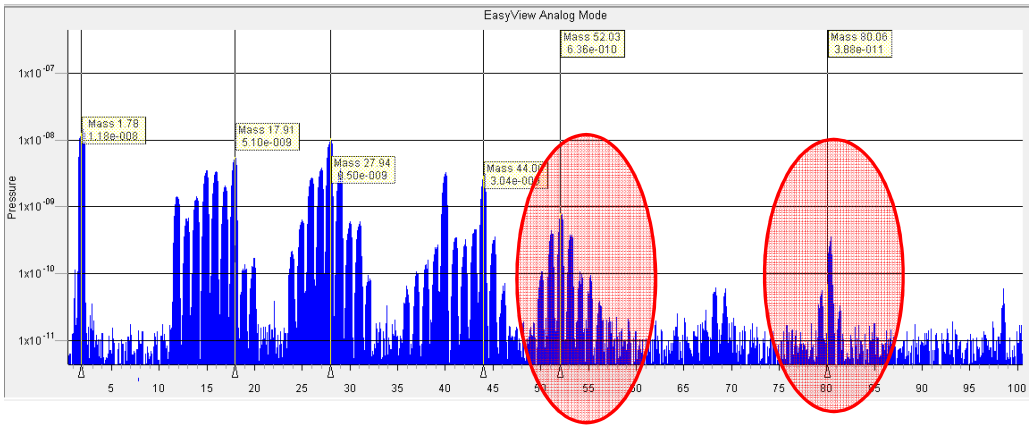


Conditioning_2

125 mA



135 mA



MACOR degradation ?

Plan for measurements with beam

Stripline characterisation with beam

1) Measurements without HV DC power supplies: **Beam coupling impedance**
   - The striplines assembly, together with the absorber, could have an impact on the ring impedance.
     - Measuring the beam impedance of the total ring before and after the installation of the striplines.
     - Single bunch measurements to determine TMCI threshold and detuning slope.
   - Following impedance measurements of the striplines, they will be replaced by a beam pipe and measurements remade: this will allow the influence of the absorber to be assessed.

Stripline characterisation with beam

2) Measurements with the HV DC power supplies: **Transverse field homogeneity**

- The electrodes will be powered by DC HV power supplies and will not be resistively terminated.
  - Simulations shown that powering the electrodes with DC voltage does not result in higher field inhomogeneity.
    - Only electrostatic field will be used to deflect the beam (the striplines will be open-circuited).
    - One issue that could appear when the terminations are open-circuited is the temperature increase at the electrodes
- A voltage of 45 V to 60 V will be delivered to the FUG power supplies due to the image currents flowing through the electrodes, when a beam of 150 mA is circulating through the striplines [calculations done in ALBA].
  - A low-pass filter could be used to protect the FUG power supplies (presently being studied).

Stripline characterisation with beam

2) Measurements with the HV DC power supplies: **Transverse field homogeneity**
   - A local angle measurement will be performed with 4 BPMs
   - Slow acquisition
   - Using a multibunch filling pattern
   - Calibration of the BPM non linear behaviour is under way

Stripline characterisation with beam

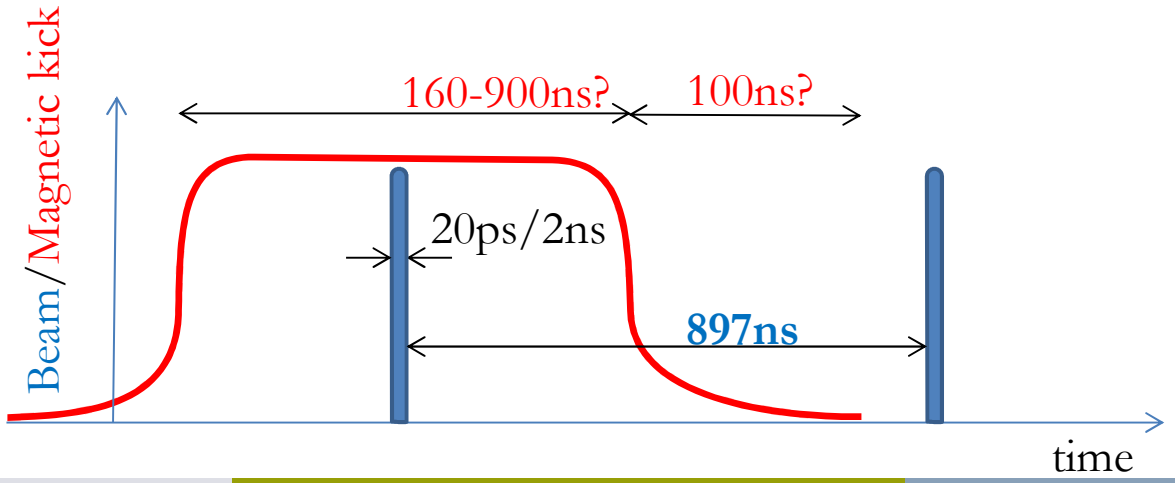
3) Measurements with the Inductive Adder: **Field flat-top stability, pulse-pulse repeatability, longitudinal field homogeneity**.

- Two inductive adders (J. Holma's presentation) are expected to be supplied by CERN at the end of 2017.
- There is some concern about the radiation next to the beam line and its potential influence upon the MOSFETS of the inductive adders.
  - The inductive adder could be placed in another area and connected to the striplines by using 10 – 15 m long cables.
- Transient studies of the magnetic field pulse have been completed (C.Belver presentation).

Stripline characterisation with beam

3) Measurements with the Inductive Adder: **Field flat-top stability, pulse-pulse repeatability, longitudinal field homogeneity**.

- Variable pulse delay
- Flat top might be an issue, ALBA rev time is 897 ns
- Measurements done in single bunch
- Using BPMs TbT readings with enough averaging
- Use global amplitude measurement with all 122 BPMs



NEXT STEPS

1) Find another solution for the MACOR rings

   → Already under discussion with the manufacturer

2) Conditioning the stripline with beam

3) Impedance measurements

4) Conditioning stripline with HV

5) Measurements with beam and dc HV

6) Measurements with the inductive adder