

PAUL SCHERRER INSTITUT



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BPM Pick-Ups & Mechanics

DLS-2 / SLS 2.0 Information Exchange

BPMs and Beam-Based Feedbacks - November, 30th, 2020

- About 116 “regular” BPMs are foreseen in the SLS2 ring.
- Special BPMs are foreseen in the injection straight (2 units, larger aperture) and eventually in the insertion device straight sections (also very few units, smaller aperture). Their dimensions is not yet defined.

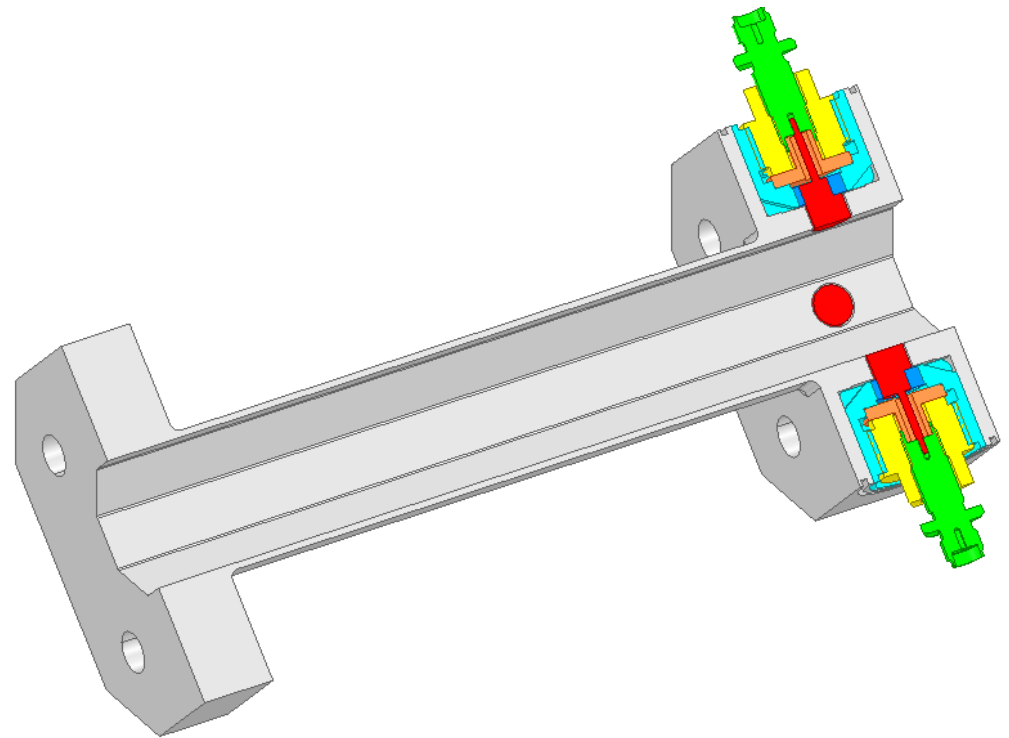
This presentation concerns the regular BPMs only.

They are conceived for an octagonal 18mm (inner aperture) beam pipe, where the aperture at the BPM location is tapered to 21mm aperture, to avoid that synchrotron radiation hits the buttons.

BPM pickup and beam pipe for corrector are one piece, flanged. Flange to flange length is 142mm.

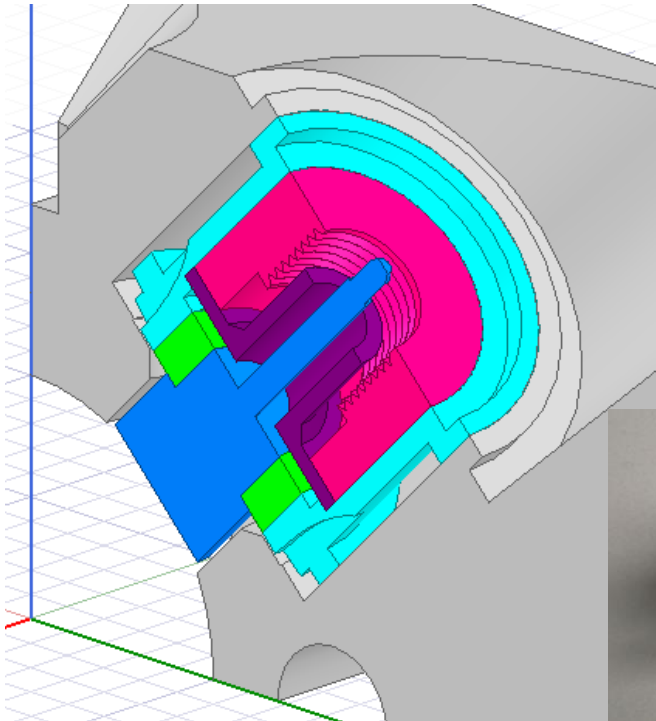
Made of stainless steel, with 5µm Cu coating.

After welding the buttons, further coated with 500nm NEG layer.



BPM button design

- Feedthrough dielectric insulator is borosilicate glass (in green in the picture)
- RF connector is standard SMA female
- Button diameter 6.4mm. Gap diameter 0.3mm.
- Fixed at the main body by welding.

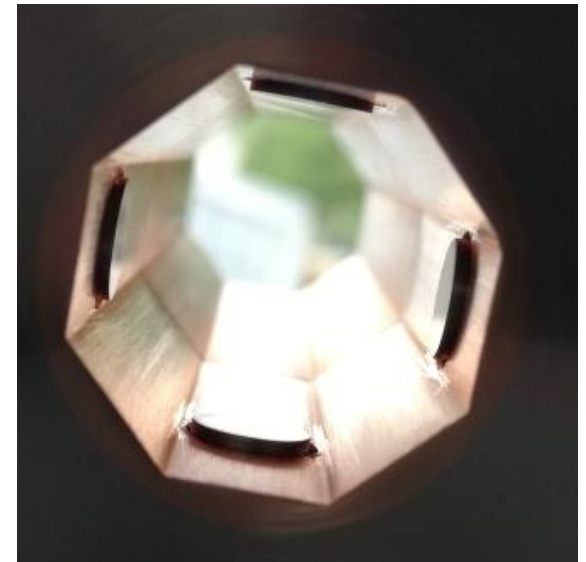


First BPM button prototypes (1)

1. **Ten buttons** have been ordered (February 19).
Supplier is BC-Tech. Delivered in May 19.
2. Vacuum group designed two BPM vacuum chamber blocks. Delivered at PSI in February 2020.
3. Two BPMs ready (buttons welded in the blocks) at the end of March 20.
4. Visual inspection (see picture) and RF measurements at the end of April.

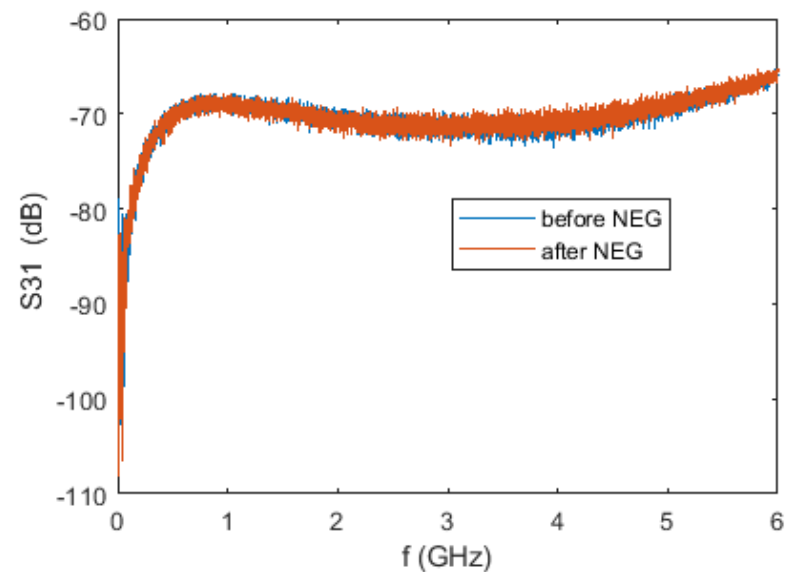
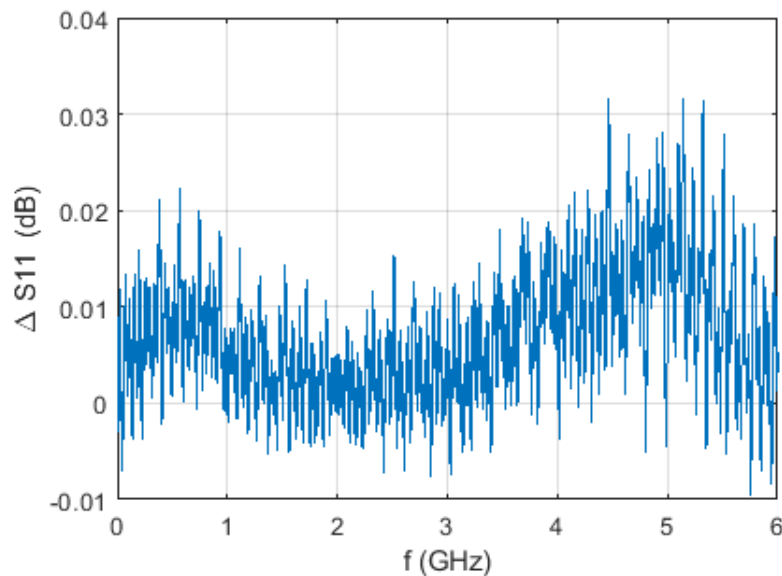
The buttons appear to protrude a lot into the vacuum chamber. Asked for metrology. Measurements confirmed that each button protrudes about 0.5mm inside the pipe. This is due to the combination of two errors:

- the feedtrough parts were correctly machined but assembled out of tolerances. Then the buttons result 0.3mm too long
- the button housing in the BPM block was designed 0.2mm too deep.



First BPM button prototypes (2)

- Then the two prototypes passed the leak tests after few heating cycles and some other mechanical stresses.
- 2 μm thick NEG layer has then been deposited on the beam pipe surfaces (in SLS2.0 we will only have 0.5 μm).
- RF measurements repeated. No significant differences observed. Examples of S-matrix measured parameters in the following plots.



- Additional 10 μm NEG layer will be now deposited and the RF test repeated again.

BPM vacuum chambers

- Two more pieces ordered. Unlike the previous ones they will have 5 μm copper coating.
- After delivery the buttons will be welded and then a 500nm NEG layer applied.
- The goal is to test the whole production procedure and in particular the copper layer quality, its adhesion before and after cleaning, state near the welding, the NEG deposition on this copper layer.

Buttons

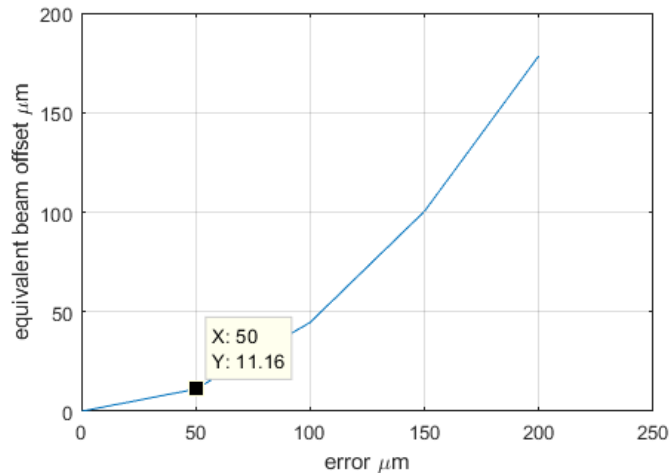
- A second series (30 pieces) has been ordered. Delivery expected by the end of the year.
- A solution to damp the trapped TE11 mode has been implemented.
- Most important tolerances better specified. Main goal is to test if the necessary mechanical precision is feasible with the present design.

Button mechanical tolerances

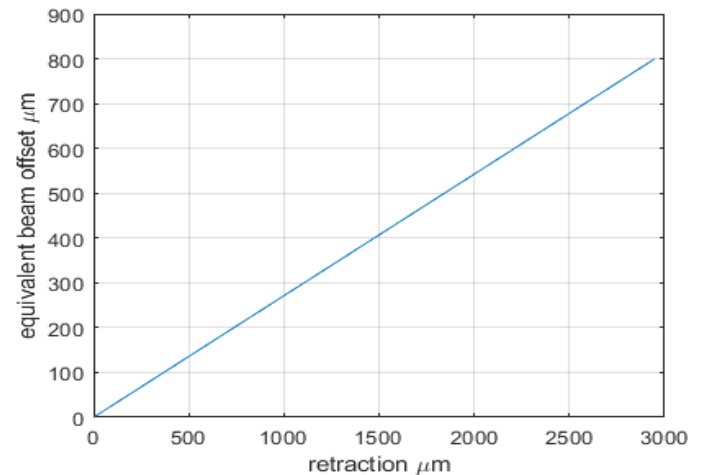
According to the specified tolerances:

- The button concentricity (gap uniformity) must be better than $50\ \mu\text{m}$.
- No protrusion accepted, max retraction $50\ \mu\text{m}$.

Estimate of position error determined by a BPM with one not centered (left plot) or retracted (right plot) button. Signals produced by a centered beam are equivalent to those obtained in an ideal BPM with an off-center beam.



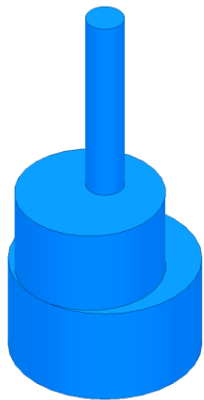
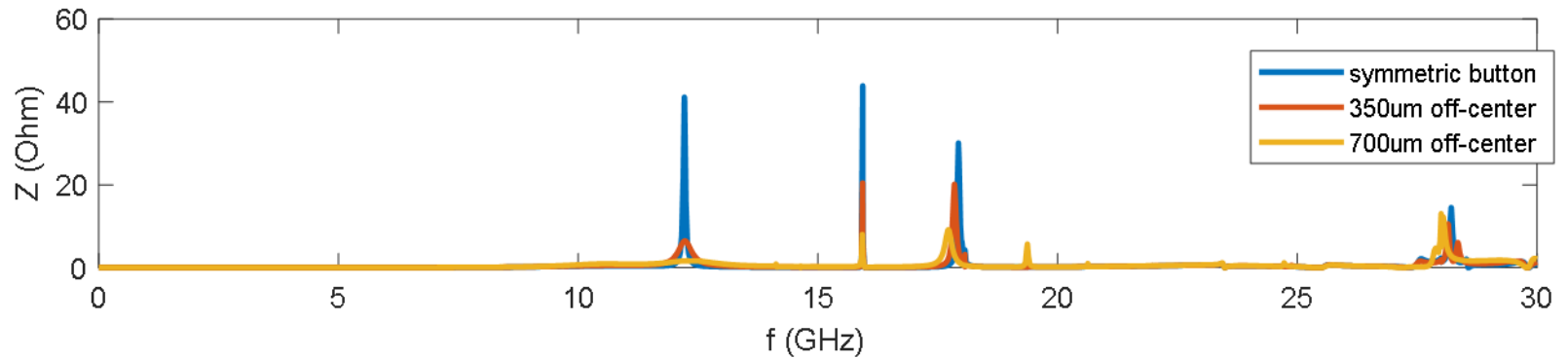
The maximum specified tolerance for concentricity error is equivalent to $11\ \mu\text{m}$ offset.



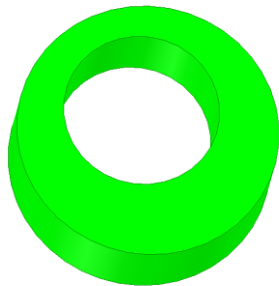
When retraction is $50\ \mu\text{m}$, the equivalent beam offset, in the same axis of the retracted button, is $<15\ \mu\text{m}$.

HOM damping

BPM longitudinal impedance (4 buttons)

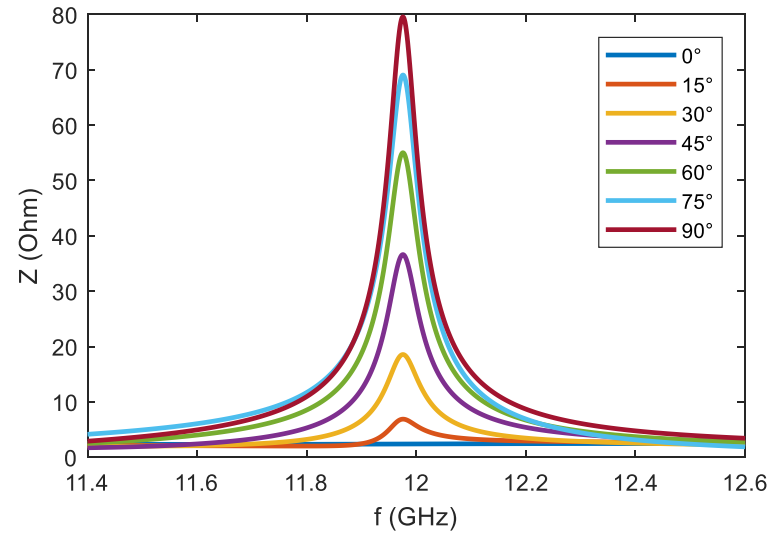


Feedthrough
center pin
(eccentricity 0.7mm)



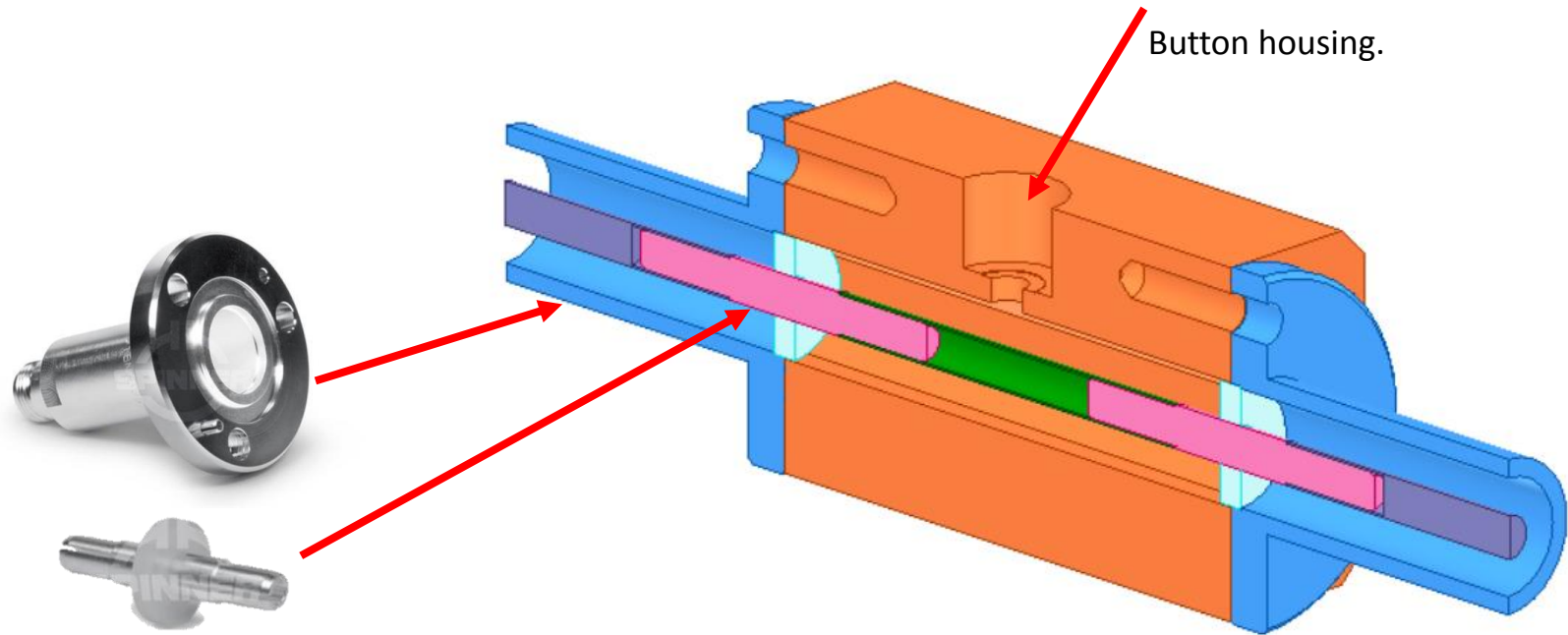
Glass

angle between asymmetry and beam axis



New buttons provided with markers for proper alignment

To be used to sort buttons according to their electrical characteristics



Button housing.

Commercial RF adapters
(N to 7/8 inches standards)

For a quick check of mechanical tolerances.

