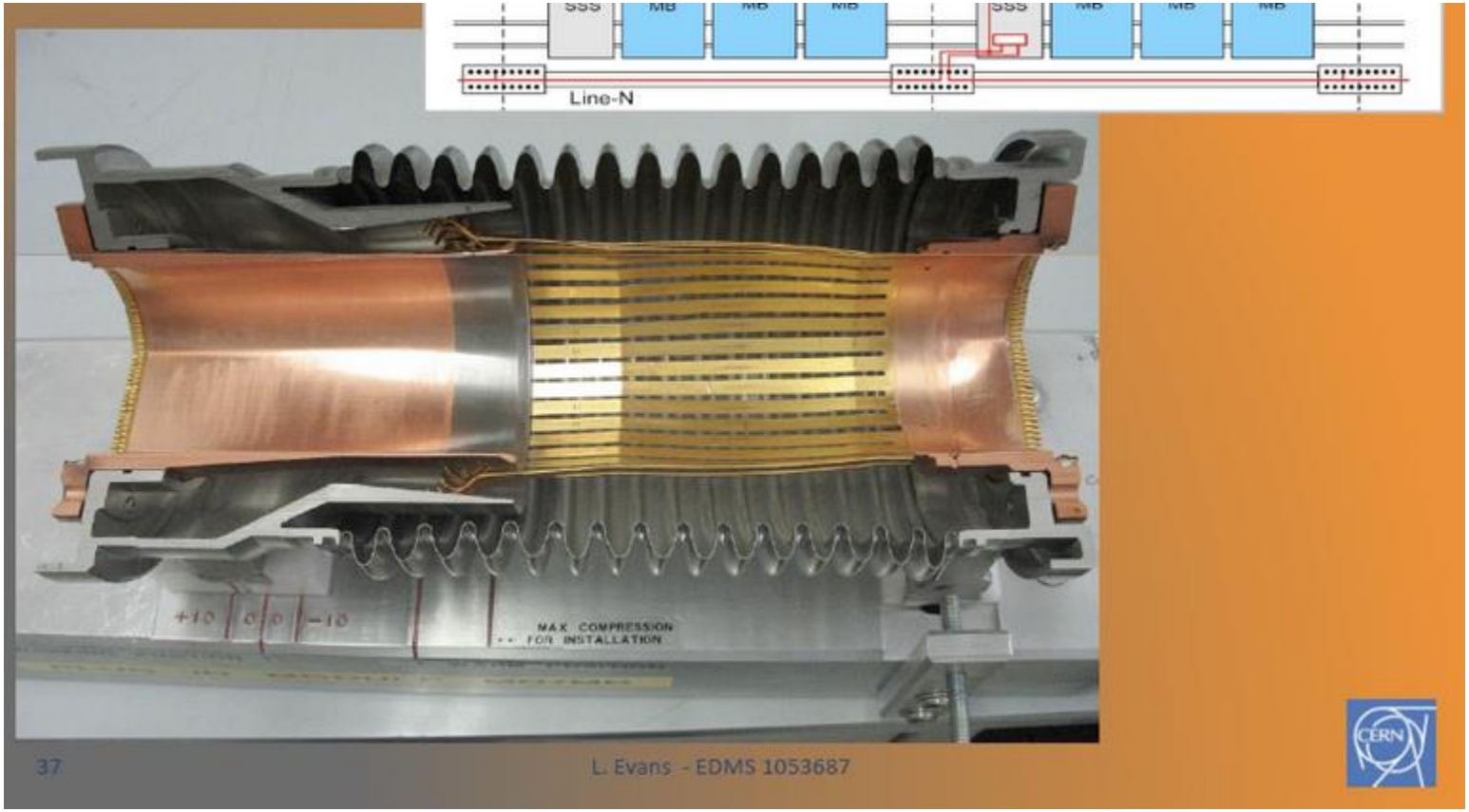
Heat load from impedance of non-conformity in interconnects

Francesco and Benoit

BE-ABP/HSC section meeting

19-06-2017

LHC PIMS



→ Need to check in elongated position

Non-conformity observed by Cedric Garion

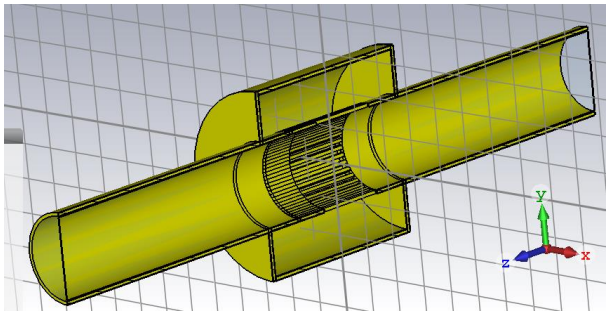
"[…]one clear non-conformity has been observed on the V1 line in the interconnection QQBI.18L1 . On the picture, a gap in the 1 mm range can be seen between a finger and the copper insert.

It would be interesting to assess the impact of such type of defect on the impedance and heat load.

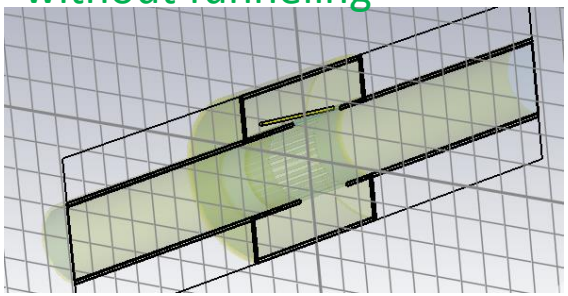
Educational dimensions for the vacuum CAS

Impact of non conformity and funneling

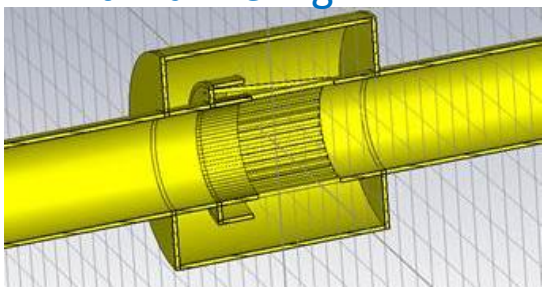
Perfect contact

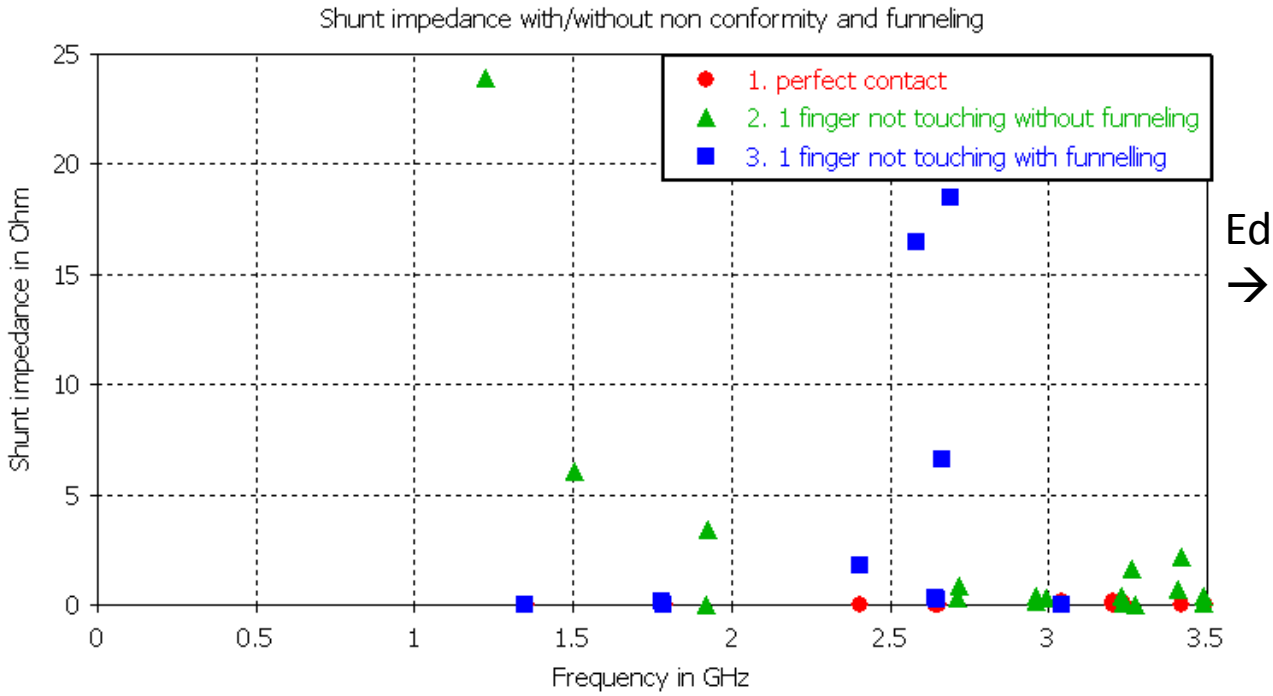


1 finger not touching without funneling



1 finger not touching with funneling





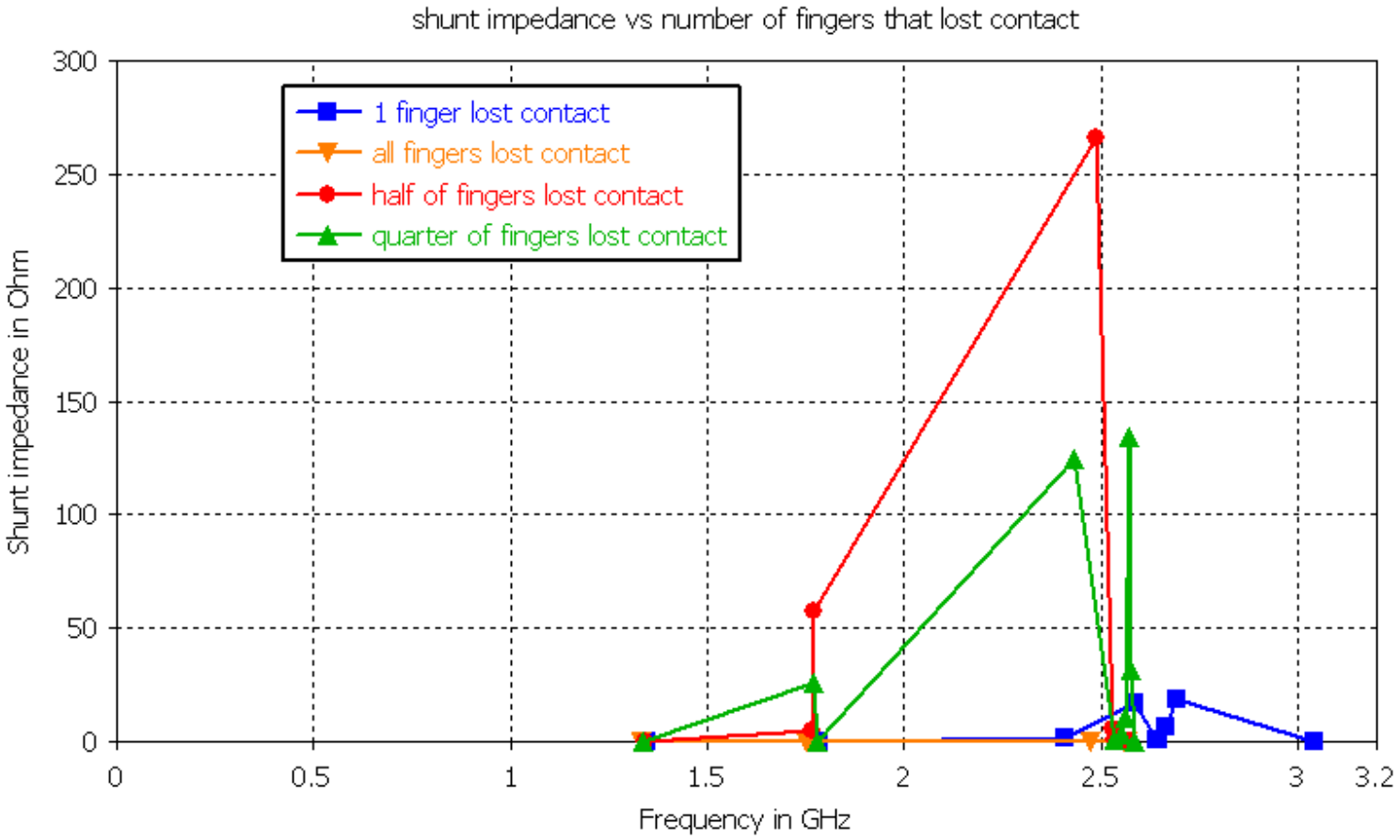
Educational dimensions

→ Fingers and bellow are shorter

→ it is important to ensure funneling in case of loss of contact

→ This is the case of the LHC PIMS in the arcs

Impact the number of fingers that lost contact with funneling

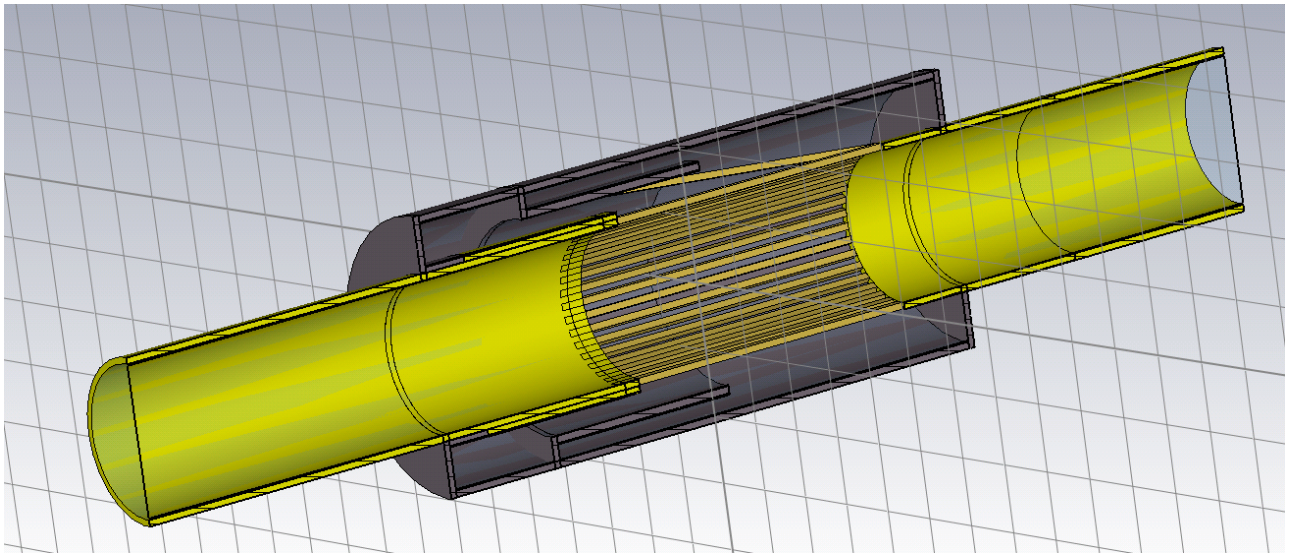


→ At maximum, 60 Ohm before 2 GHz

→ With 25 dB attenuation, 2200 bunches and 1.1e11 p/b, this reaches at most 20 mW for half of the fingers not in contact but funneled.

More realistic parameters

thanks to TE-VSC colleagues for advice (Cedric and Sergio in particular)



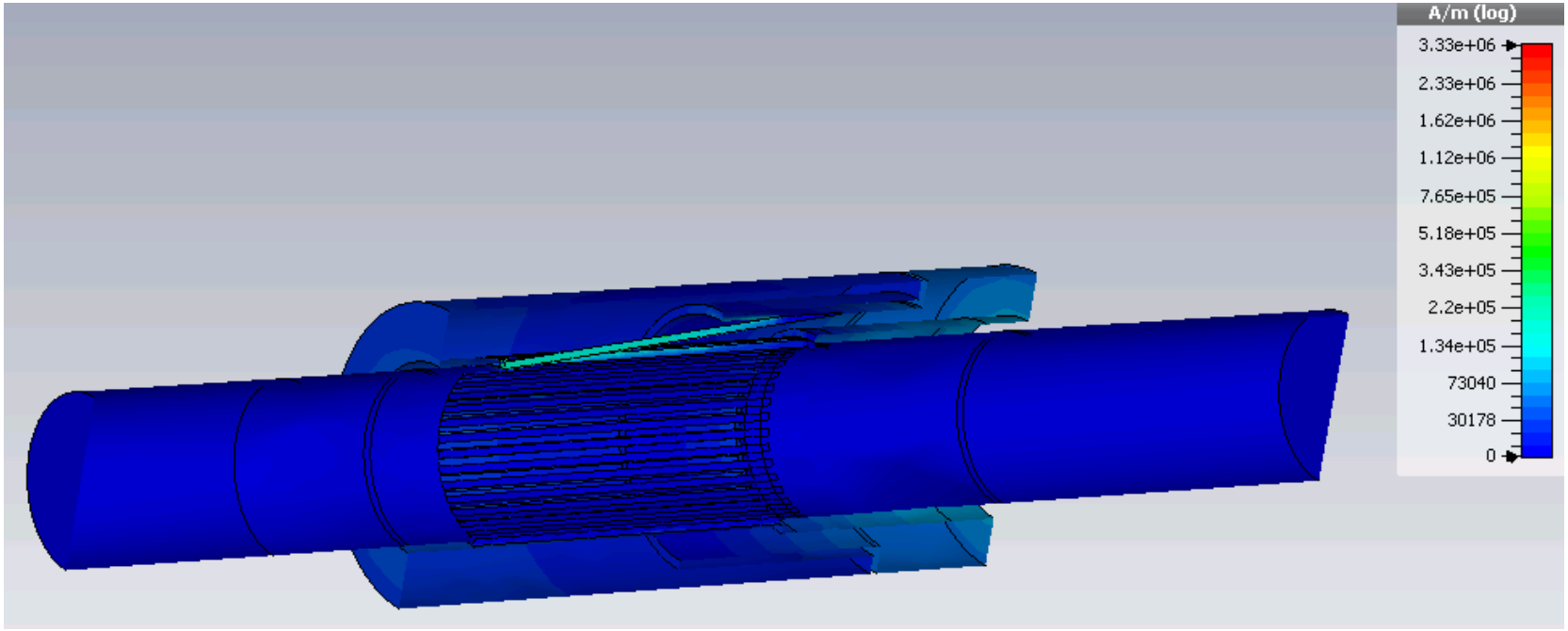
Main differences with simpler design:

→ longer RF fingers (~10 cm)

→ contact of the funnel on the top not the bottom

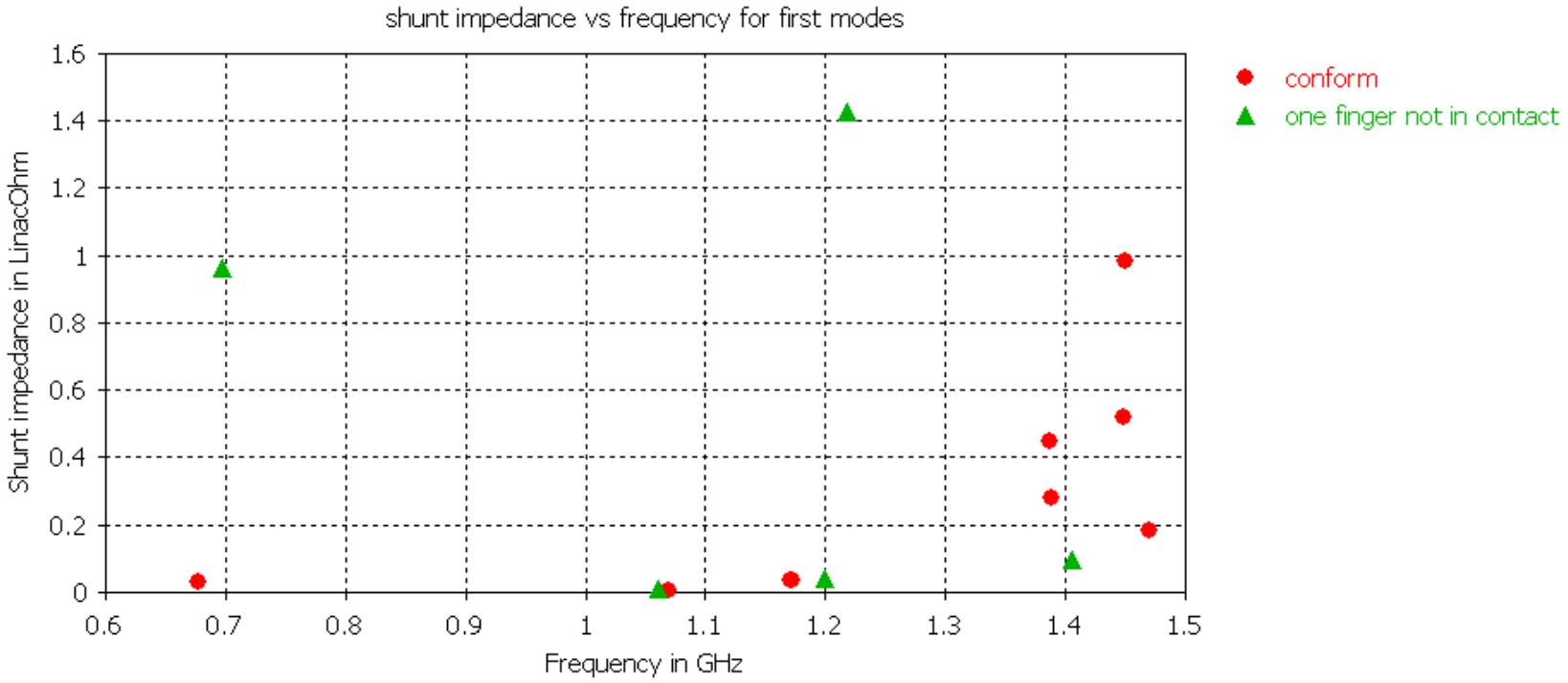
→ access to larger cavity and longer lengths behind the fingers

1 finger not in contact



→ Where is the power loss going? → mainly fingers and around the beam screen

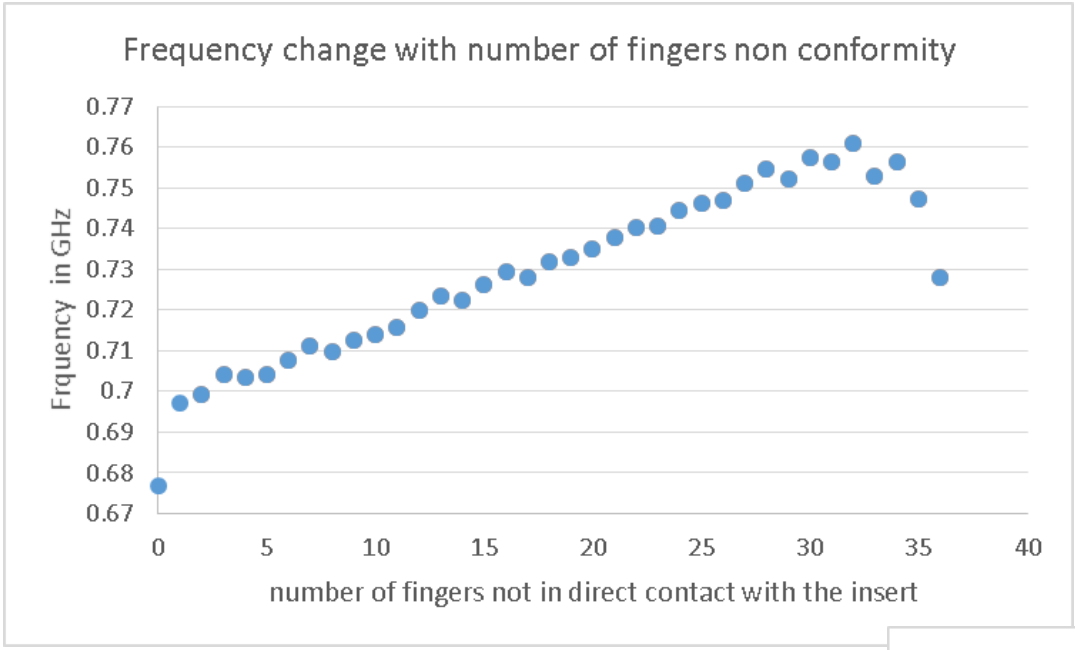
Simulation results for more realistic geometry



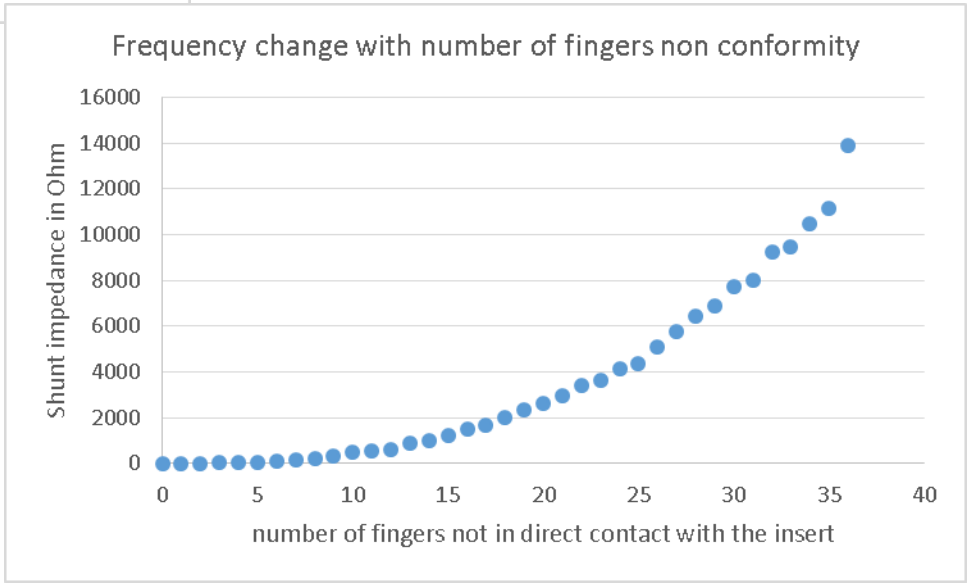
1 LinacOhm at 700 MHz corresponds to ~25 mW for a physics fill with
For 2500 bunches at 1.1e11 p/b if hitting a major resonance line.

This would be the non conformity mentioned by Cedric (i.e. 1 finger seen not touching the copper insert)

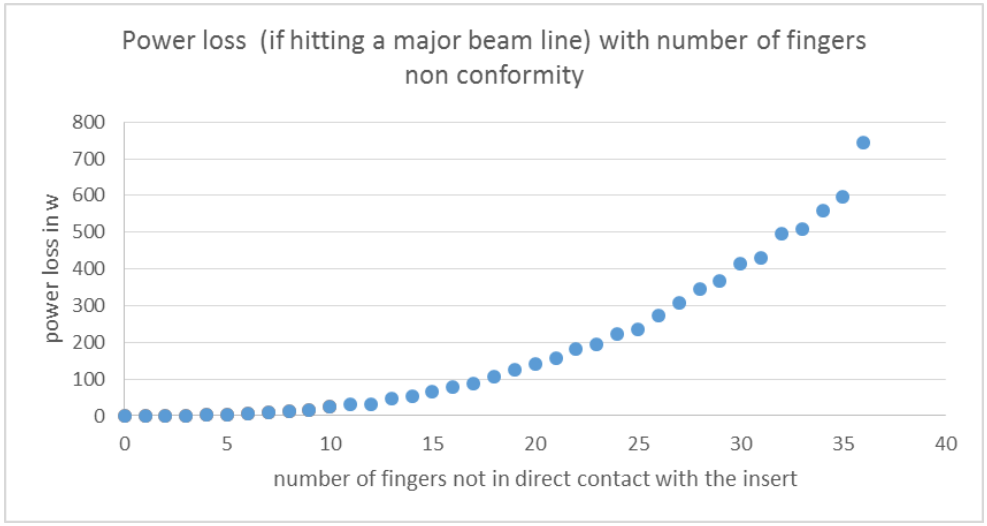
Simulation results for more realistic geometry

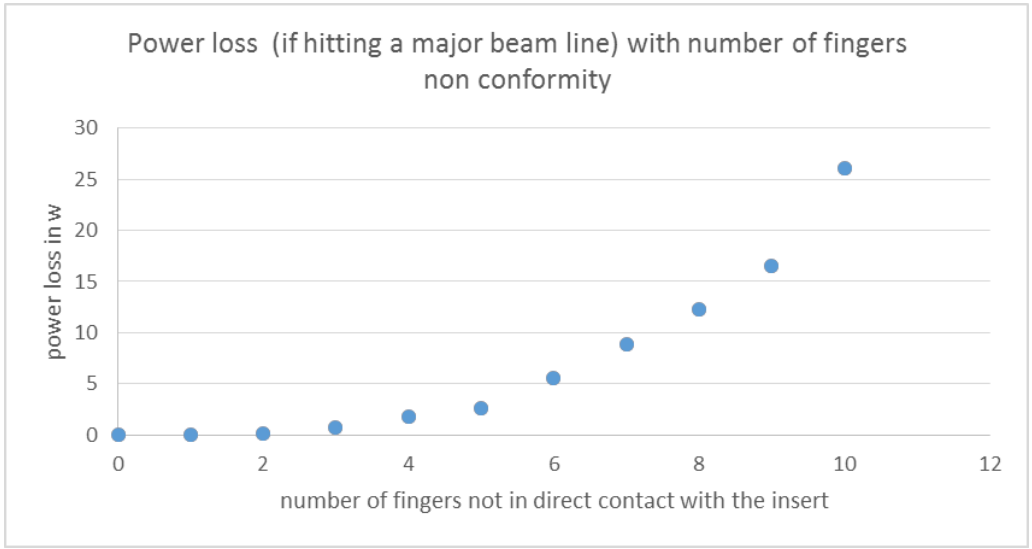


→ Can lead to larger shunt impedances if several fingers are not touching



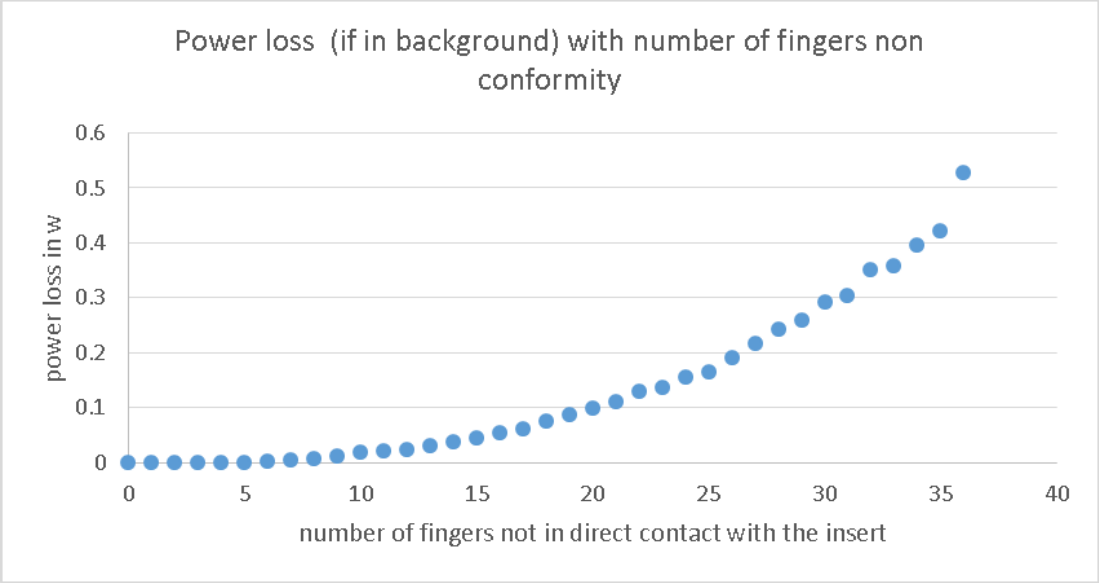
Power loss if hitting a major line

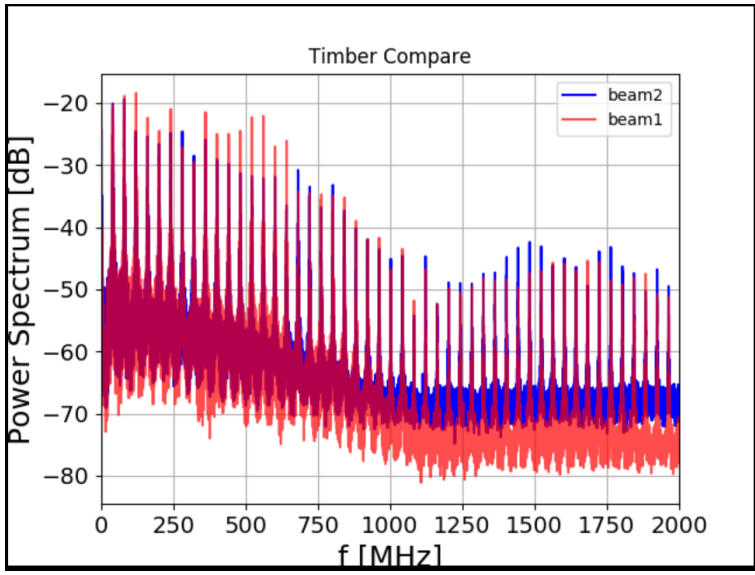




→ But should not be as otherwise would also be there for 50 ns beams (see Francesco's talk).

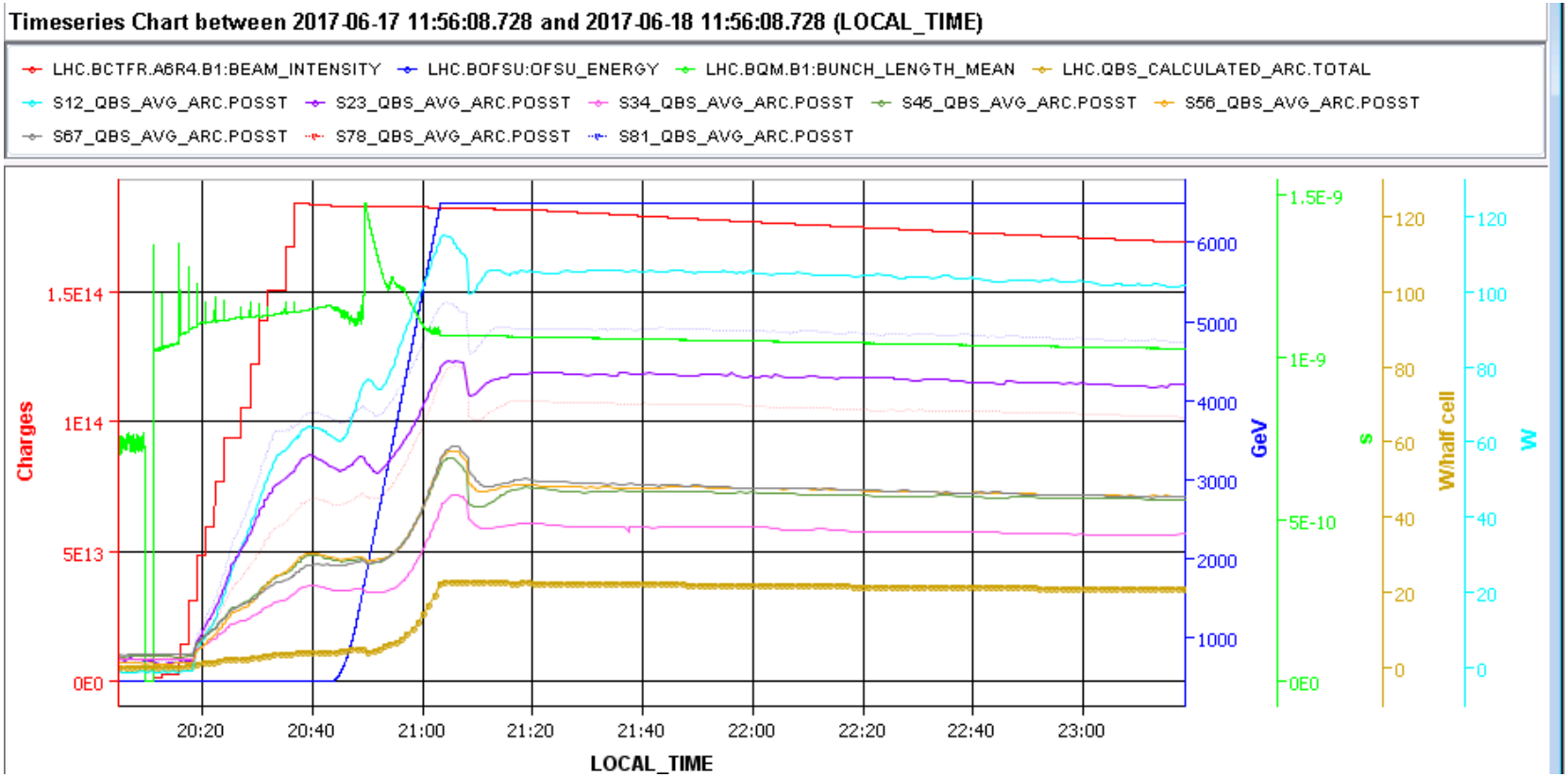
Power loss if in background





→ Would need a lot of fingers and a lot of non conforming PIMS to reach what is needed.

Reminder of order of magnitude



→ 70 W/hc difference between sectors

Summary

- The non-conformity observed by TE-VSC (1 finger losing contact on the tube) would lead to maximum 25 mW per PIM if it hits a major beam spectrum line.

- Worse non conforming situation with fingers in PIMS can lead to large shunt impedances (up to ~14 kOhm for all fingers that lost primary contact), and large power loss (several 100s W) if hitting a major resonance line.

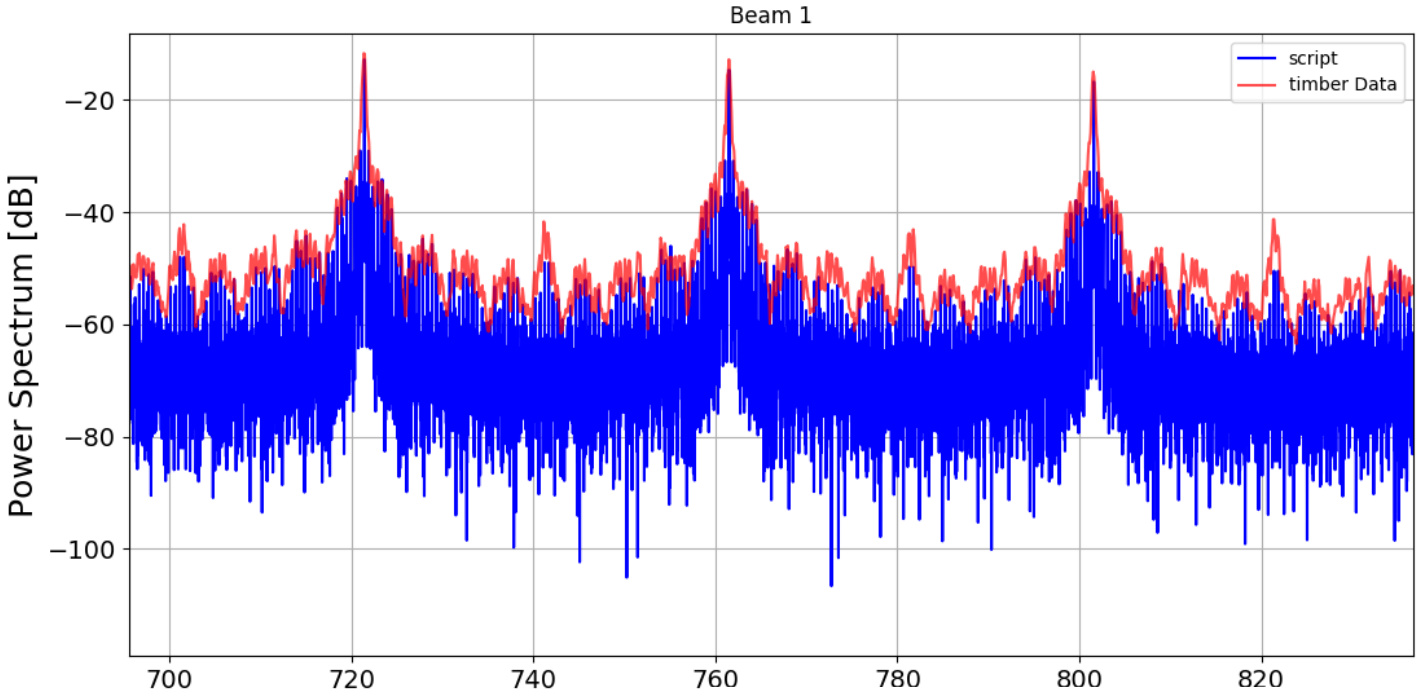
  → these non-conformities should be avoided

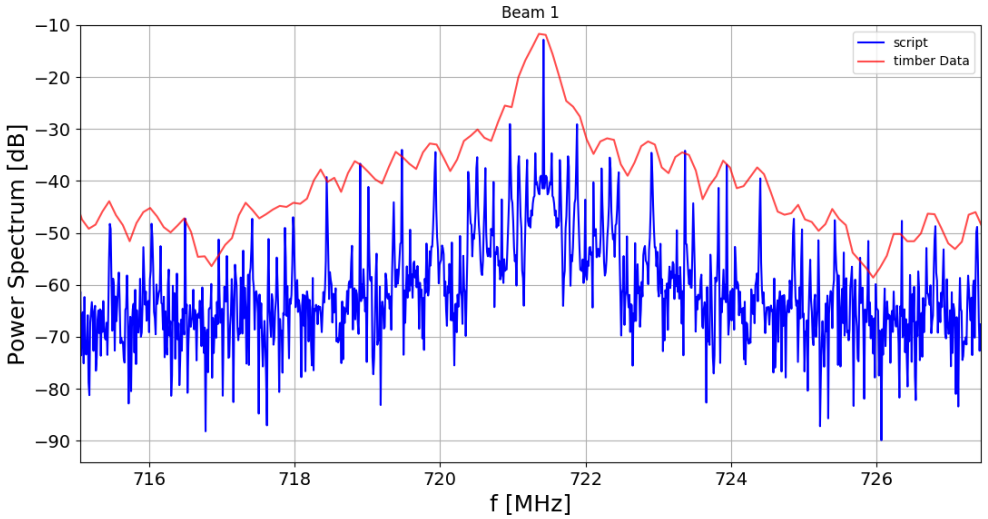
- Is hitting a major resonance line or a sideband a possibility when looking at various filling schemes?

- A detailed study was needed to know if any type of impedance could generate the range of power loss observed for different filling schemes

  → work by Francesco Giordano (Master student with Pasquale Arpaia)

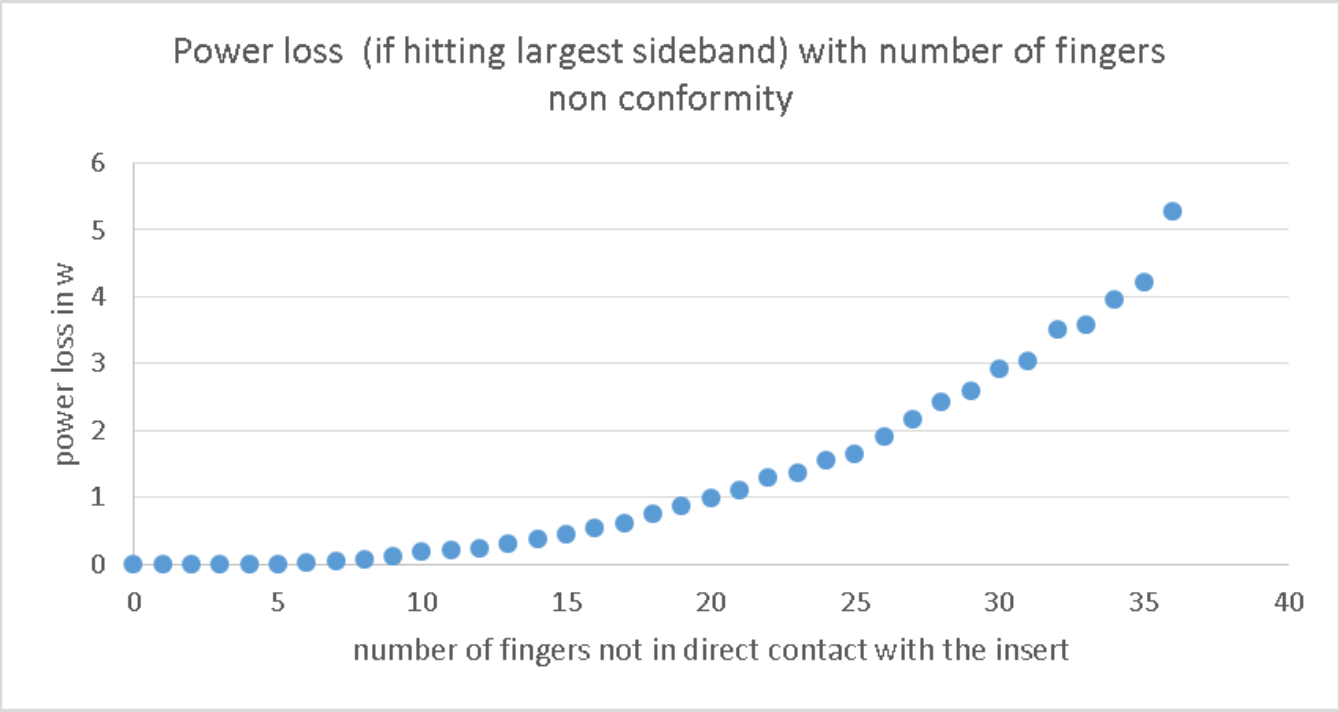
Latest plot from Francesco





→ Largest sideband at -30 dB

Power loss when hitting largest sideband



No contact at all