Dummy septum impedance measurements

S. Persichelli, O. Berrig,

J. Kuczerowski, J. Herbst

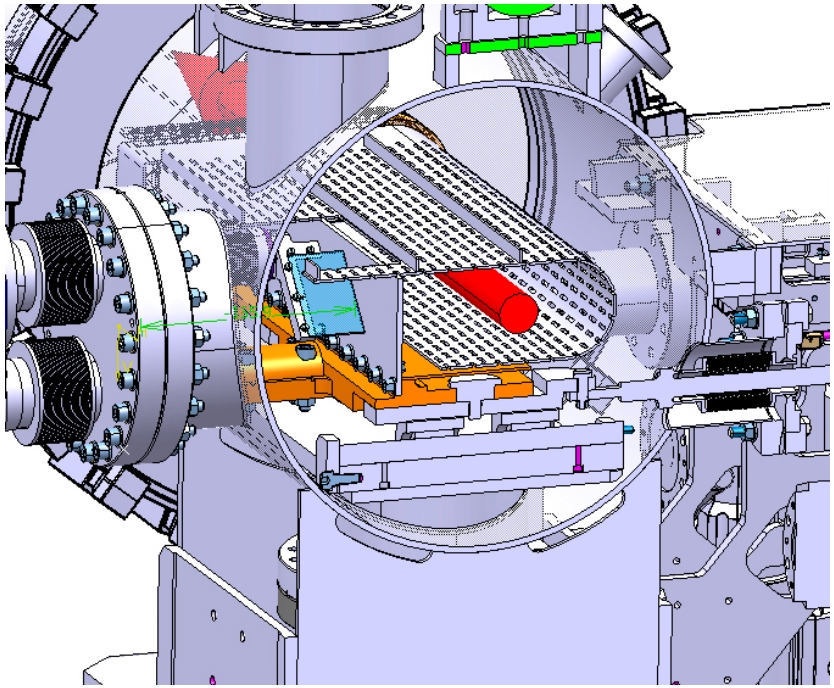
Dummy septum meeting

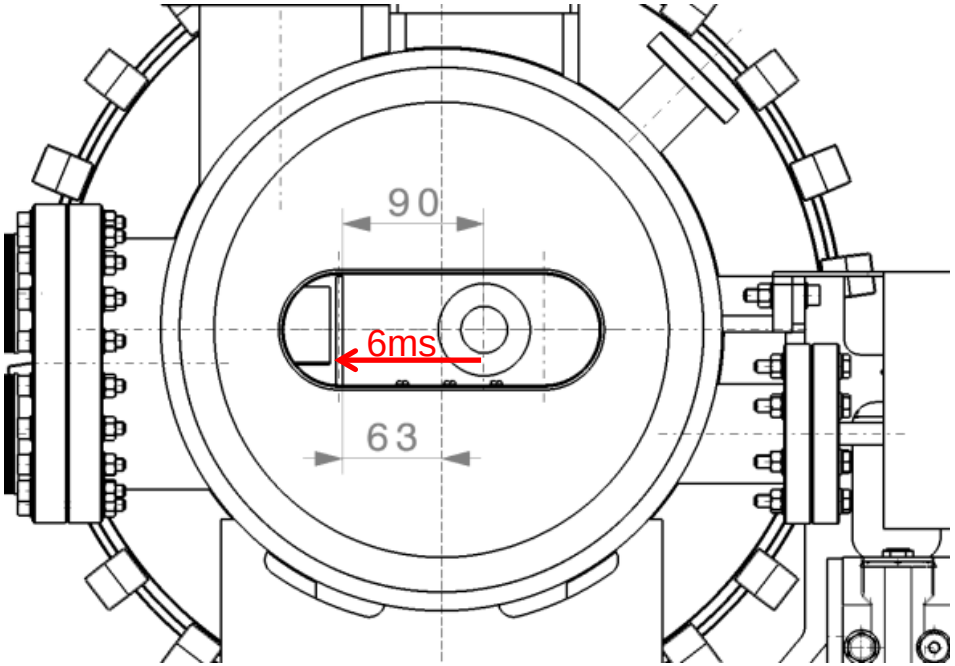
21-11-2013

Acknowledgements

F. Caspers, H. Damerau, M. Hourican,
S.Gilardoni, M. Giovannozzi, E. Métral, M. Migliorati, B. Salvant

Dummy septum during PS MT extraction





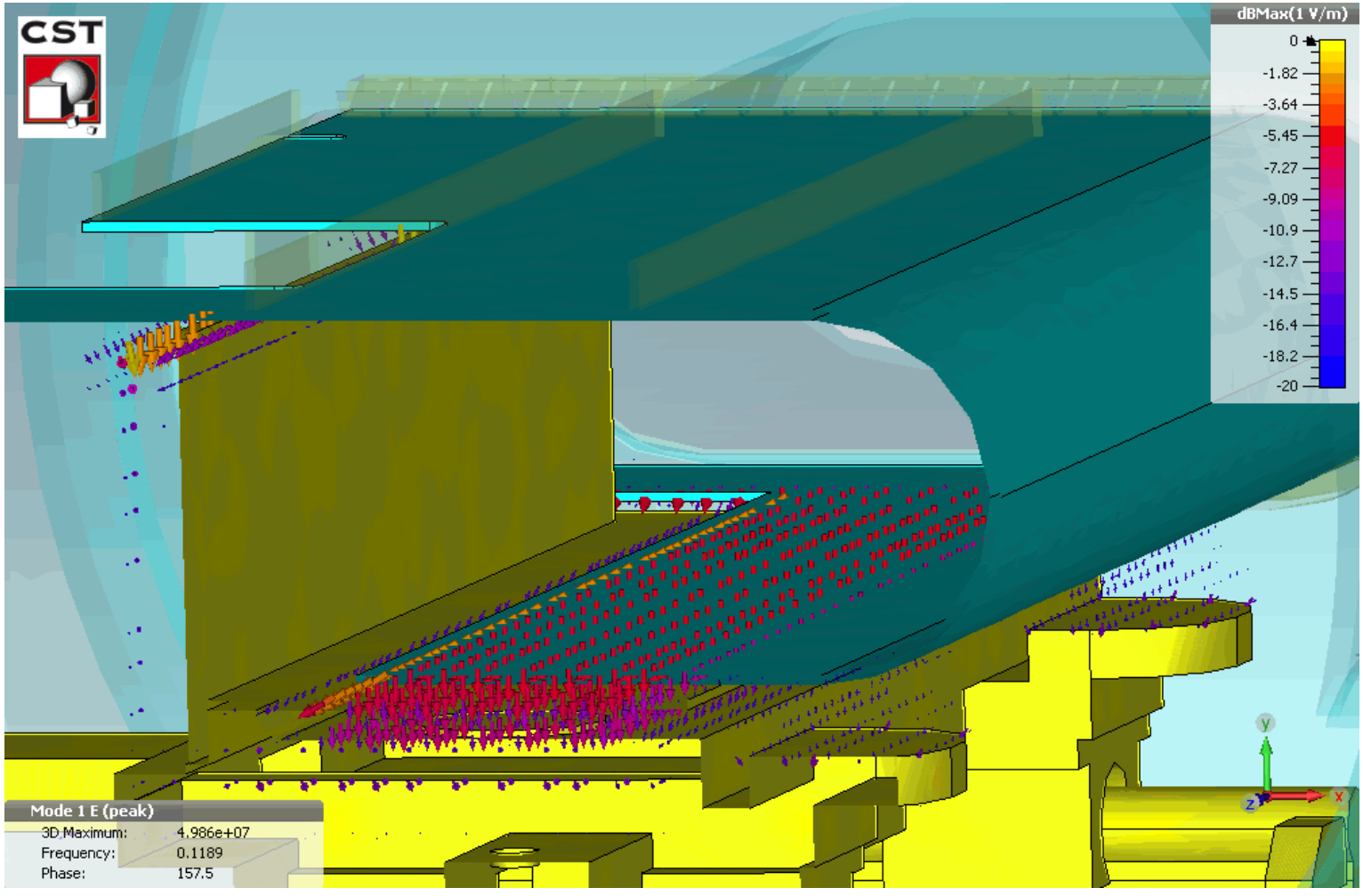
Courtesy of Mike Hourican

- **The beam circulates in a position displaced of 27 mm from the geometrical centre of the septum;**
- During extraction the beam takes **6 ms** to move from the orbiting position to few mm from the blade;
- The beam is going to stay very close to the blade only for few turns, then it is extracted;
- **The nominal position of the blade is between 80 and 100 mm from the orbiting position;**
- For simulation only the position of the blade shown in figure has been considered.

Without sliding contacts

Trapped mode at 119 MHz

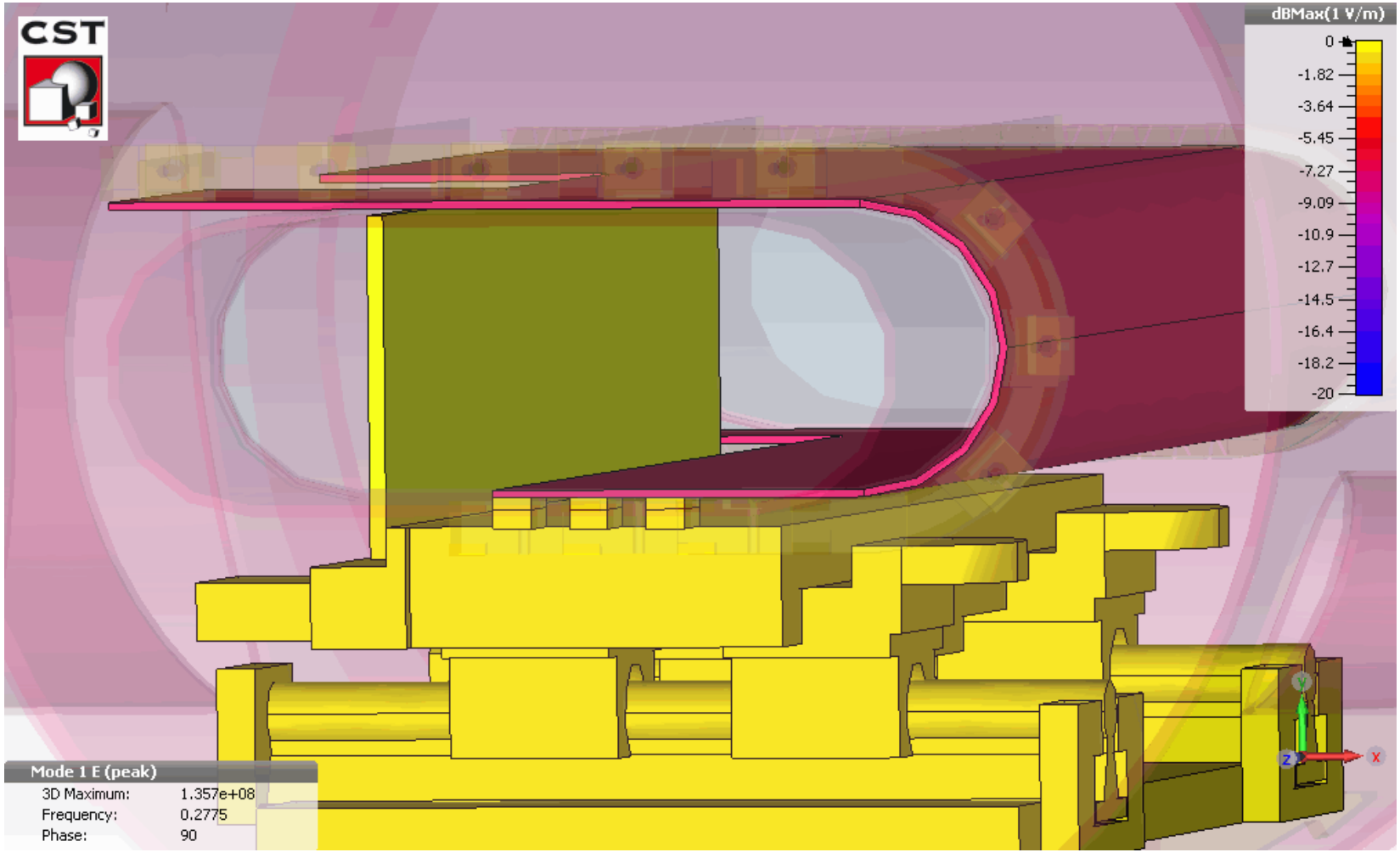
The mode at 118 MHz is localized mainly in the gap between the screen and the support table and in the gap between the screen and the blade .



With Sliding contacts

270 MHz mode electric field

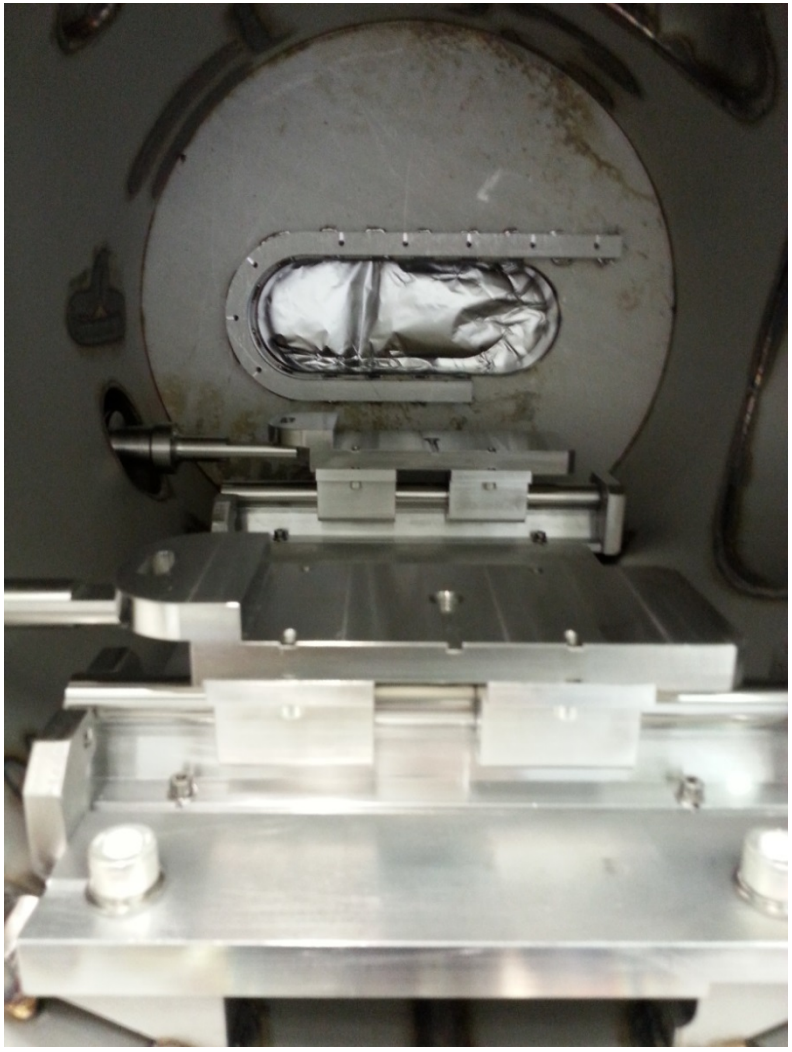
The mode at 118 MHz in cancelled and the main resonance is now 270 MHz localized at the gap between the blade and the screen.

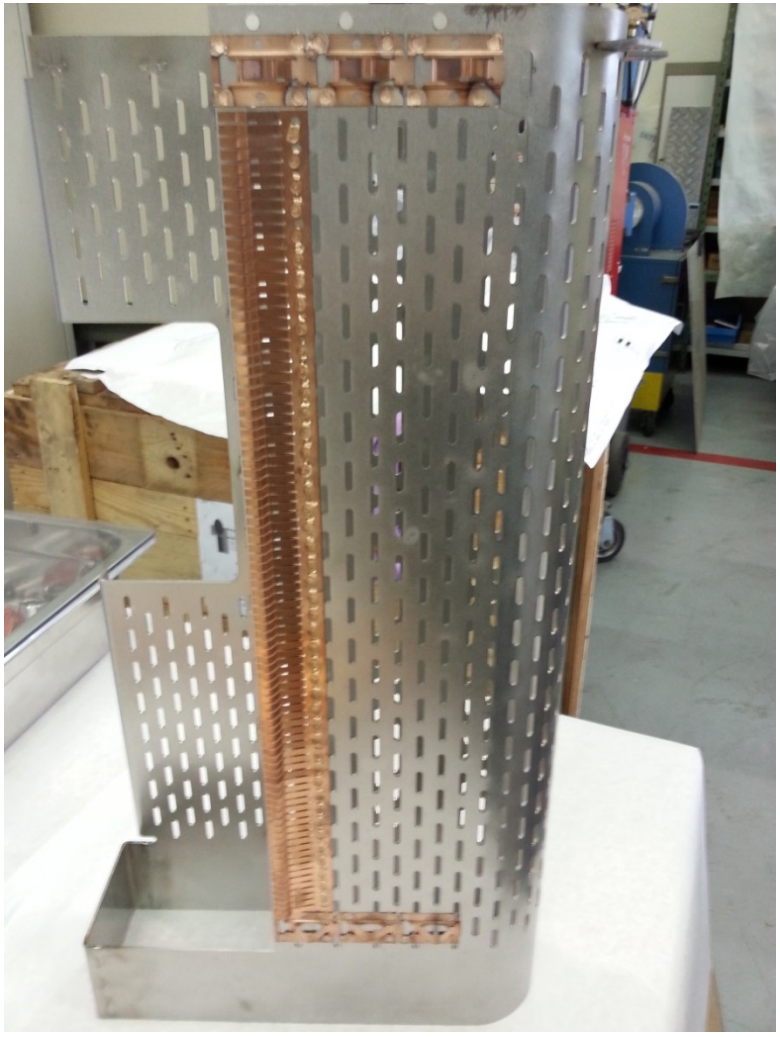


Dummy Septum: impedance measurement

Sliding contacts: mode cancelling

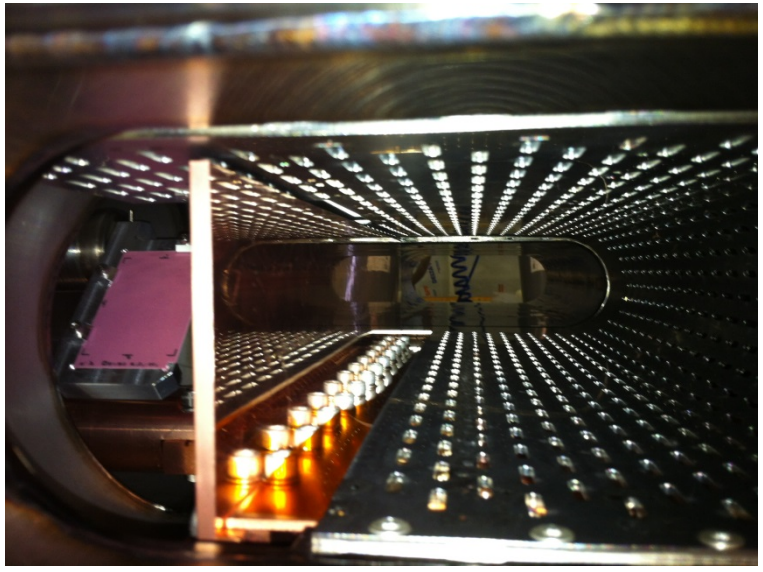
Sliding fingers allow contact between the screen and the support table, avoiding the generation of some low frequency trapped modes

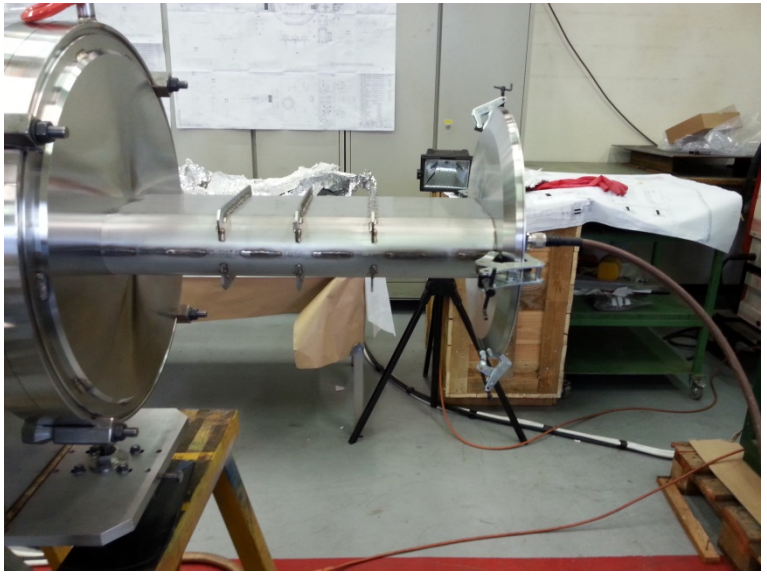


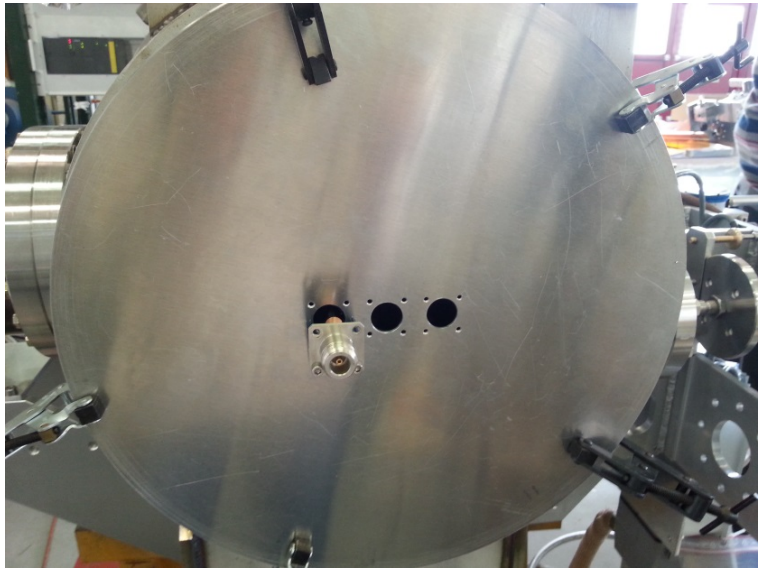


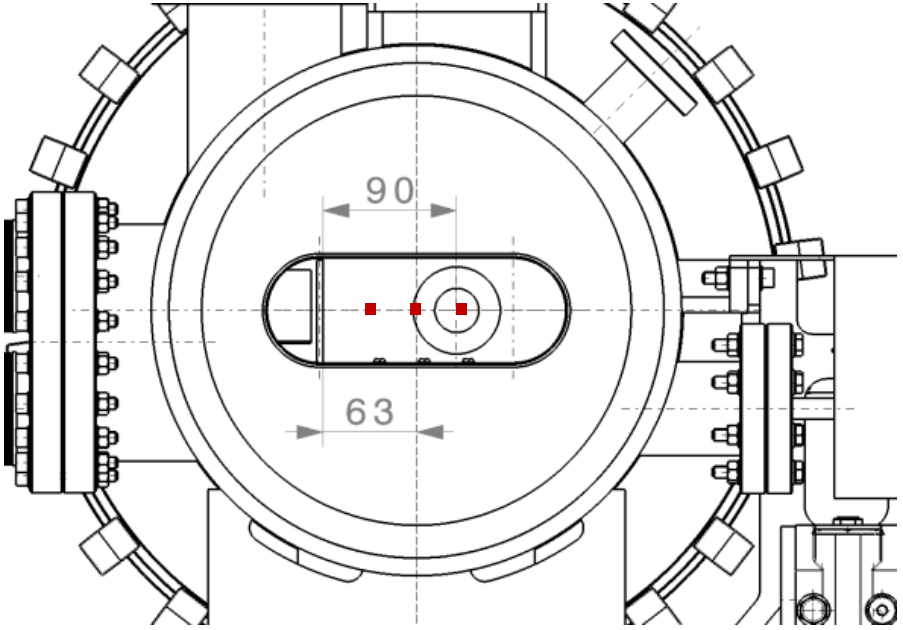
Dummy Septum: impedance measurement

Measurement setup



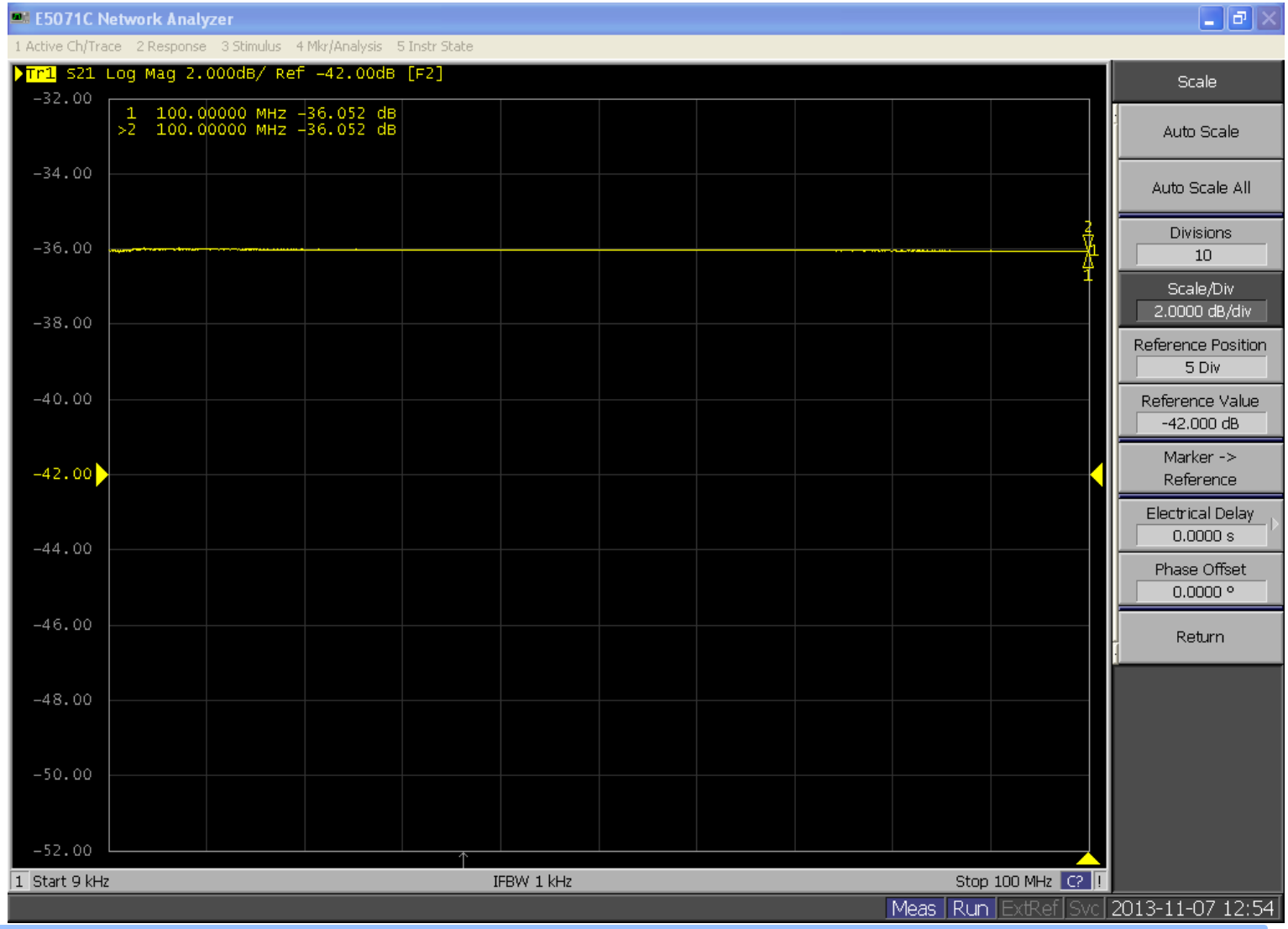






Dummy Septum: impedance measurement

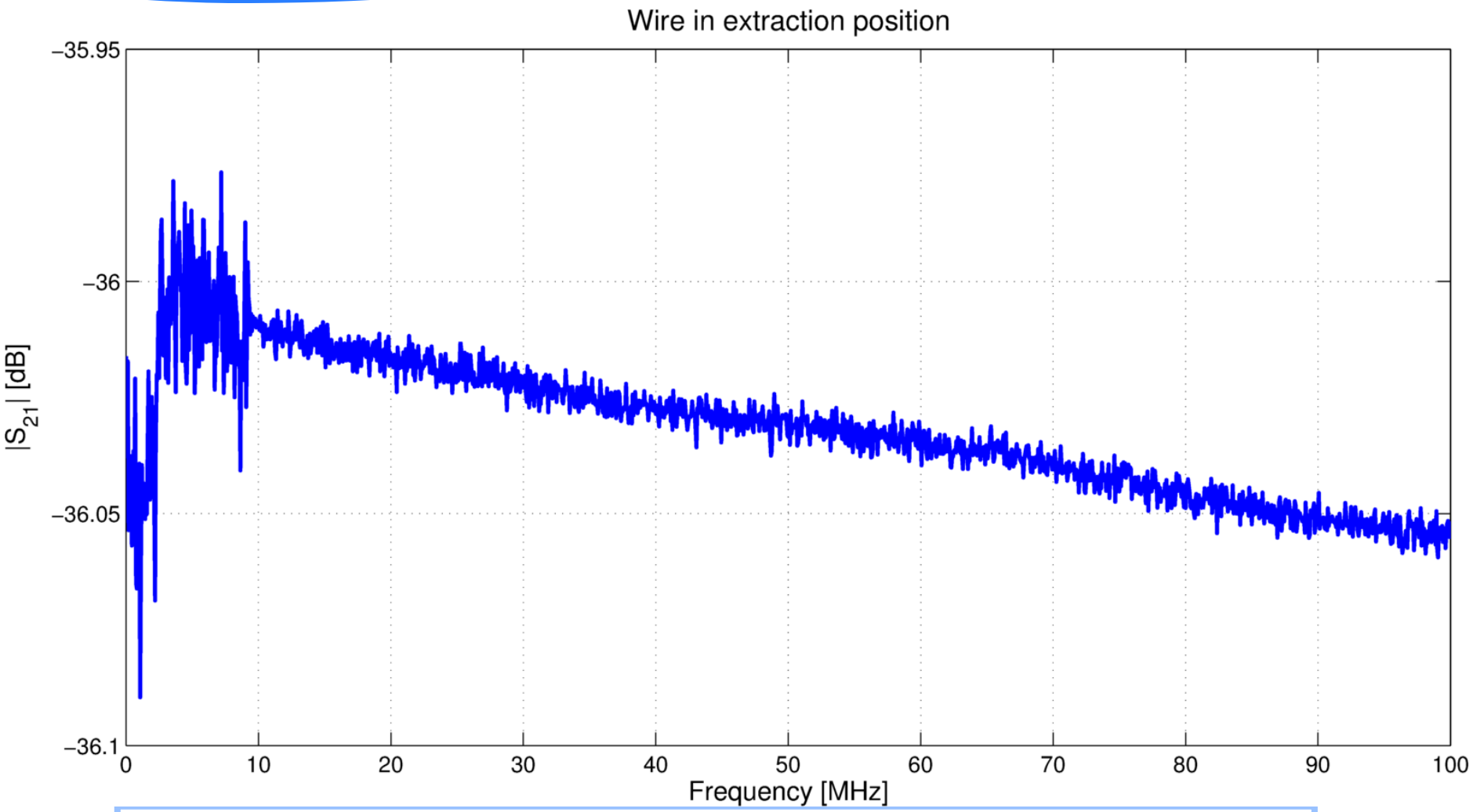
Low frequency S_{21}



It seems that the wire cannot excite trapped modes below 100 MHz!

Dummy Septum: impedance measurement

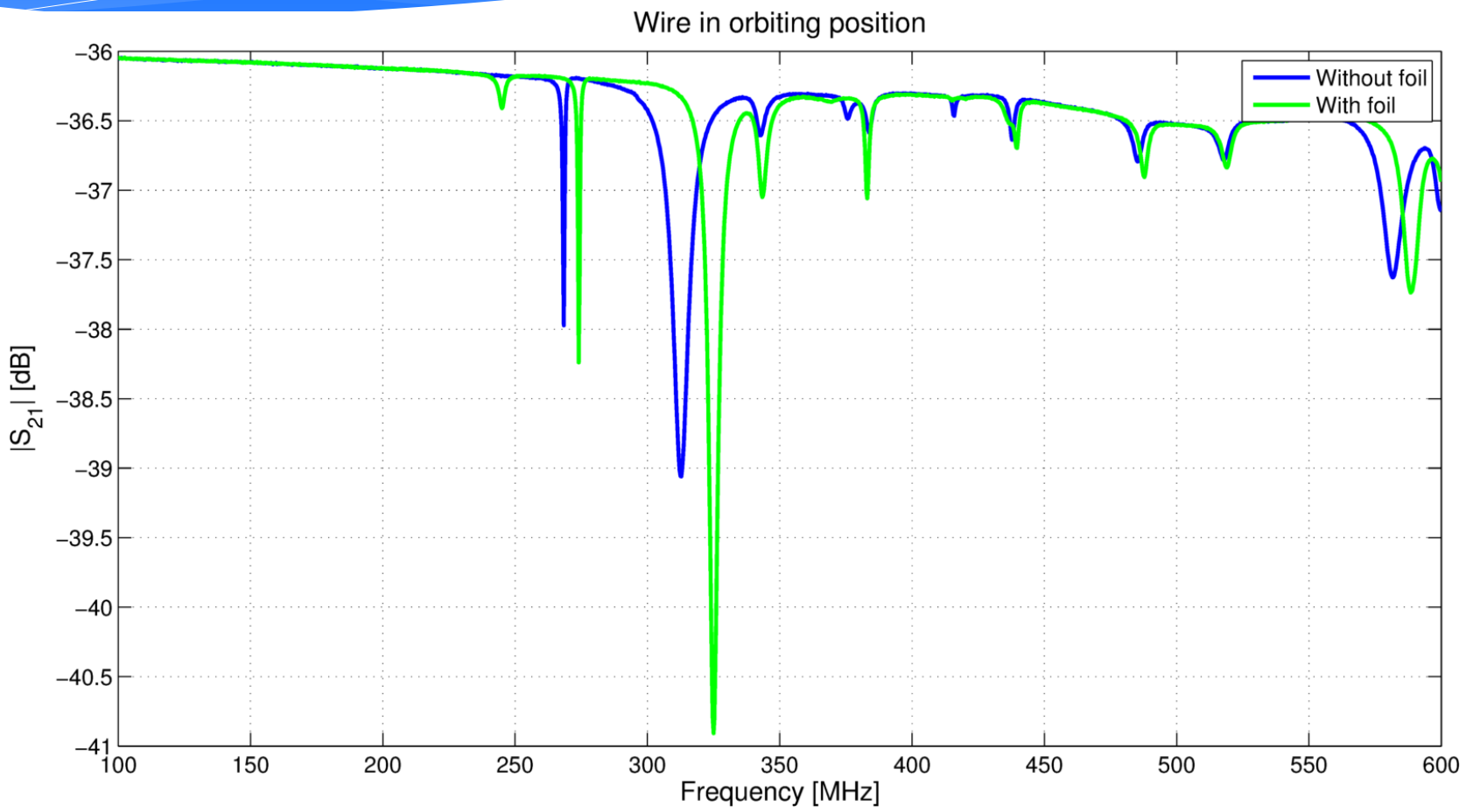
Low frequency S_{21}



It seems that the wire cannot excite trapped modes below 100 MHz!

Dummy Septum: impedance measurement

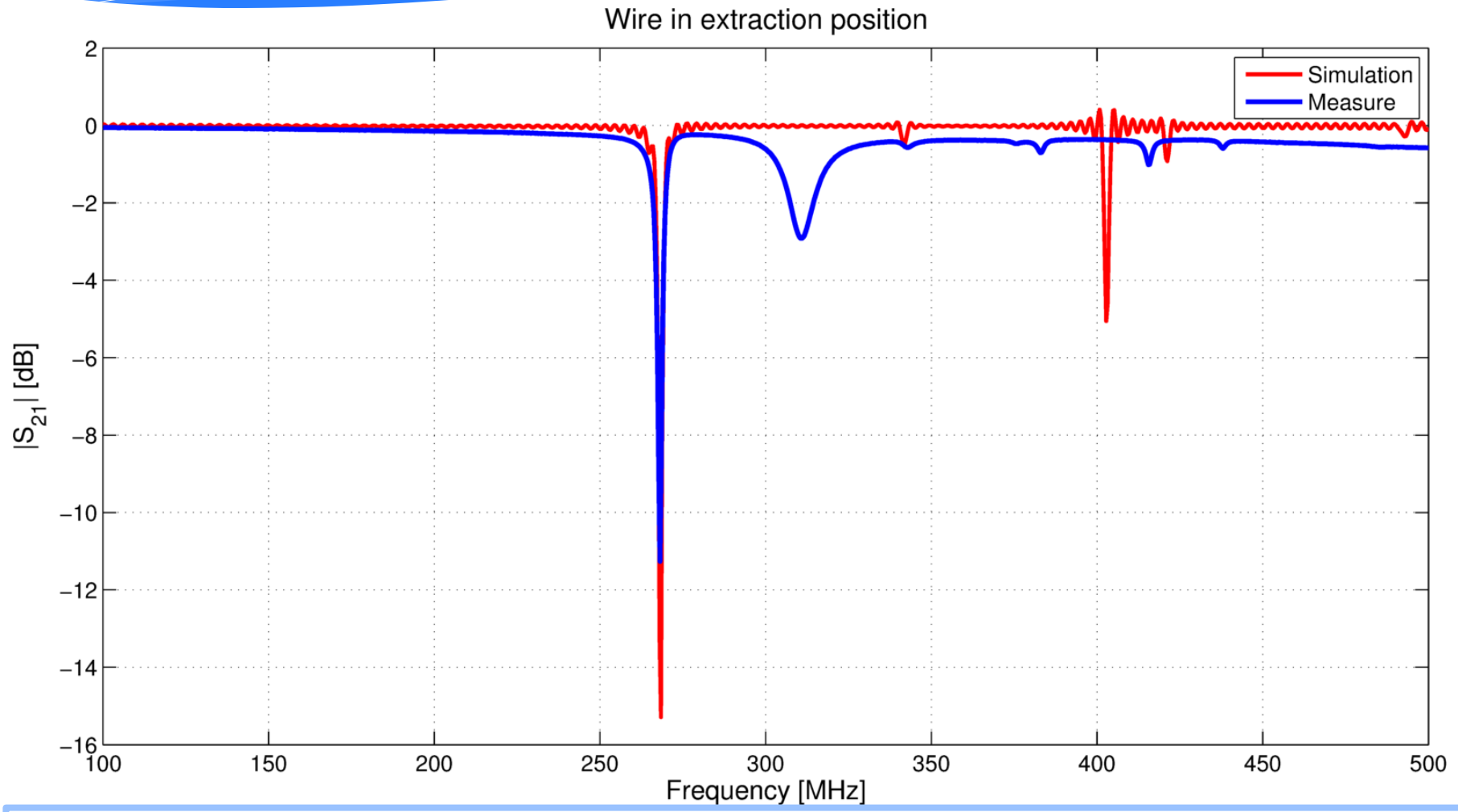
Insulations of the fingers



To verify the correct behaviour of the fingers, we tried to obtain insulation between the screen and the support with a foil. Using the insulation a lower frequency peak (230 MHz) is generated.

Dummy Septum: impedance measurement

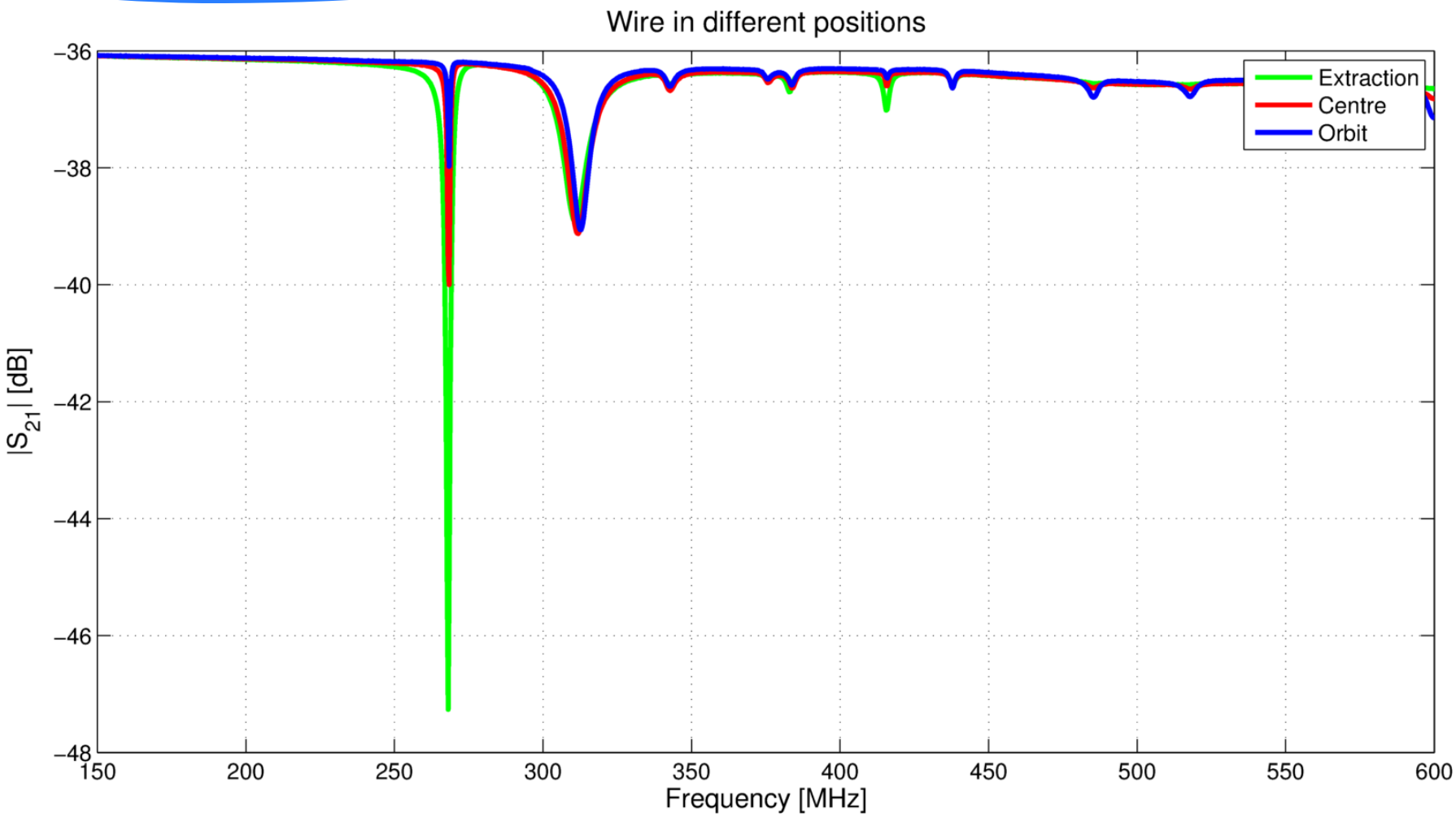
Comparison measurement and simulations



Measurements have been compared with simulations in time/frequency domain. Both measurement and simulation agree on the first trapped mode at the frequency of 270 MHz. The fingers are working well on low frequency mode cancelling.

Dummy Septum: impedance measurement

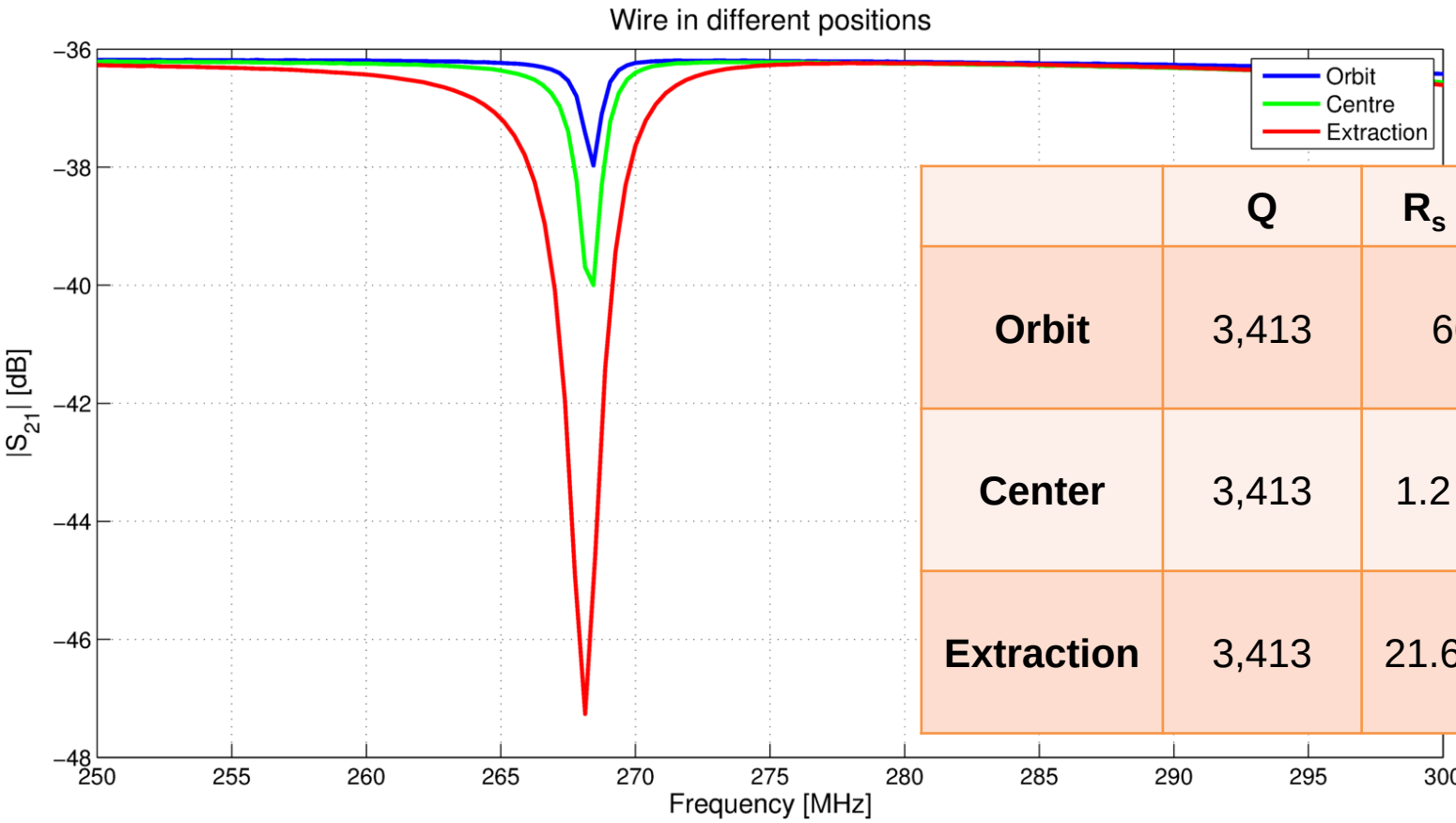
Wire in different positions



The 270 MHz mode is generated by resonances due to the space (3mm) between screen and blade. Measurements confirm what observed in simulations, that during extraction increases the amplitude of this mode.

Dummy Septum: impedance measurement

270 MHz resonant parameters



	Q	R_s [Ω]	R/Q
Orbit	3,413	66	0.02
Center	3,413	1.2 kΩ	0.36
Extraction	3,413	21.6 kΩ	6.35

NB. 200 MHz cavity: Q~100, R_s=5.7 kΩ, R/Q=57 (Linac convention)

Conclusions

- Thanks to the sliding contact low frequency modes that are potential source of coupled bunch instability do not appear to be excited.

- Both longitudinal and transverse measurements show that the first trapped mode in the dummy septum has a frequency of 270 MHz, too high to be a source of coupled bunch instability in the PS.

- Longitudinal and transverse measurements are in agreement with simulation performed with CST both in time and in frequency domain.

- For the broadband impedance, the effective longitudinal impedance was already predicted to be negligible compared to the imaginary part of the total impedance (longitudinal and transverse) measured for the PS .

- For the trapped modes, the resonance around 270 MHz is not believed to be source of operational issues:

    - *Heating* : the first mode is inside the beam spectrum and the power at 270 MHz is -40 dB at extraction. Thanks to the cooling system this is not predicted to be an issue.

    - *Longitudinal instabilities*: when the beam is in the orbiting position, the shunt impedance of the first mode is 66 Ω, and the impact is expected to be limited. When the beam is few mm far from the blade the shunt impedance is 21 kΩ, but anyway the beam is going to approach the blade only for a limited time.
      The growth rates of the instability, for mode 0, are negligible for this mode, in particular when we compared them to the extraction time of 6 ms (3 synchrotron periods).

- Conclusions of the last meeting are still valid.