# HOMs at 915MHz in the SPS cavities

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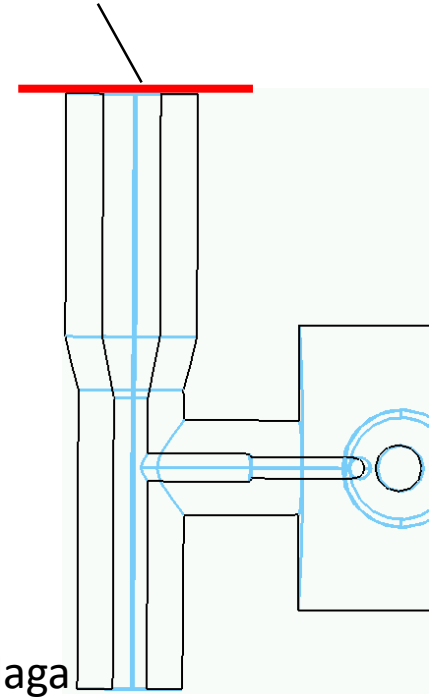
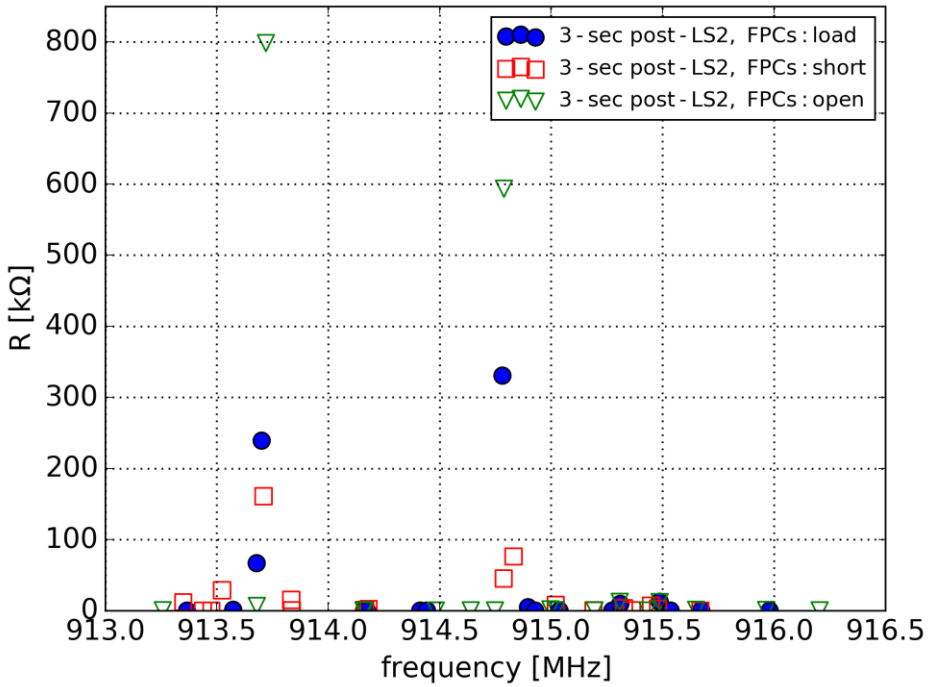
# Recap

- The new Fundamental Power Couplers (FPCs) also couple to the HOMs around 915 MHz
- Impedance of the 915 MHz HOMs depends on the termination of the FPCs



*R. Calaga




- Impedance increase due to both Q and R/Q
- R/Q doubles (short-> open)
- Qs around 5k-20k

# Outline

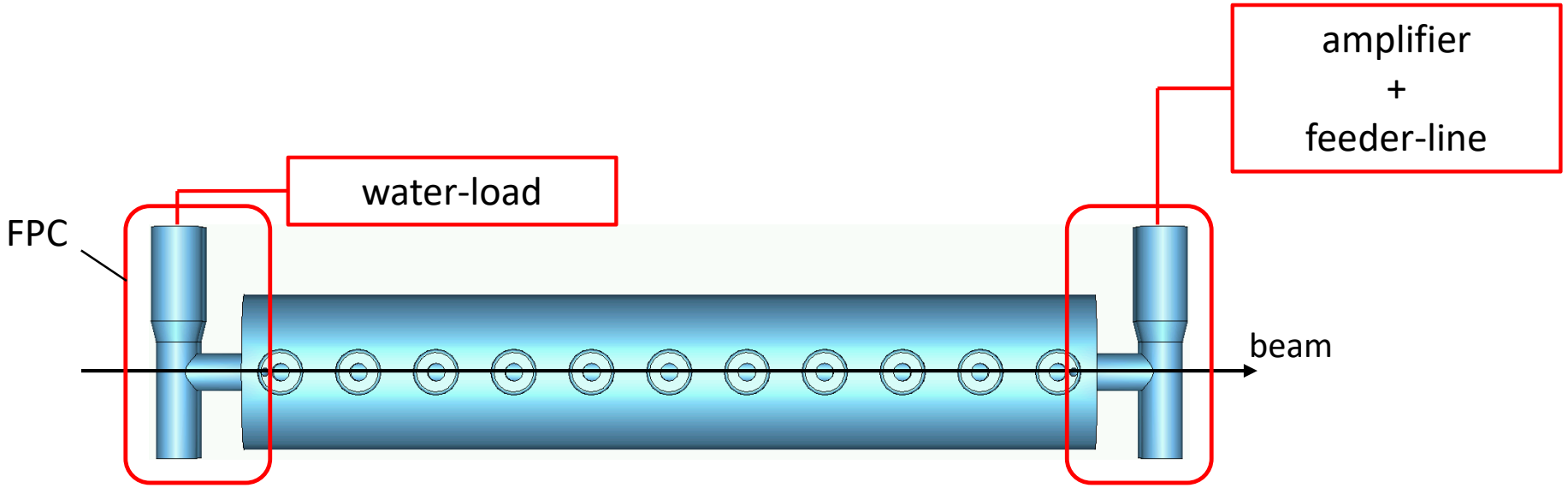
- Part 1
  - Characterisation of cavity termination at 915 MHz as present in the SPS tunnel
- Part 2
  - Approaches to improved damping of HOMs at 915 MHz

# Part 1

Characterisation of cavity termination at 915 MHz

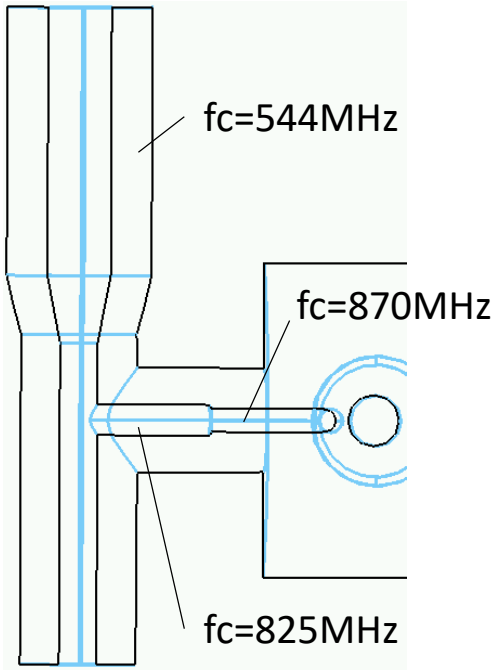
# Characterisation of cavity terminations

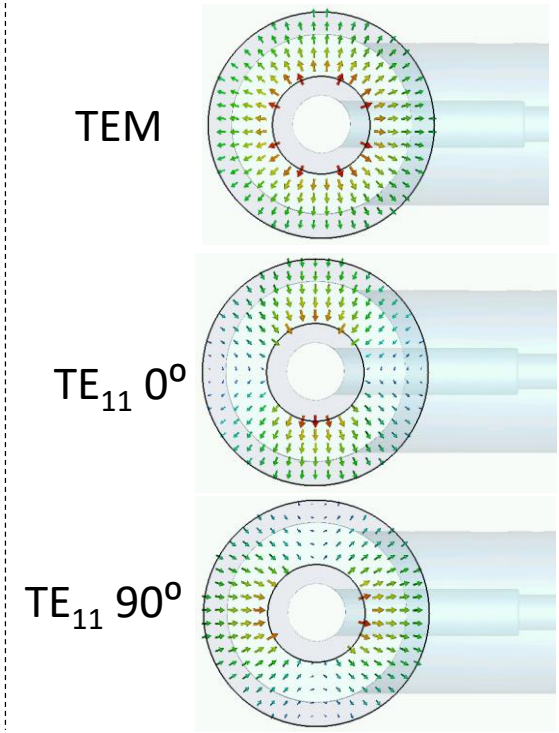
- What do water-load and feeder-line & amplifier look like to the cavity at 915 MHz ?
- Characterisation of their (electrical) impedance required
- Coupling of the new FPCs needs to be characterised in detail as well

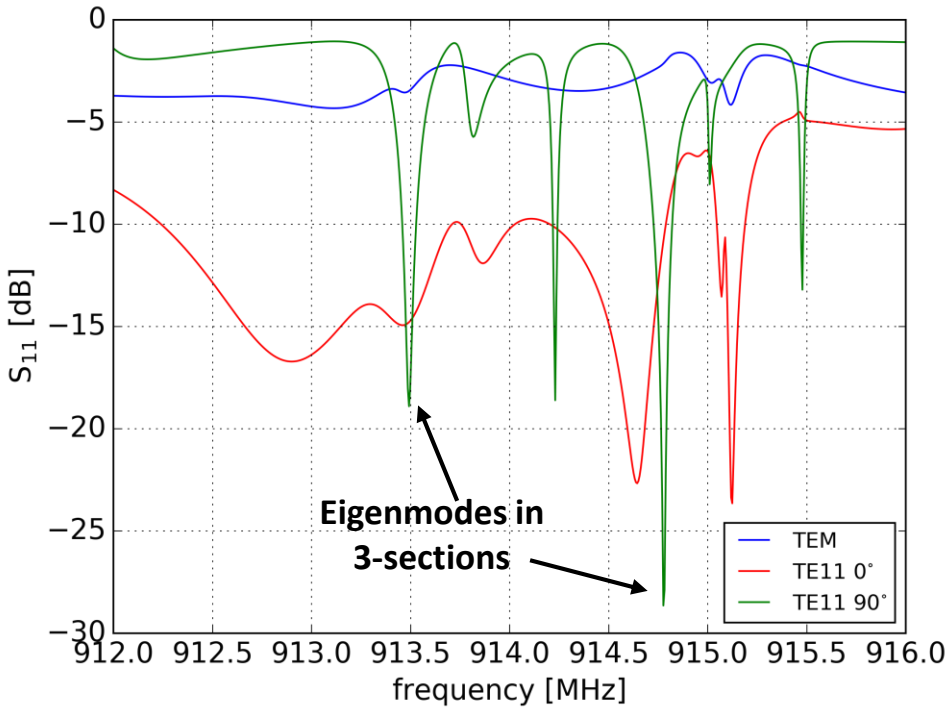


# Characterisation of the new FPCs

- The $TE_{11}$ cut-off frequencies $f_c$ of the coaxial coupler are below 915 MHz
  - → Possible coupling also to $TE_{11}$ mode (in addition to TEM)
- Especially the TE11 modes (2 polarisations) couple to 915 MHz

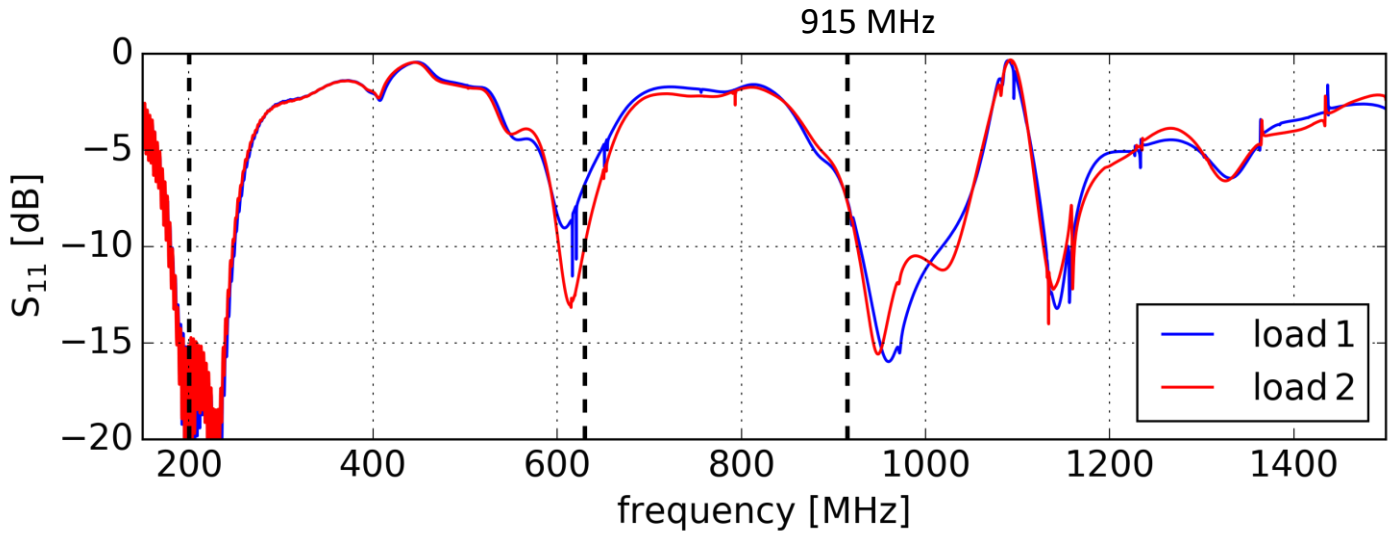


# Characterisation of the water-loads

- So far, merely $S_{11}$ of the TEM-mode can be measured
  - Fairly good match at 630 & 915 MHz for TEM mode
- Measurement of $TE_{11}$-mode would require…
  - … reliable mode selective excitation/ coupler
  - … TEM-$TE_{11}$ mode converter



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- Measurement of $TE_{11}$-mode would require…
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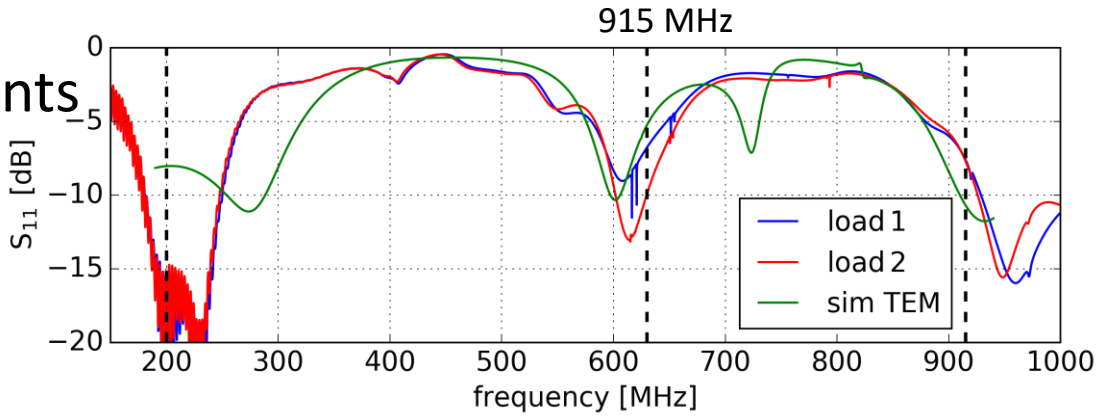
- $S_{11}$ of the $TE_{11}$-mode can be simulated
  - Correct modelling of the dielectric and conductive properties of the water difficult
  - Merely rough agreement with measurements



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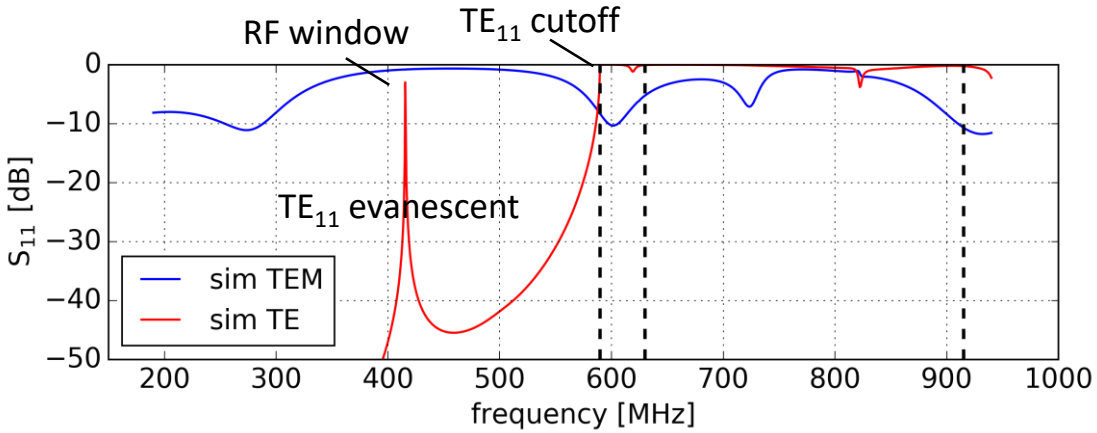
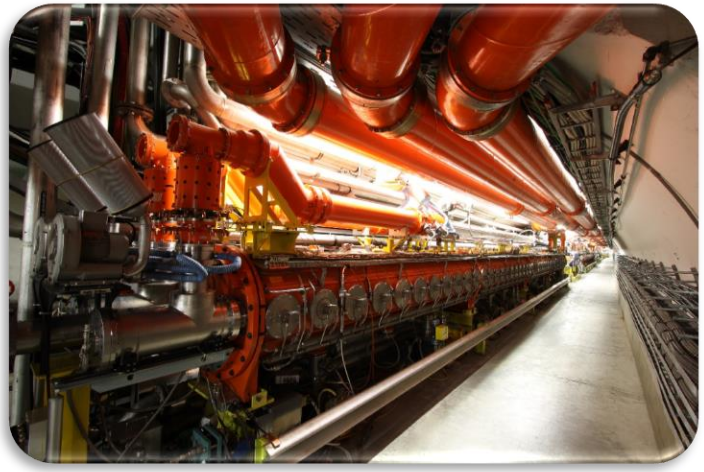
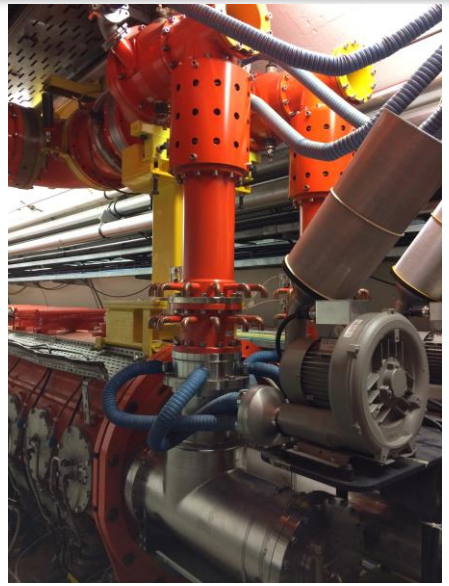
- $S_{11}$ of the $TE_{11}$-mode can be simulated
  - Correct modelling of the dielectric and conductive properties of the water difficult
  - Reliability of simulations questionable
  - Simulated $TE_{11}$ $S_{11}$≈0.2dB at 915 MHz



# Characterisation of the feeder lines

- RF input of cavity is connected via >100m long coaxial feeder-lines to the amplifiers on the surface
- Characterisation of feeder-lines via simulations:
  - $f_{c,TE11}$=393MHz, $f_{c,TE21}$=771MHz
  - Attenuation at 915MHz: 0.34dB/100m
  - $v_{g,TE11}$=0.86c, round-trip delay: 0.78µs
- Characterisation regarding the $TE_{11}$-mode by measurements would again require additional hardware (mode-converter etc.)
  - y-chamber, hybrid, amplifier



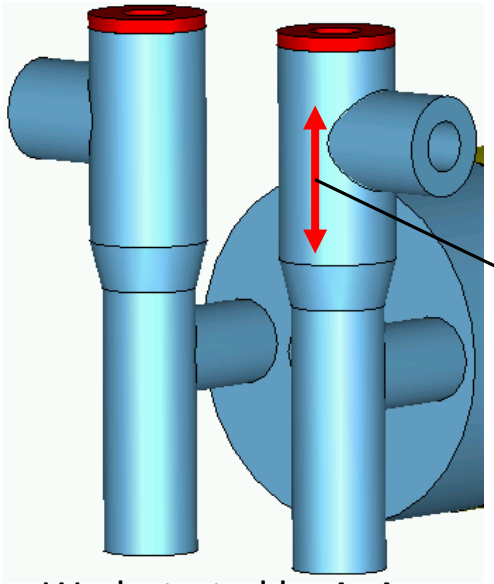


# Part 2

Improved damping of HOMs at 915 MHz

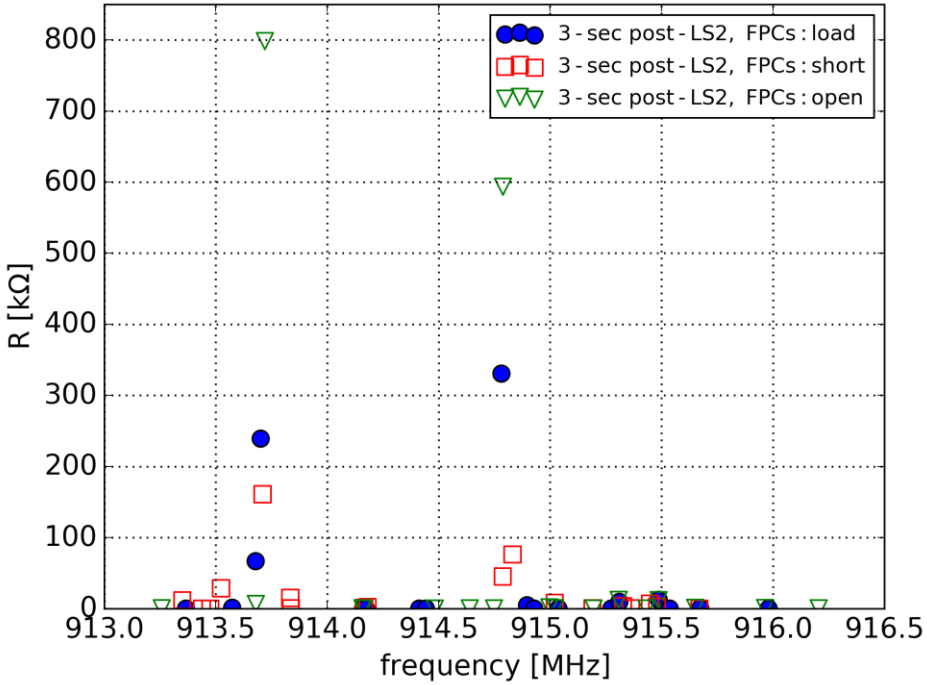
# Enforcing a defined termination - standing

- Make 915MHz <u>fully standing wave</u>
  - The FPC termination at 915MHz can be defined by a stub on the FPCs
  - Correct positioning of the stub required to ensure phase leading to lowest impedance



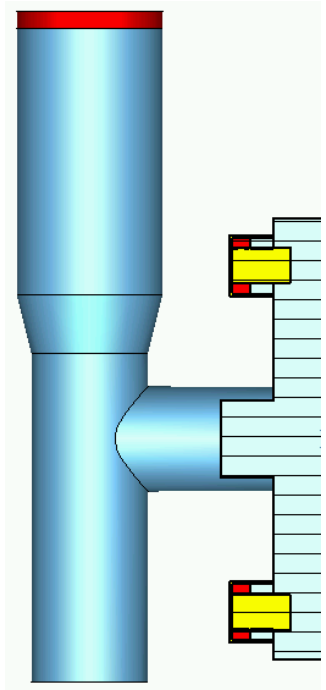
Stub position adjusts phase (short<->open)

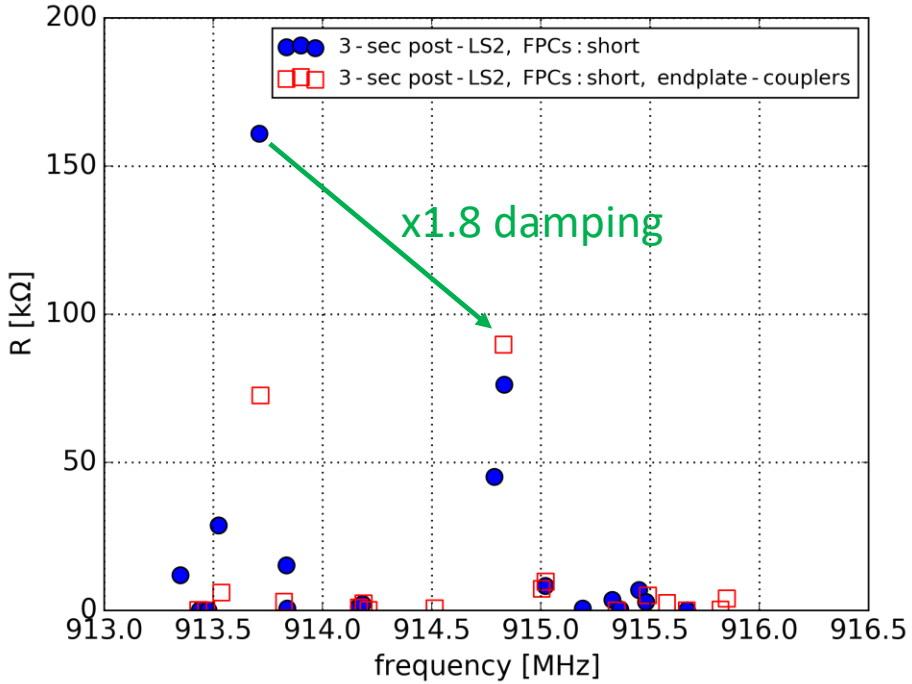
Work started by A. Angus & A. Farricker

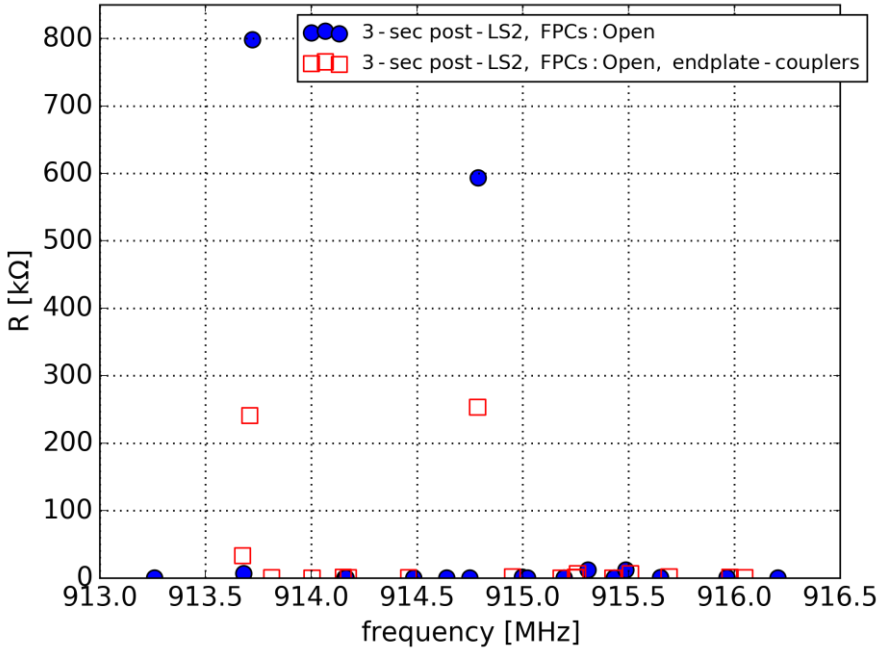


# Enforcing a defined termination

- Make 915MHz <u>fully travelling wave</u>
  - A broadband match to 915MHz can be realised via the endplate-ports
  - First look at impact on FPB seems acceptable
  - Impedance still dependent on FPC-termination (simulations on-going)



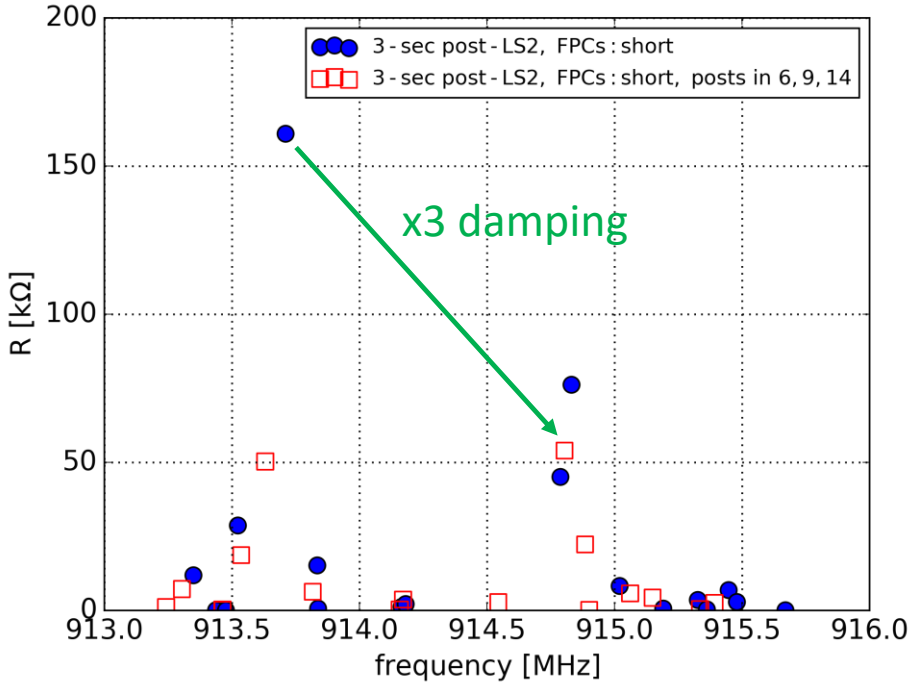


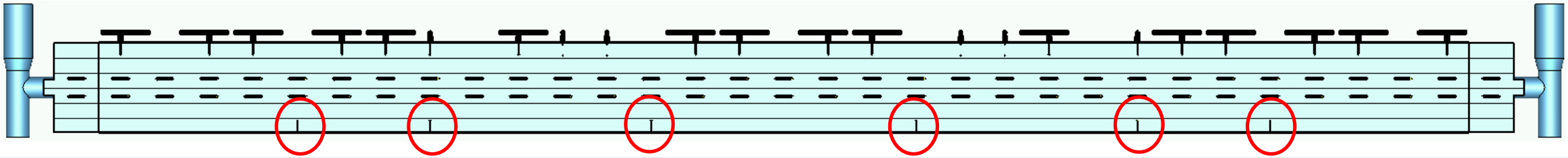



# Improved damping by posts in VPPs

(vacuum pumping ports)

- Posts in bottom of cavity can act as a counter-weight to the numerous HOM couplers at the top
  - Damping performance most likely dependent on FPC termination (simulations on-going)
  - x3 damping for short-termination on FPCs



# Concluding remarks

- For a precise evaluation of the impedance situation at 915 MHz RF measurements are required
  - Requires design & implementation of a TEM-$TE_{11}$ converter
- Improved damping of 915MHz HOMs seems feasible for the standing wave case