PETS components and waveguide connections

CLIC Workshop 2007

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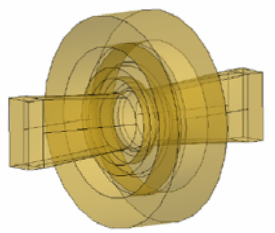
A design to connect PETS with accelerating structures will be discussed

- choke flange

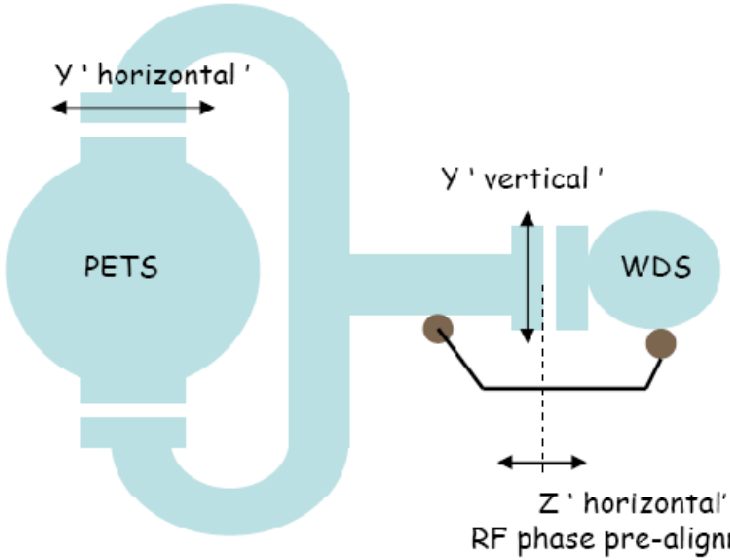
And also we will deal with two components for testing the PETS

- Input coupler
- Single test bar device

Choke flange X-band



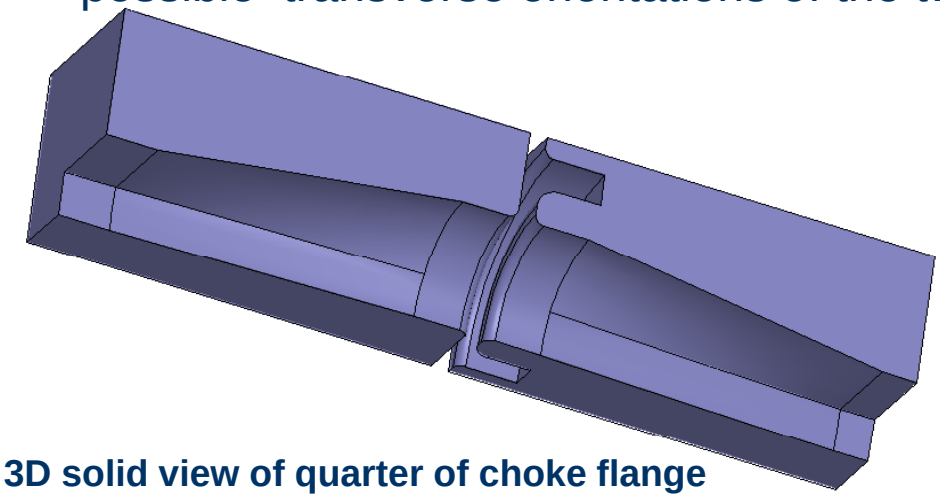
- This device allows power transmission without electrical contact between waveguides
- **Motivation**: During the CLIC operation the two linacs (drive and main) will have independent alignment. That is why the development of the special device which transfer power without mechanical contact from PETS to accelerating structures is important



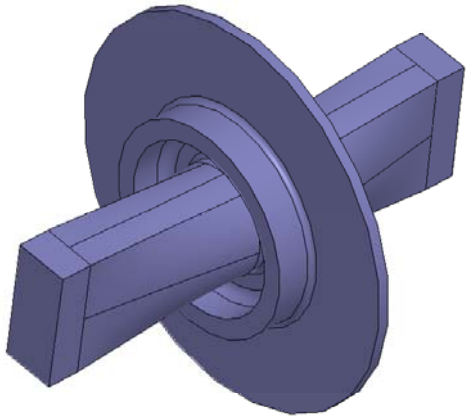
Schematic layout of independent alignment of the two linacs with the **fixed RF phase**

Choke flange

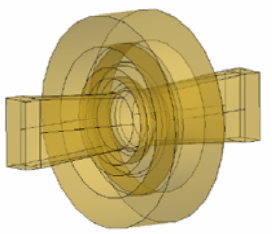
- It consists of a transition from rectangular to circular waveguide
- In between there is a choke that stop electromagnetic energy to flow outwards and provide full transmission of energy to the other port
- This device is flexible and provides a place to produce vacuum inside the waveguide
- Being equipped with outside bellow it will provide the range of the possible transverse orientations of the two waveguides

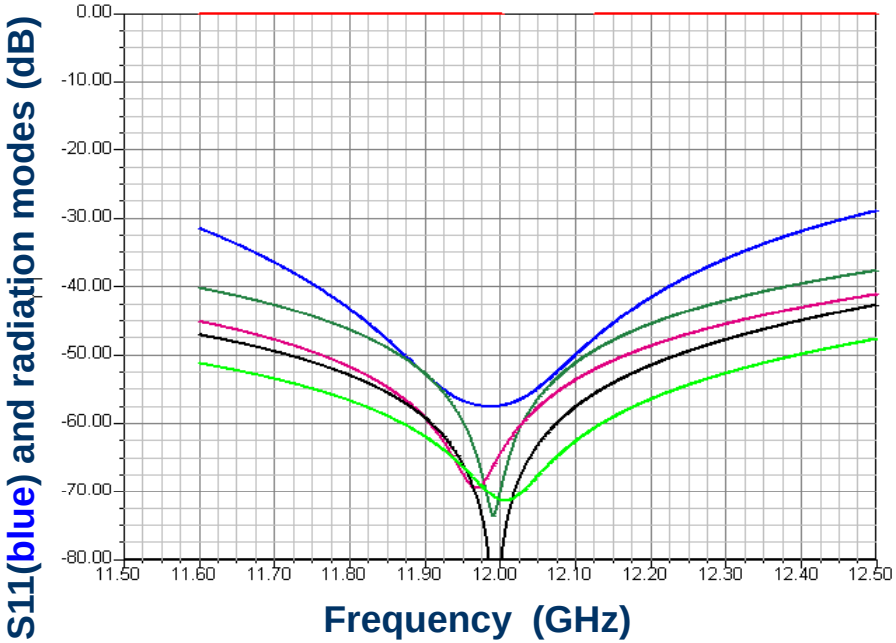


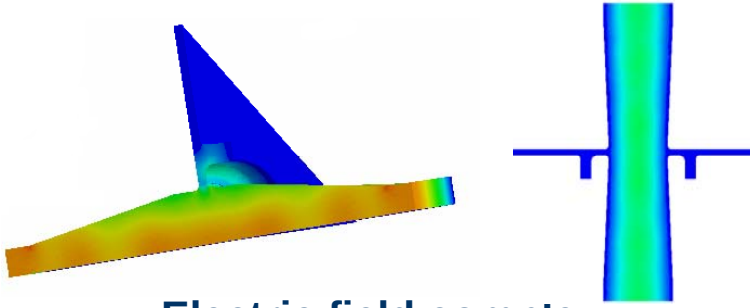
3D solid view of quarter of choke flange



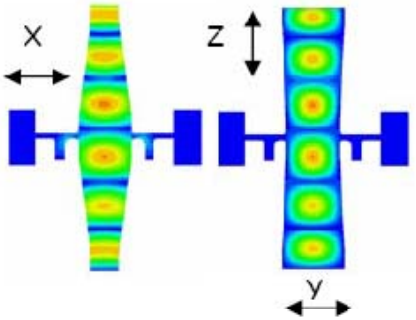
Choke flange







Electric field complex magnitude

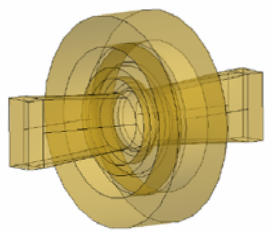


E magnitude

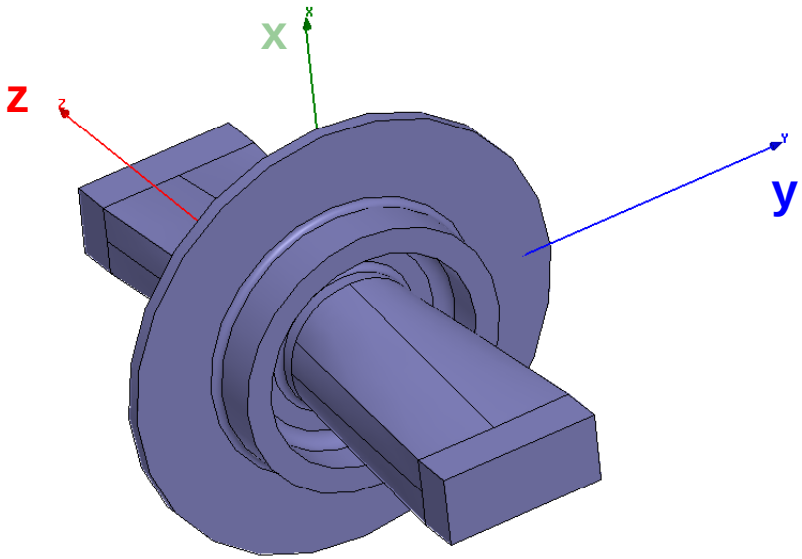
It is necessary to minimize reflection and radiation through the choke. Also there is a compromise between length and E field on the surface. Device has been designed as short as possible

It will be tested at SLAC at nominal power of 135/2 MW (E field on surface < 30 MV/m

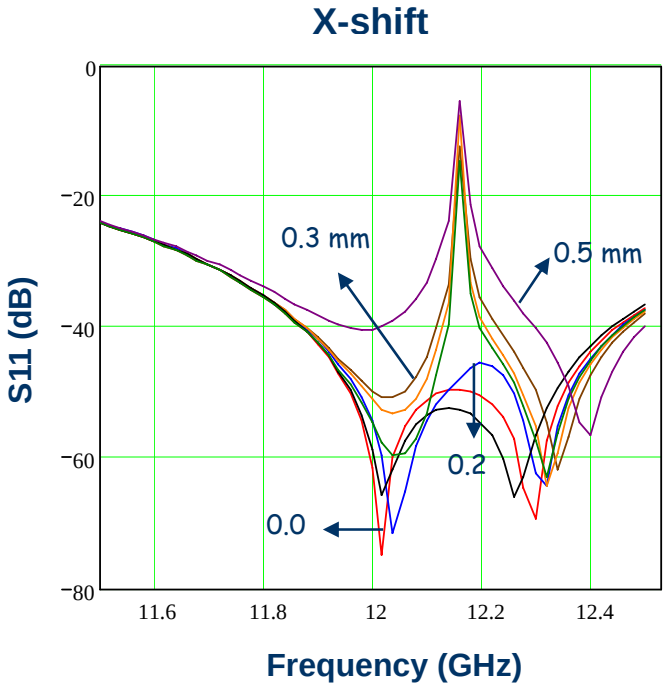
Choke flange. Shifts & twist



- Shifts in different directions and twists are simulated in order to study the device performance.

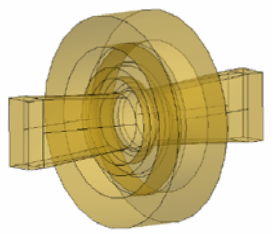


Coordinate axis

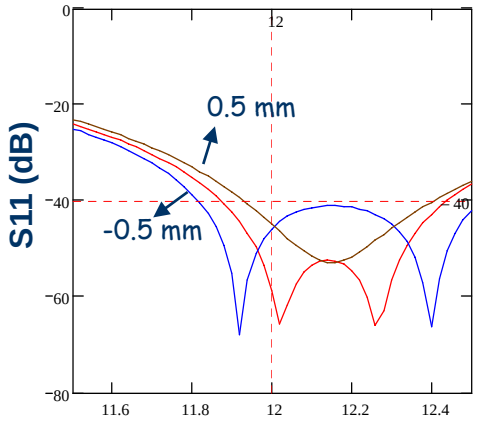


x-shift appears to be the most critical displacement issue

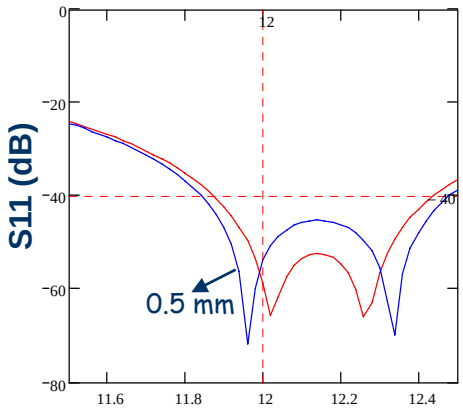
Choke flange. Shifts & twist



Z-shift

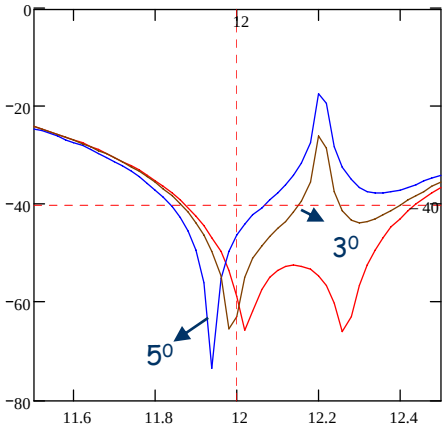


Y-shift



Frequency (GHz)

Twist



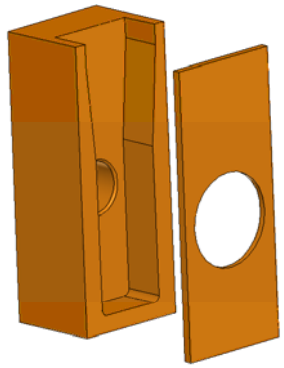
Frequency (GHz)

Dynamic range for the accepted performance (S11< -45 dB)

X – shift:	± 0.25 mm
Y – shift:	± 0.5 mm
Z – shift:	± 0.5 mm
Twist:	< 5^0

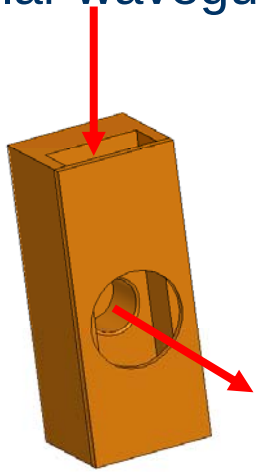
x, y shifts do not change the transmitted RF phase

Mode launcher

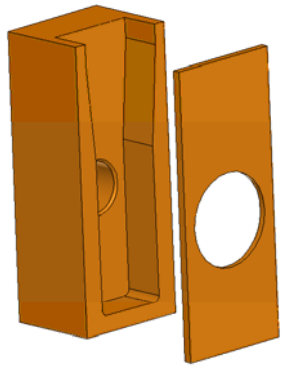


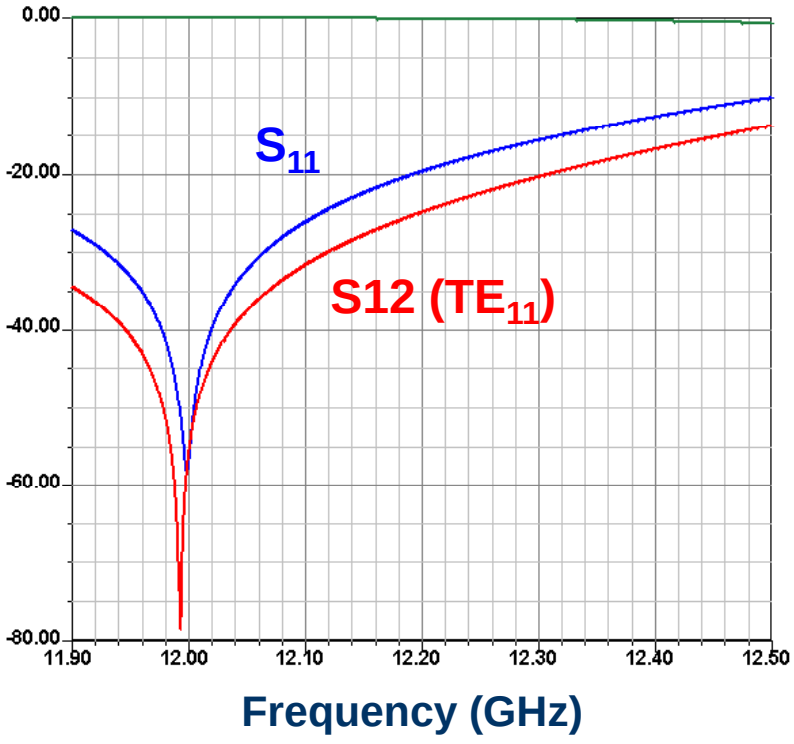
- Inside the PETS, electrons are decelerated and they produce mode TM_{01}. In order to measure PETS quality this mode must be put into the PETS by the mode launcher (coupler)

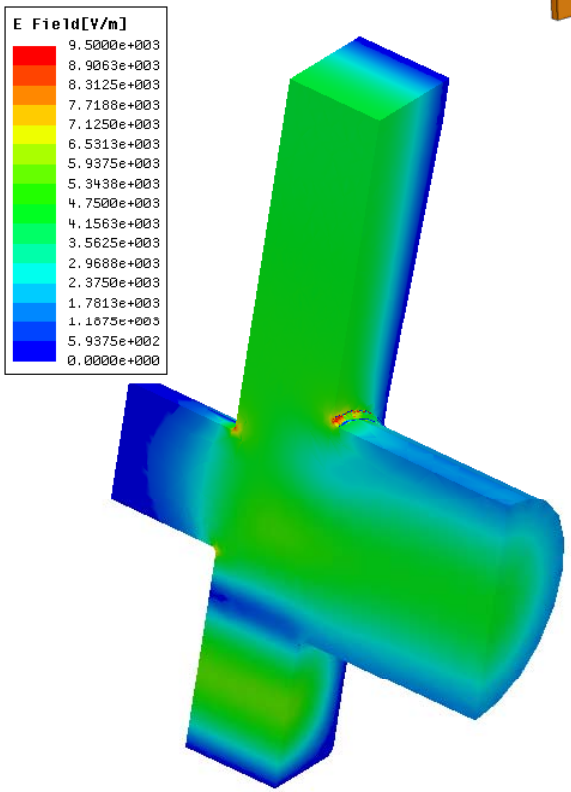
- The input signal is the fundamental one (TE_{10} mode) in the rectangular waveguide which is transformed into the TM_{01} (not fundamental) in the circular waveguide



Mode launcher





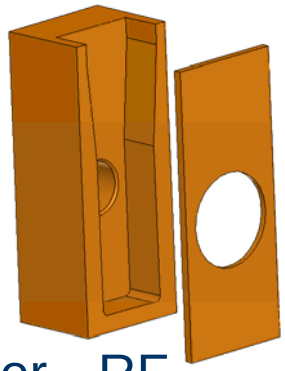


Not only reflection must be minimized but also transmission to TE_{11}

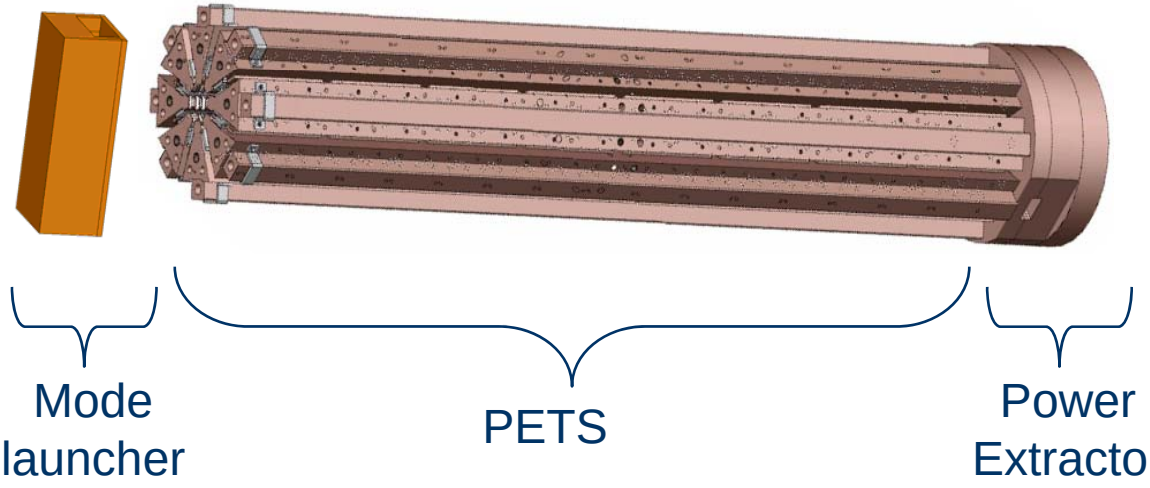
It is designed for low power tests

Electric field complex magnitude

Mode launcher

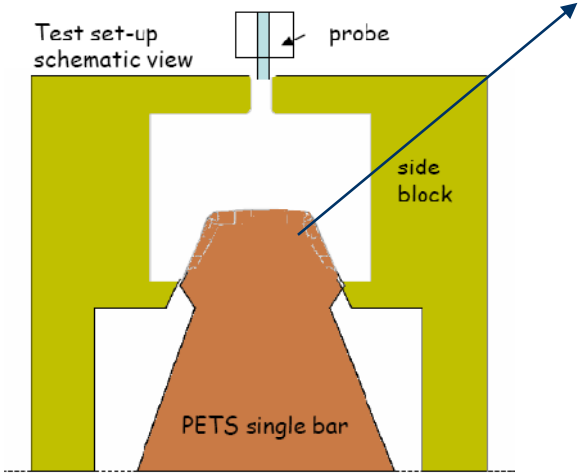


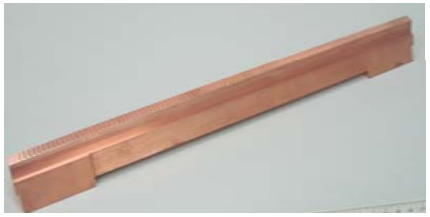
- Two couplers will be built to provide low power RF measurements
- The number of measures will be done:
  - Test the couplers themselves
  - Measure S parameters with extractor/or both couplers
  - Measure phase-advance between PETS cells



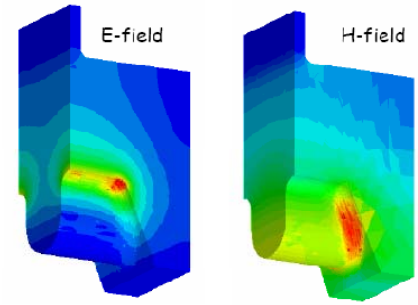
Testing single PETS bar

- A device has been designed to do RF tests of the single PETS bar
- It consists of two side blocks that will be put together with a single PETS bar in order to create inside a mode (TE_{10}) with same phase advance, v_g, etc as the decelerating mode (TM_{01})

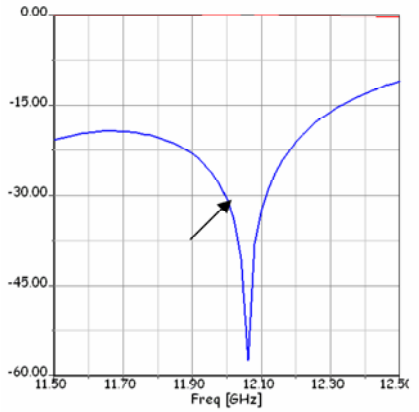




PETS Single bar



Mode TE_{10}



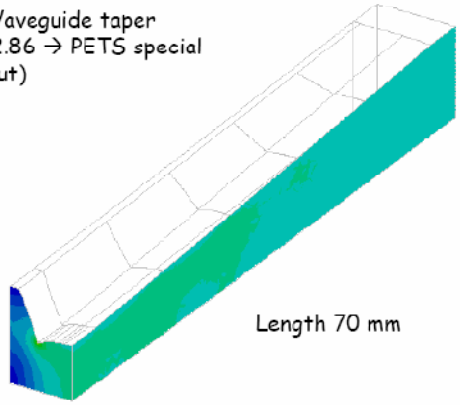
Phase/period=90

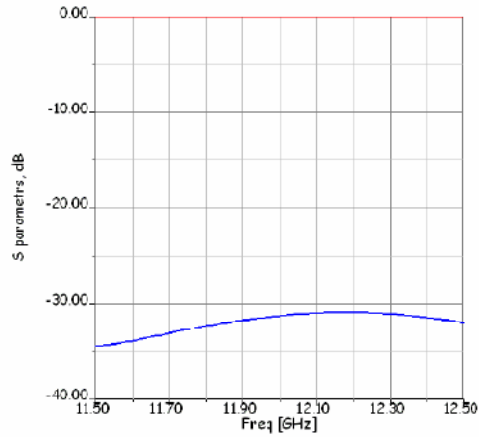
Frequency =11.994 GHz

Vg/c=0.466

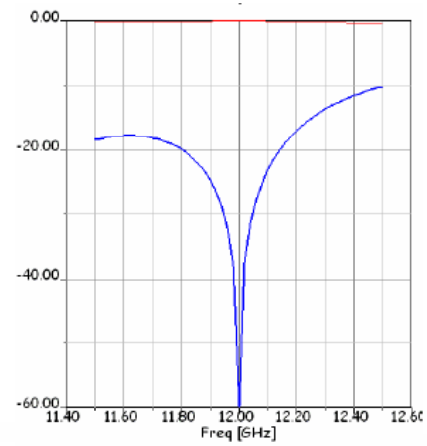
Testing single PETS bar

Linear Waveguide taper
10.16×22.86 → PETS special
(wire - cut)

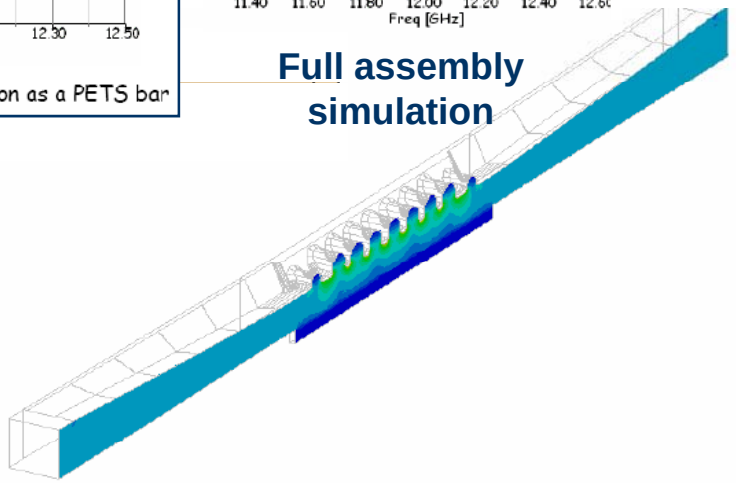


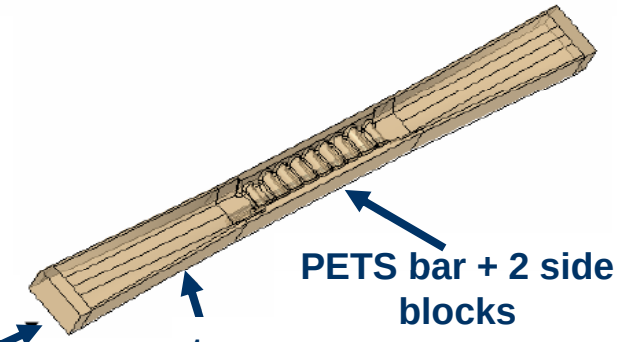


The taper length was optimised to produce similar (~ -30 dB) reflection as a PETS bar



Full assembly simulation





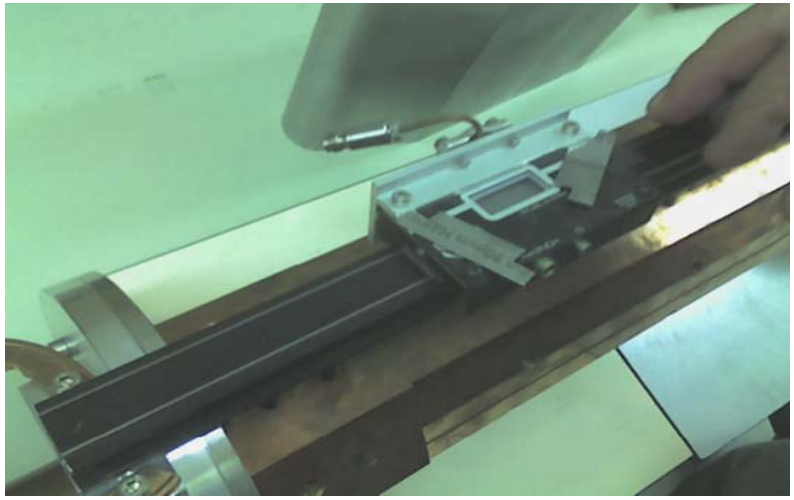
wr90

taper

PETS bar + 2 side blocks

Testing single PETS bar

- Without this device, all single bars must be put together (8 bars), and it can only be measured performance of the whole PETS as can be seen in the following picture



- With the single test bar device, a defective bar could be found (if we ever get one ☺) It would be possible as well to know specifically which is wrong with the bar (matching cells, shape profile, etc)

Conclusions

- A Choke flange design has been done, which will allow a flexible connection between PETS and accelerating structures and also will provide a vacuum port
- Single bar test device will allow us to measure RF quality of single bars before putting all together
- Mode launcher designed will be used to introduce and extract power in order to test phase-shift and S parameters for PETS