Possible design solutions to improve WFM

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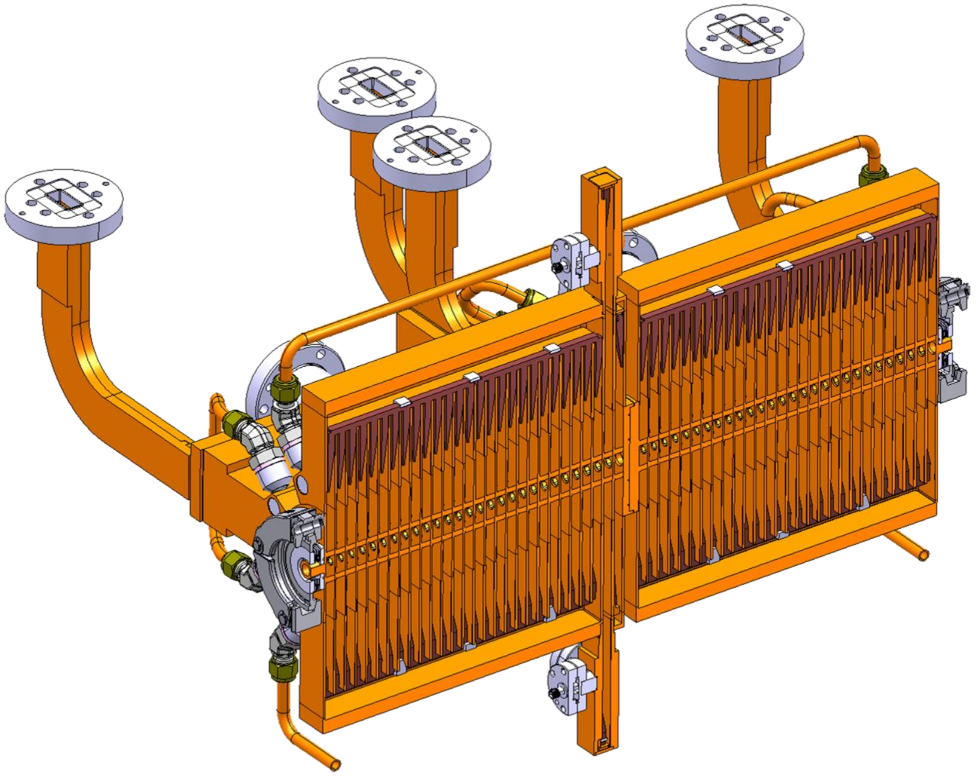
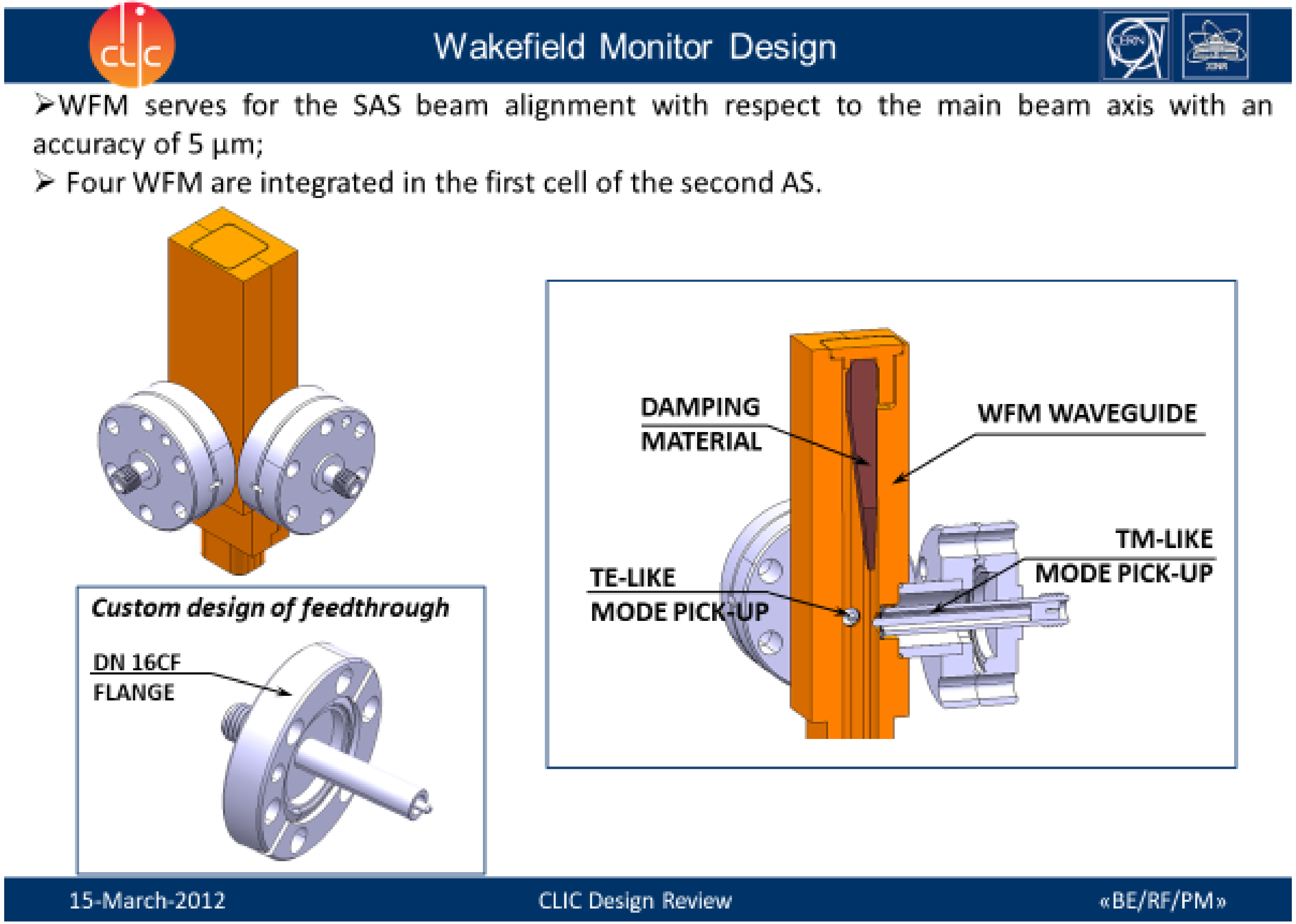
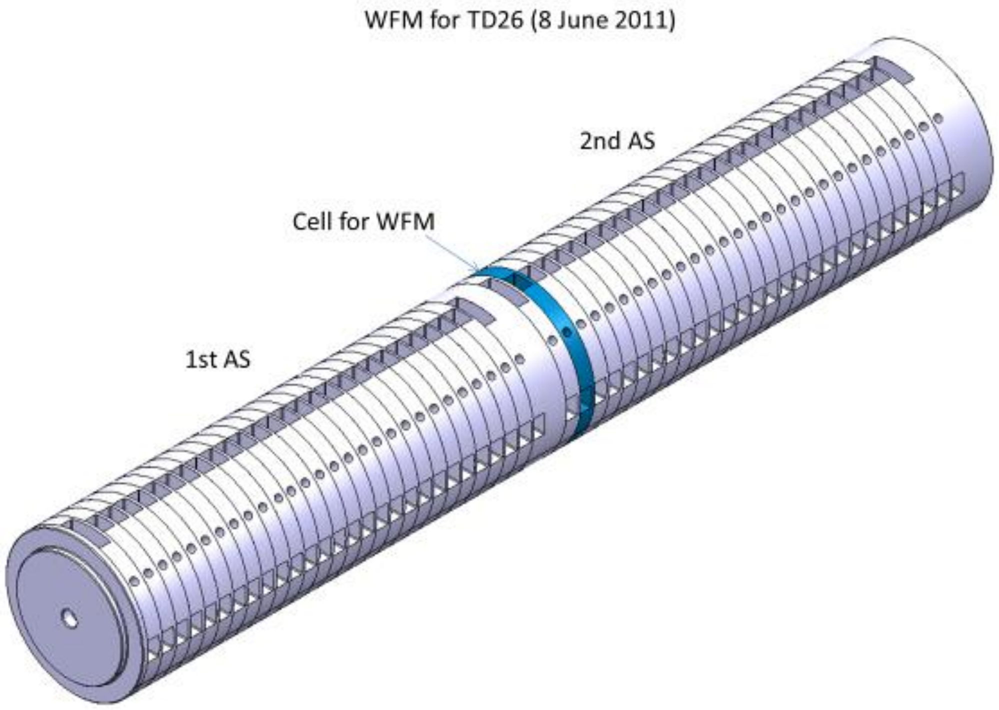
14/06/2023

CLIC structure for CLEX module and WFM

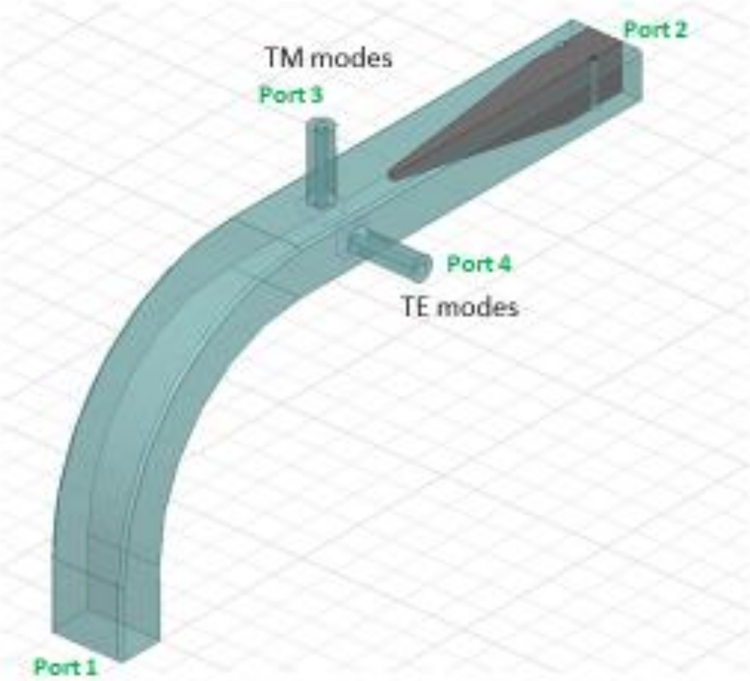




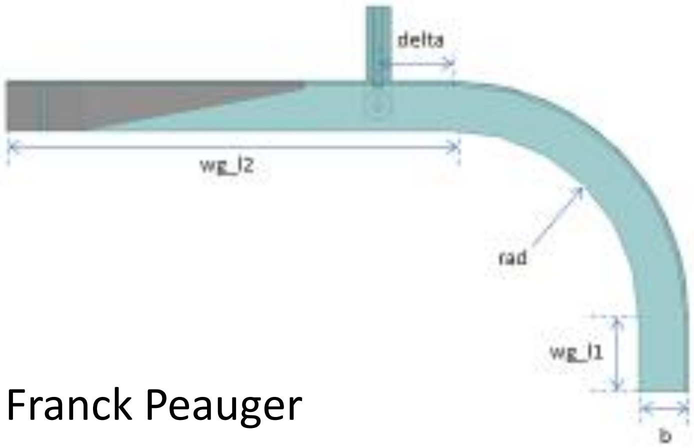
CLIC WFM RF design

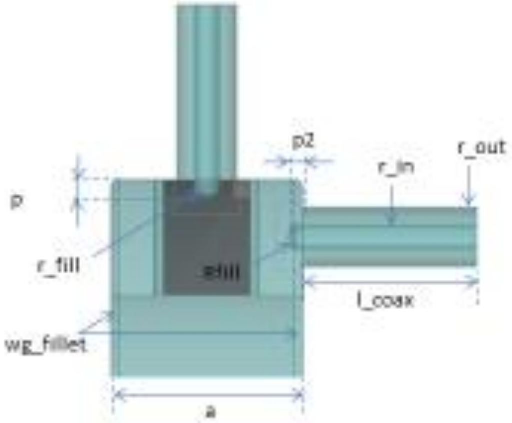


Geometry



a	11.04	mm
b	6.6749	mm
wg_l1	10	mm
wg_fillet	0.5	mm
rad	25	mm
wg_l2	60	mm
r_out	1.75	mm
r_in	0.76	mm
l_coax	10	mm
p	1	mm
r_fill	0.5	mm
delta	10	mm
Rfill	0.5	mm
p2	0.8	mm



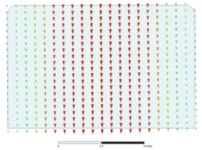


https://edms.cern.ch/document/1182237/1

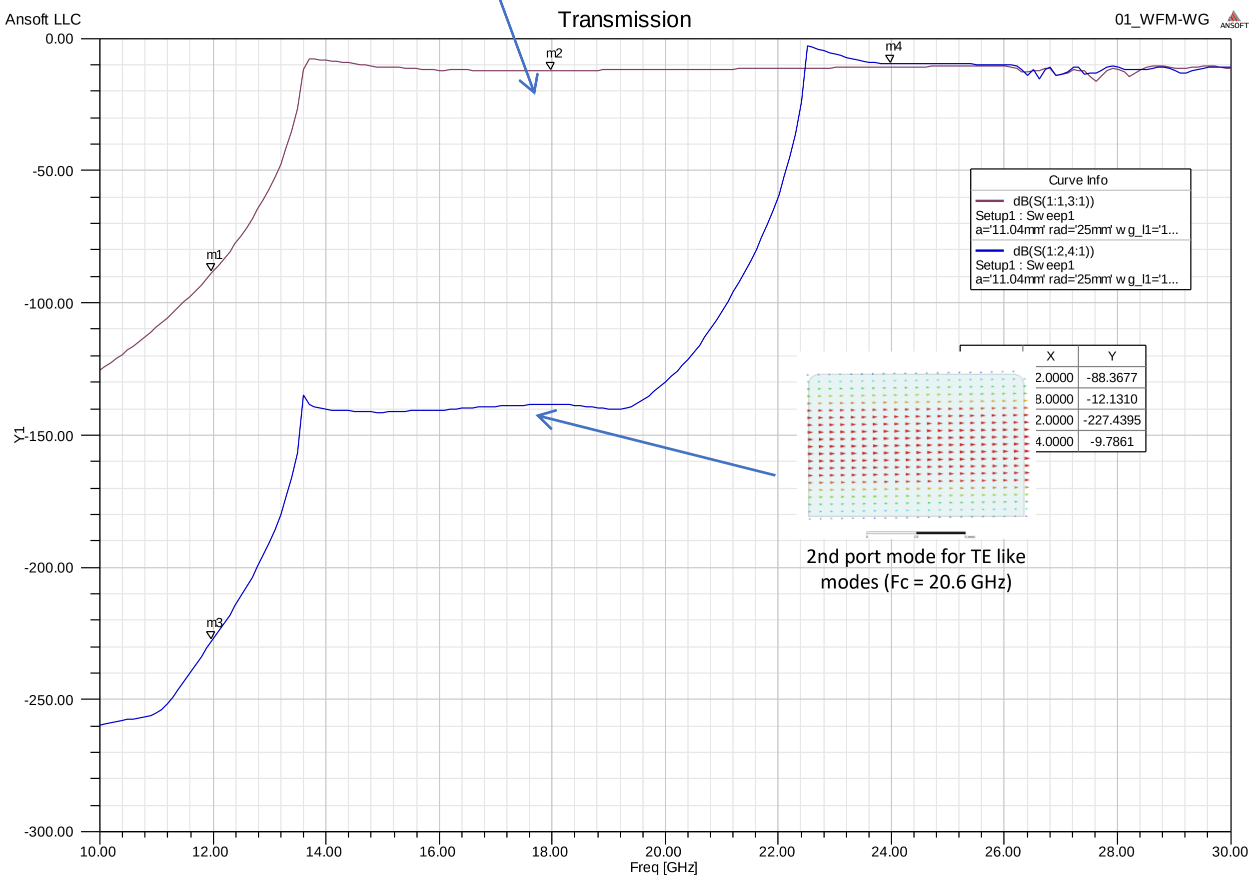
Franck Peauger

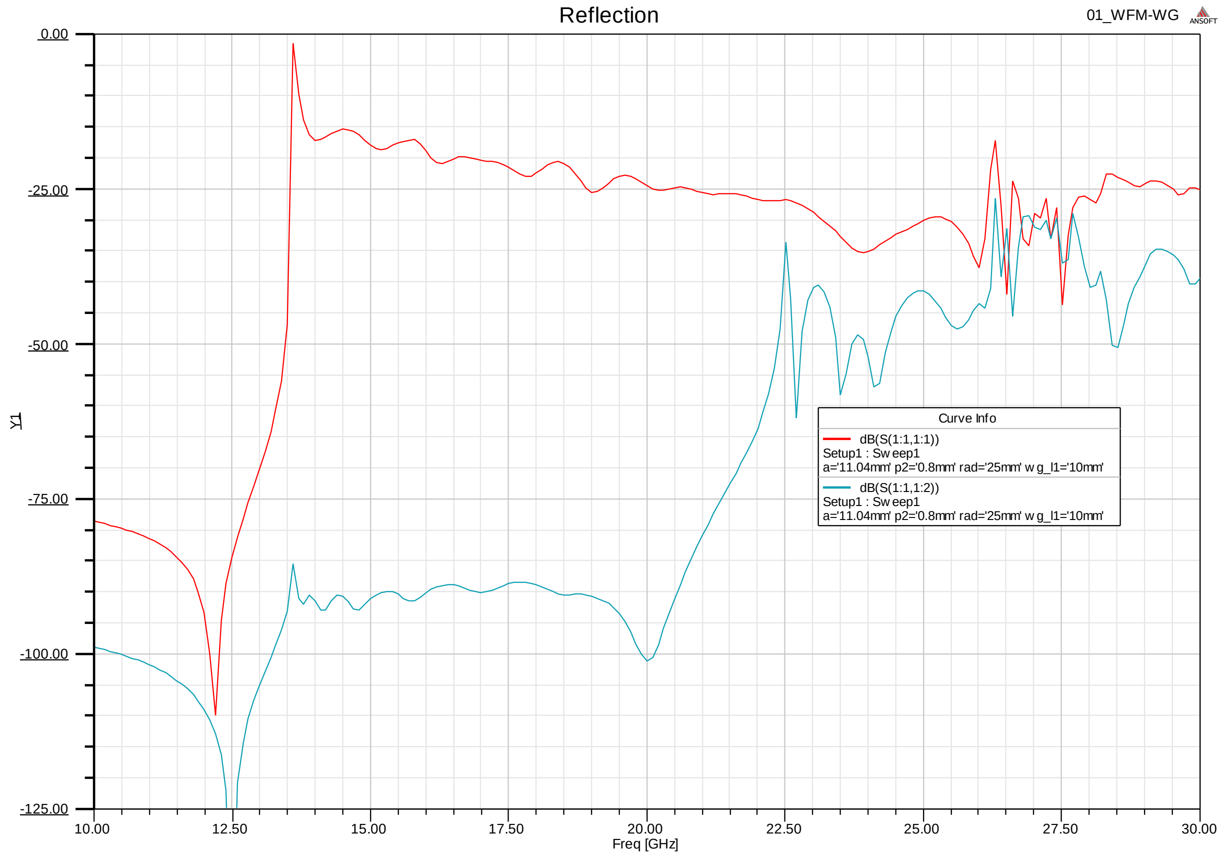
CLIC WFM RF design

HFSS results



1st port mode for TM like modes (Fc = 13.6 GHz)





Coupling:

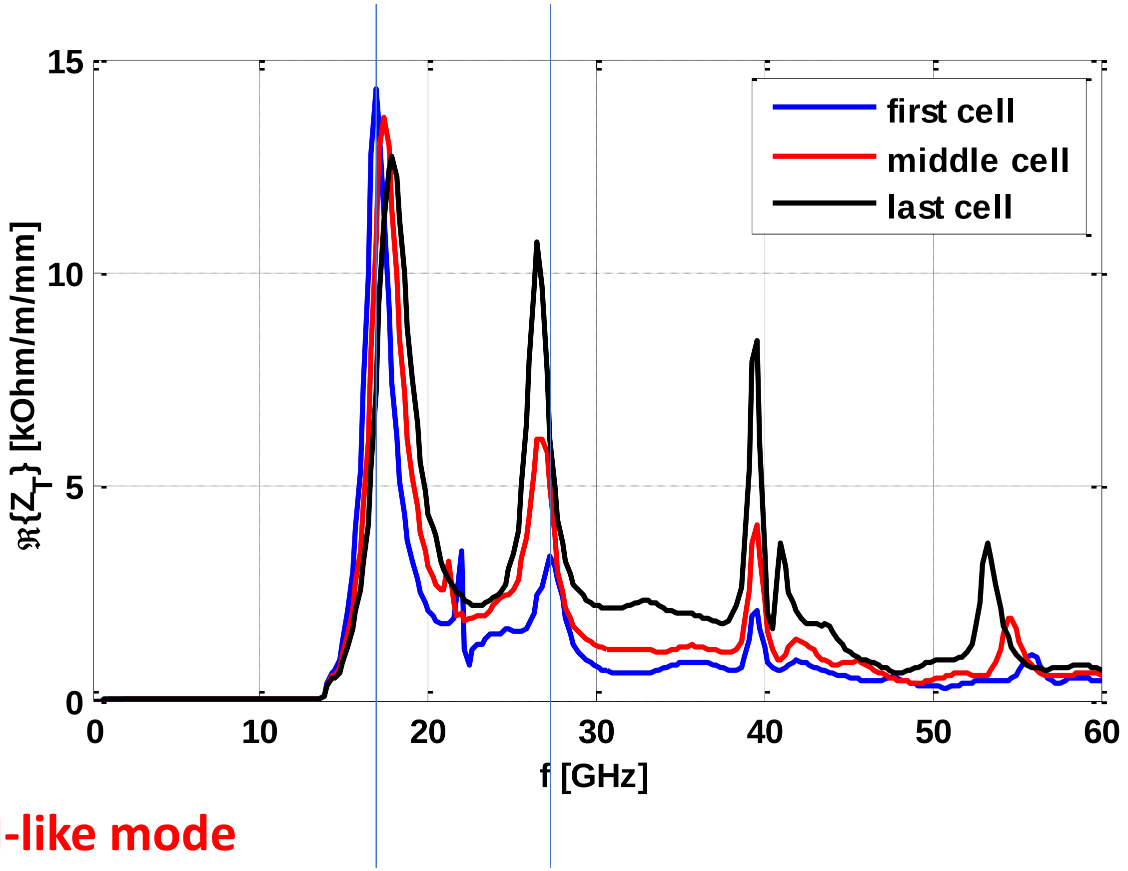
- TM modes: -12.1 dB at 18 GHz
- TE modes: -9.8 dB at 24 GHz

Reflexion: < -20 dB

Fundamental mode rejection:

- TM modes: - 88 dB
- TE modes: - 227 dB

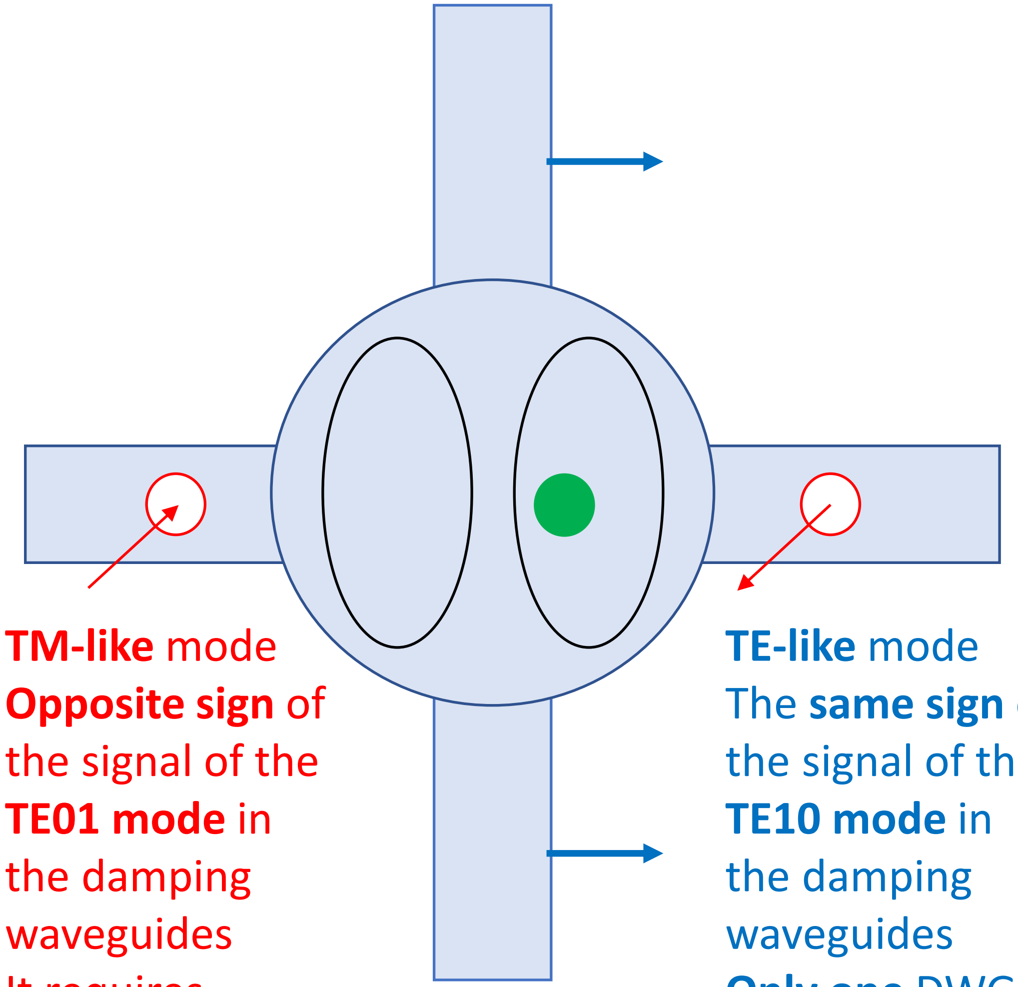
CLIC structure wake fields



TM-like mode has stronger signal

TM-like mode

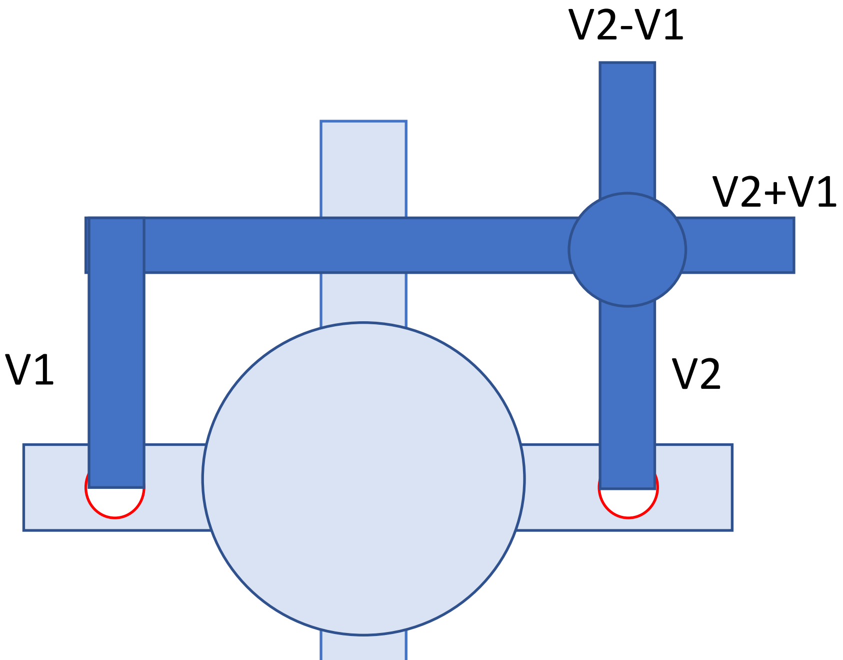
TE-like mode



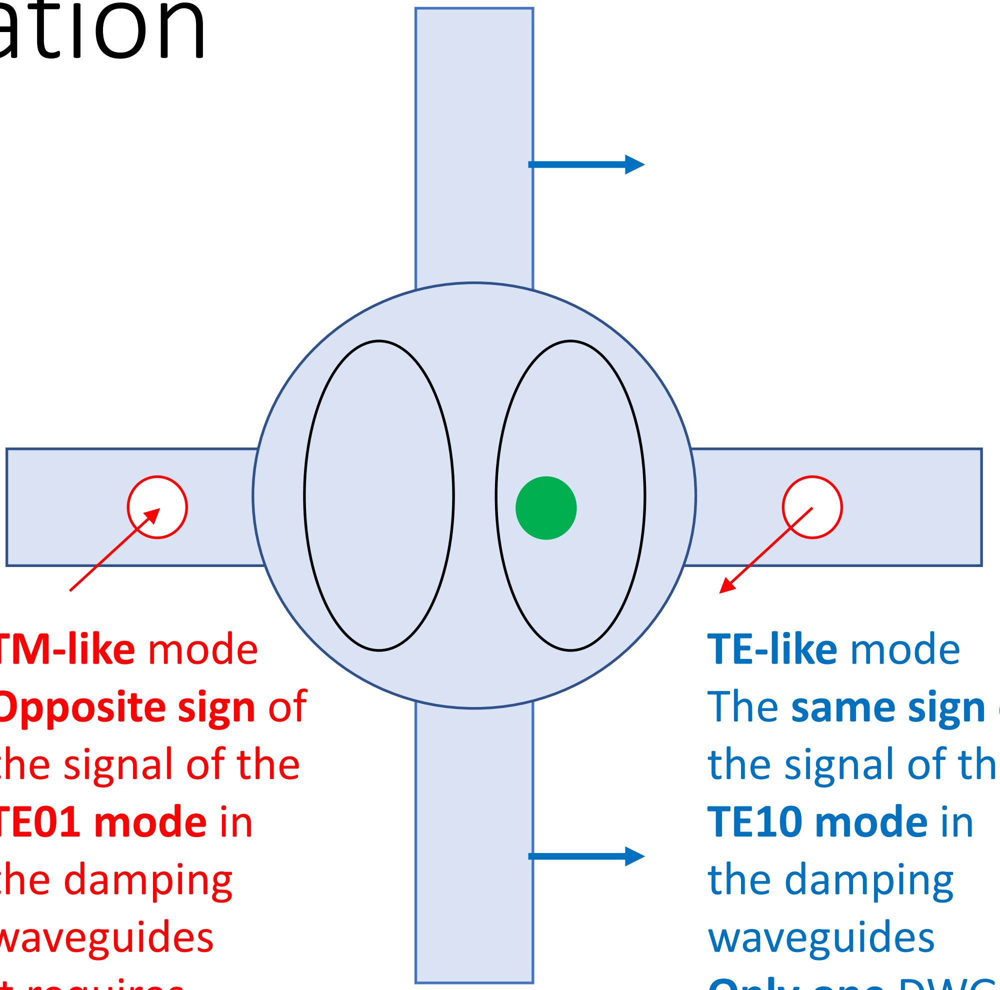
TM-like mode
Opposite sign of the signal of the **TE01 mode** in the damping waveguides
It requires **combination of 2** DWG signals

TE-like mode
The **same sign** of the signal of the **TE10 mode** in the damping waveguides
Only one DWG signal can be used

Local WFM signal combination



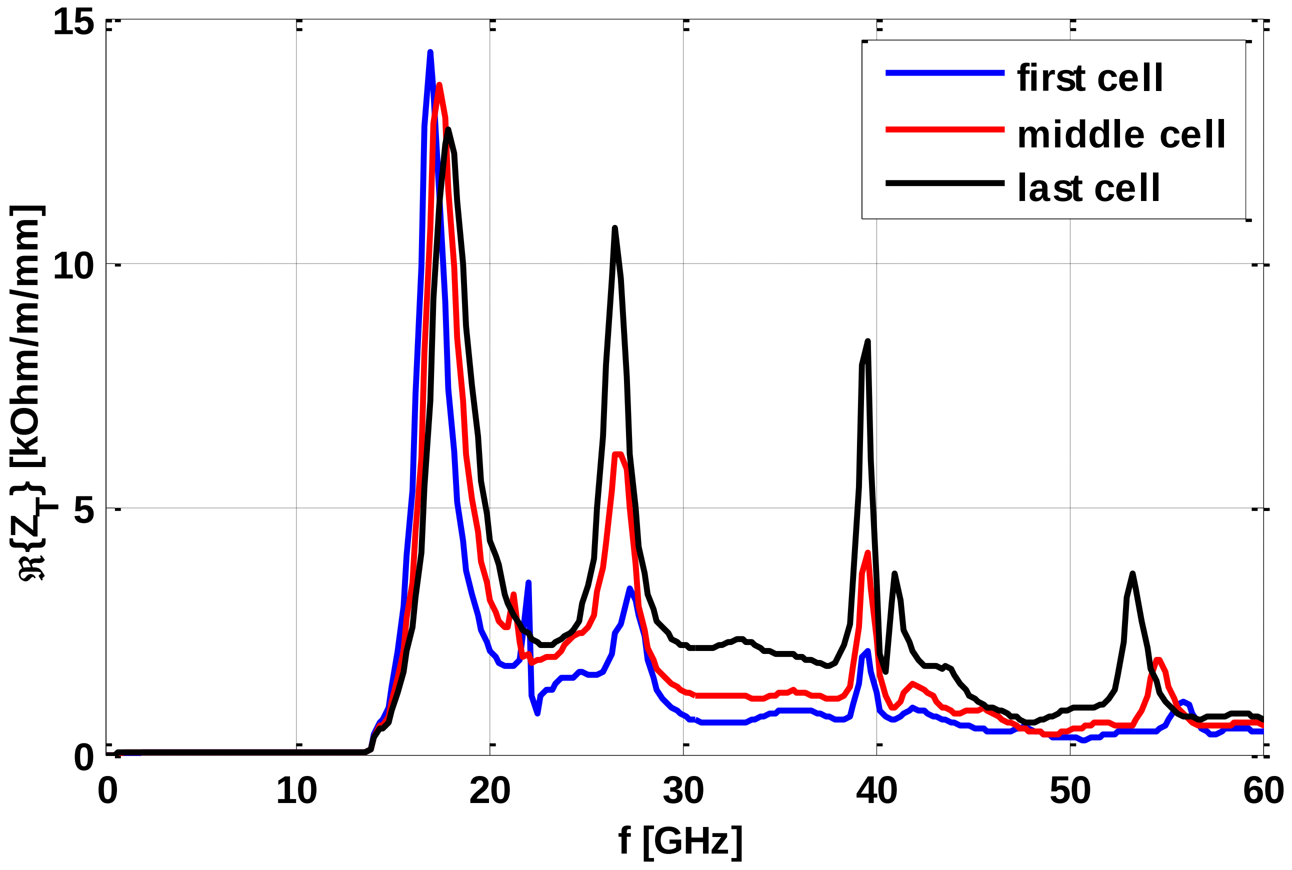
Integrated in the cell disk combiner (i.e. Hybrid or Magic-T) which is machined with high accuracy will increase the acurasy of signal combination compared to the hybrid after the cables



TM-like mode
Opposite sign of the signal of the **TE01 mode** in the damping waveguides
It requires **combination of 2** DWG signals

TE-like mode
The **same sign** of the signal of the **TE10 mode** in the damping waveguides
Only one DWG signal can be used

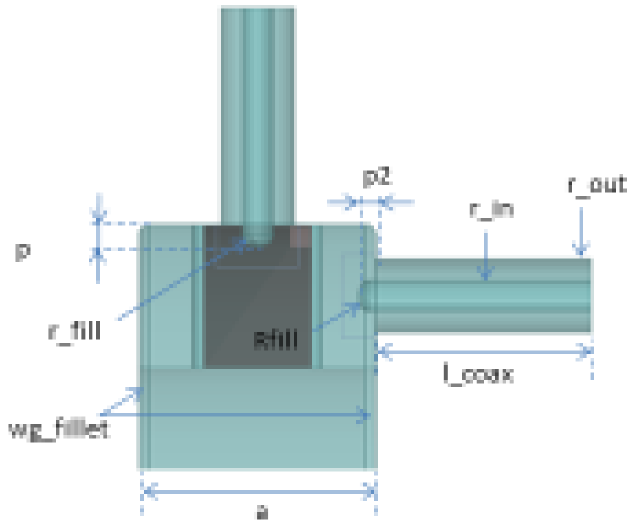
WFM cell position.



- **Last cell** has the smallest aperture
- Last cell has stronger signal compared to the first cell: ~a^3
- for the TE-like mode the effect is the strongest

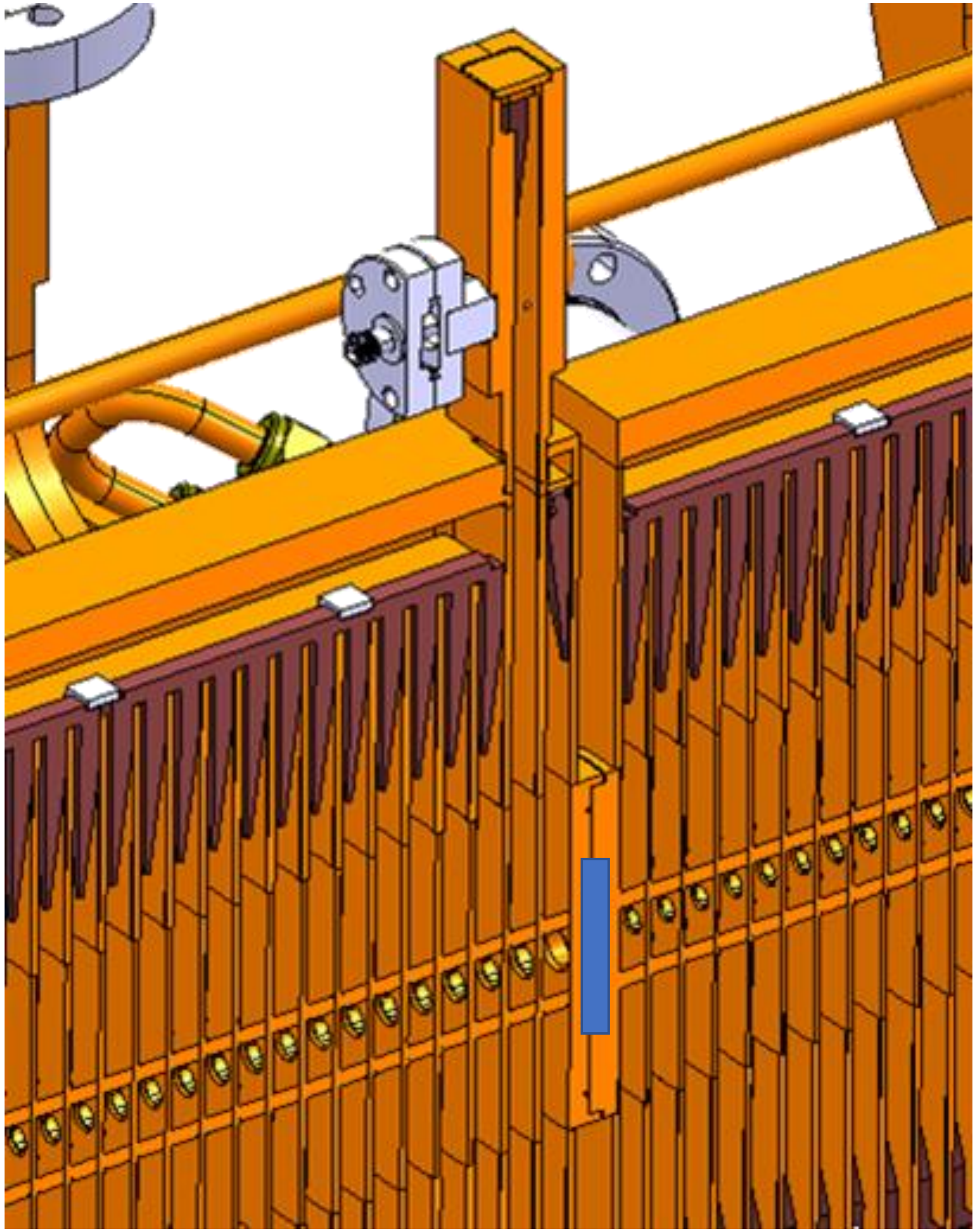
WFM signal coupling

- WFM cell must provide as good damping as any other cell
- The reflection form the WFM signal pick ups must be below **-25dB**
- This is a strong limitation on the coupling strength of the pick up. It is limited to **~-10 dB** only
- **Improving coupling keeping reflection under control** is another possible direction.
- It will require wake field studies.



Dedicate (cavity?) BPM integrated in the SAS

- Integrated BPM between two AS in the SAS will have no limitations related to accelerating cell
  - Wake frequency
  - RF power isolation
  - High gradient constraints
- It can be designed like a BPM with only one purpose to measure SAS position with respect to the beam
- It will introduce small additional impedance -> must be damped
- It must be compact, but will probably require additional length: ~5 – 10 mm (1 - 2% of SAS length)



Summary

- Improve WFM design (RF)
  - Change cell number from 1st of the 2nd AS to last of the 1st AS
  - Work with TM-like mode and do integrated hybrid
  - Or work with TE-like mode
  - Improve coupling of the pick-ups
  - Do tolerance analysis
- Design dedicated BPM integrated in the SAS (BI+RF)
- Electronics was not addressed but it is important part of the system