Cherenkov Diffraction BPM status

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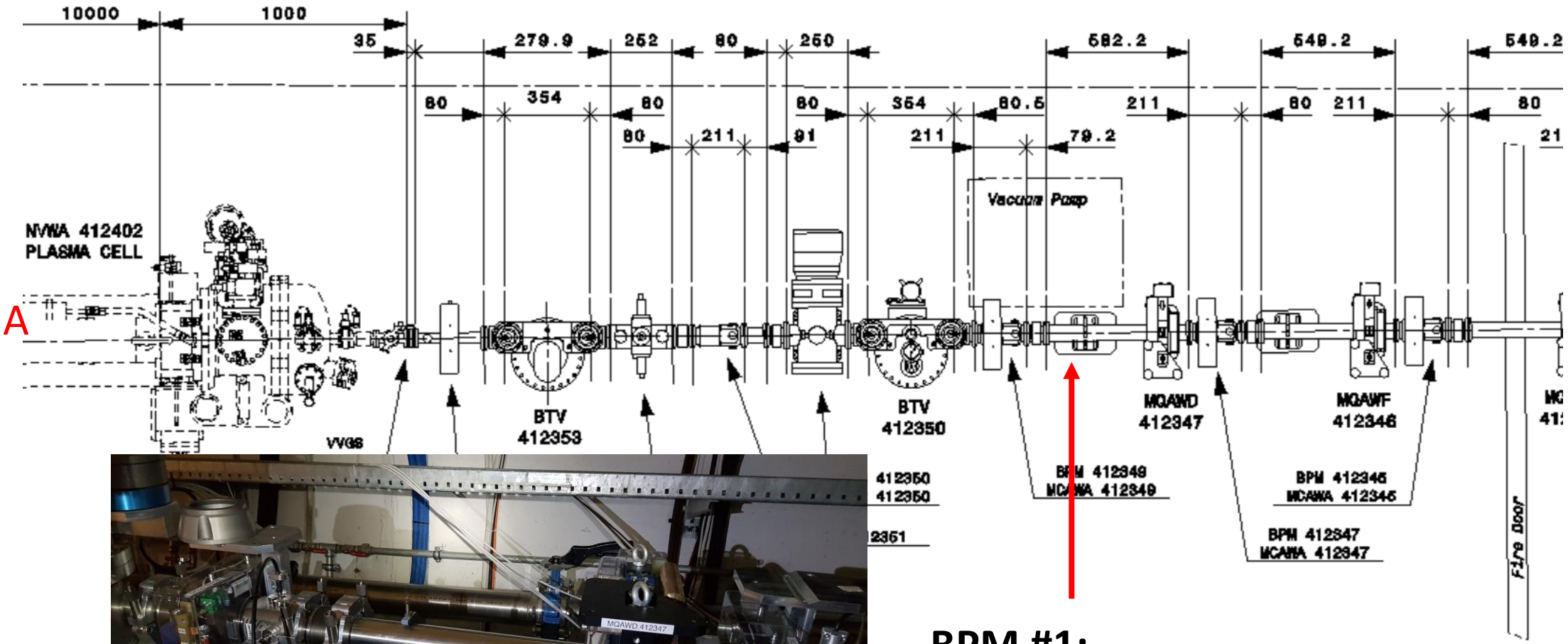
Outline

- Location
- Design, prototyping and R&D
- Detection
- Preliminary tests at CLEAR

Location

PLASMA CELL

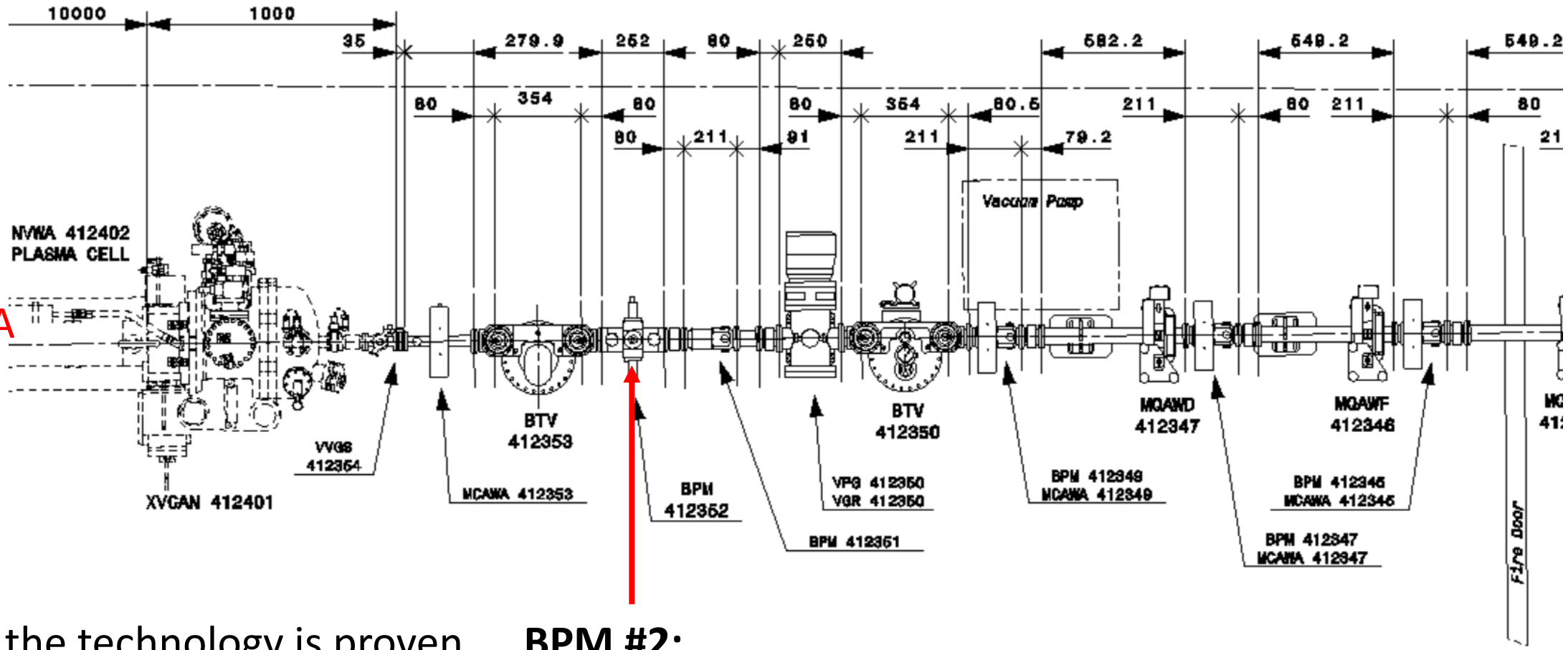


BPM #1:

Test BPM, installed in a drift.

Requires beamline modification.

Location



PLASMA CELL

Once the technology is proven … **BPM #2:**
Second BPM
(will replace pBPM)

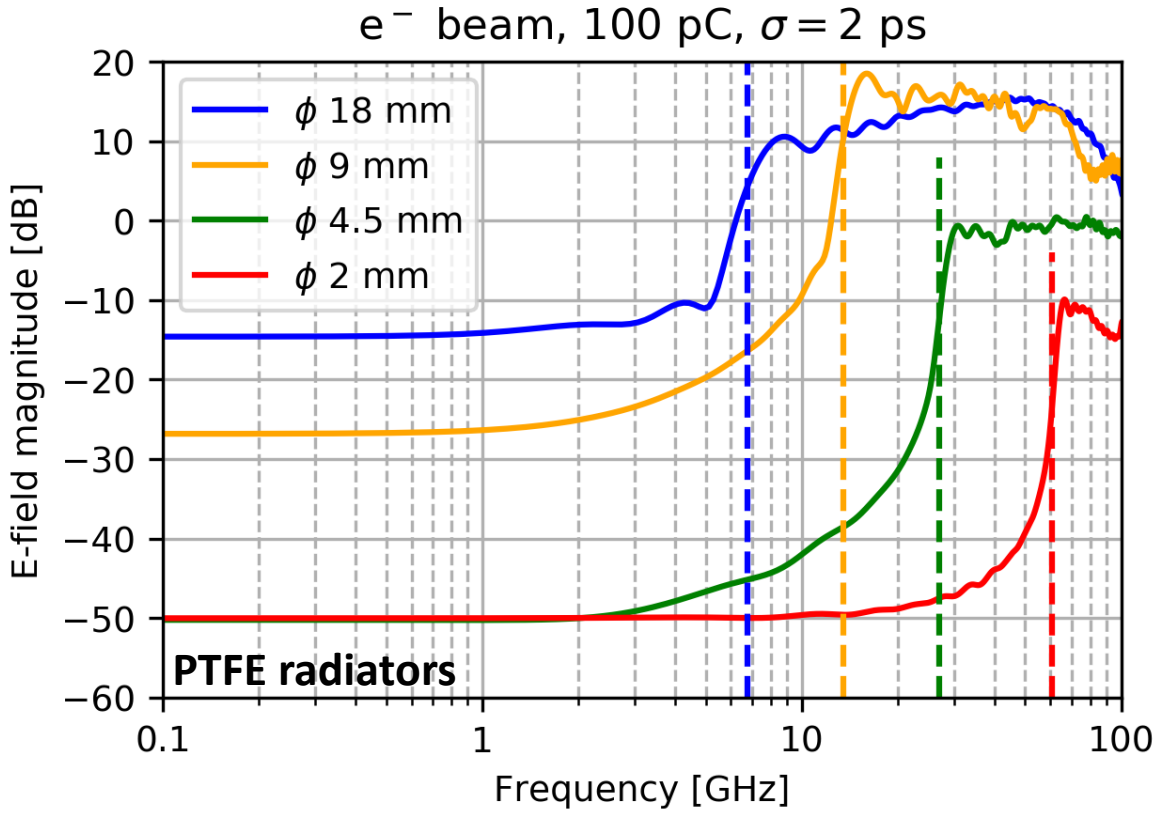
Design, prototyping and R&D

Key points from theory:

- $\mathbf{f_{cutoff}}$ depends on diameter
- **P produced** depends on surface and shape

Key issues:

- It is hard to have an absolute power estimation from simulations
- Small diameter radiators are hard to manufacture



Additional prototyping & tests at CLEAR

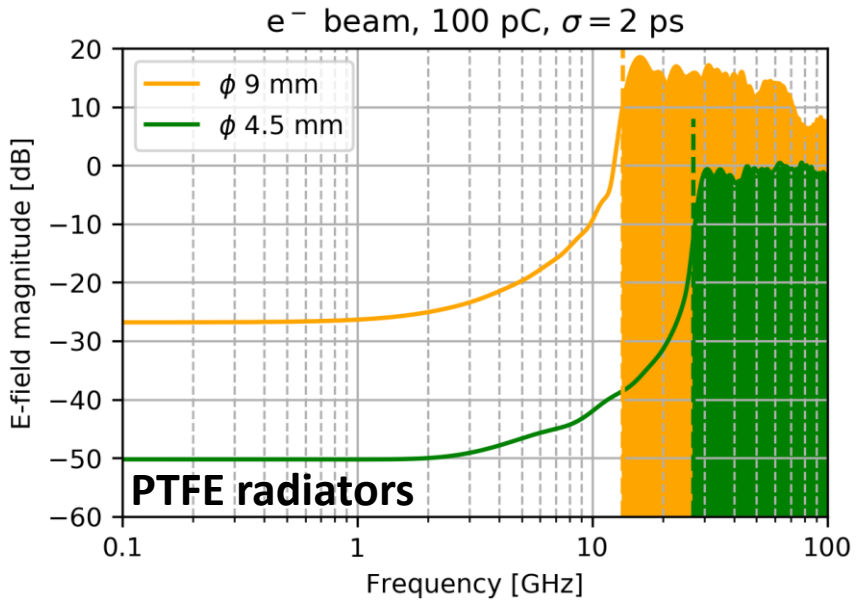
Design, prototyping and R&D

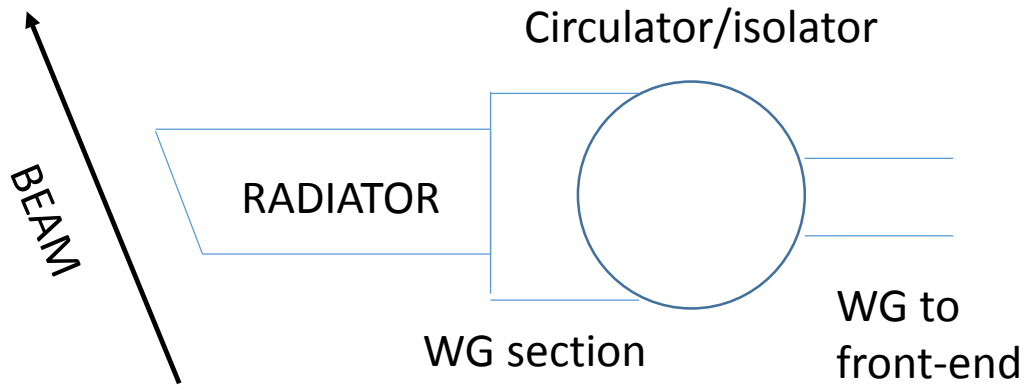
Key points from theory:

- $\mathbf{f_{cutoff}}$ depends on diameter
- **P produced** depends on surface and shape

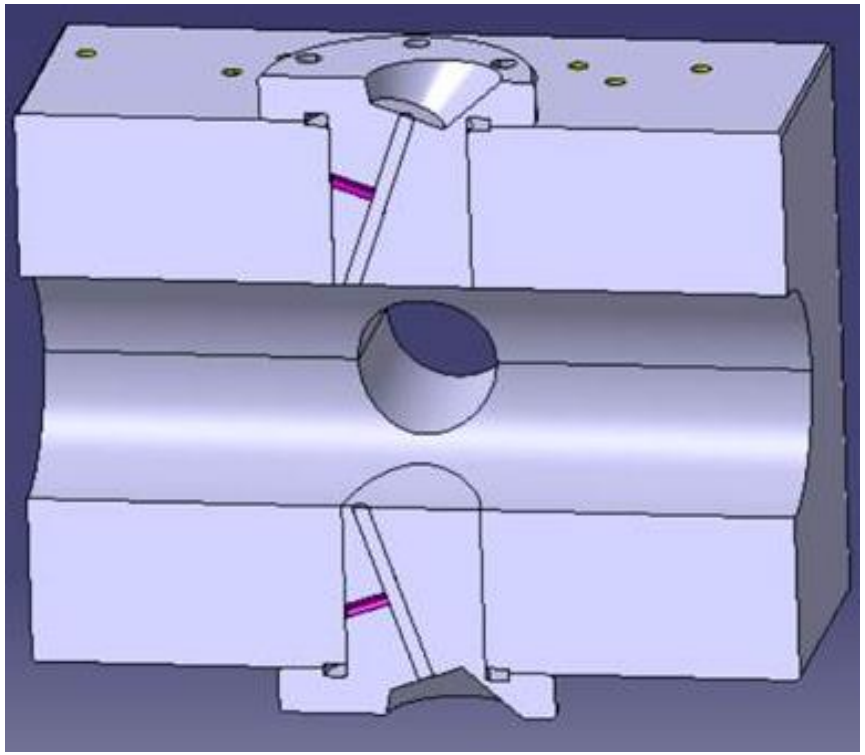
Alternative approach:

- Produce high power, wide(r)band radiation
- Highpass in the waveguide network outside the radiator
- Lower frequency RF reflected back and/or circulator/isolator



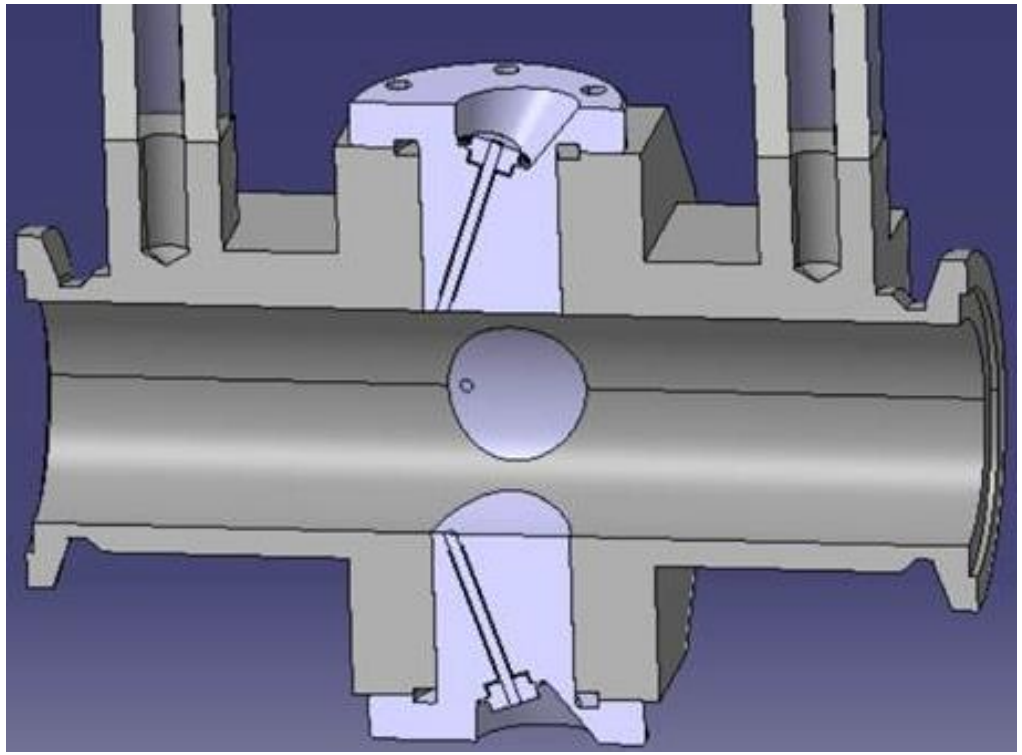


Design, prototyping and R&D



In-air test setup:

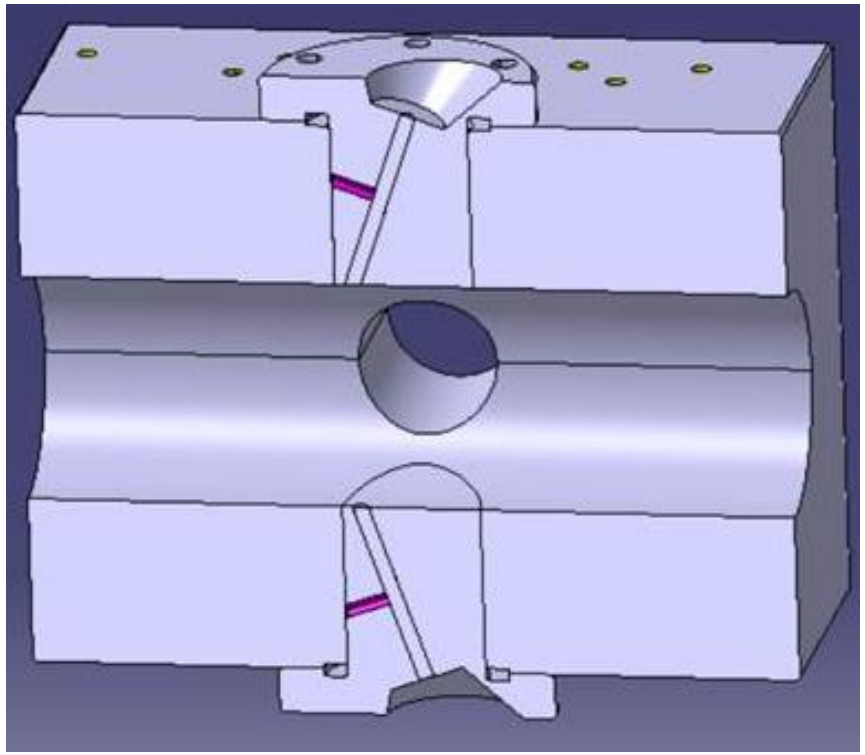
- Same button geometry
- Same aperture
- Easier and cheaper to build



AWAKE setup:

- Vacuum tight, brazed alumina
- Installed in the beamline

Design, prototyping and R&D



In-air test setup:

- Same button geometry
- Same aperture
- Easier and cheaper to build

Body:

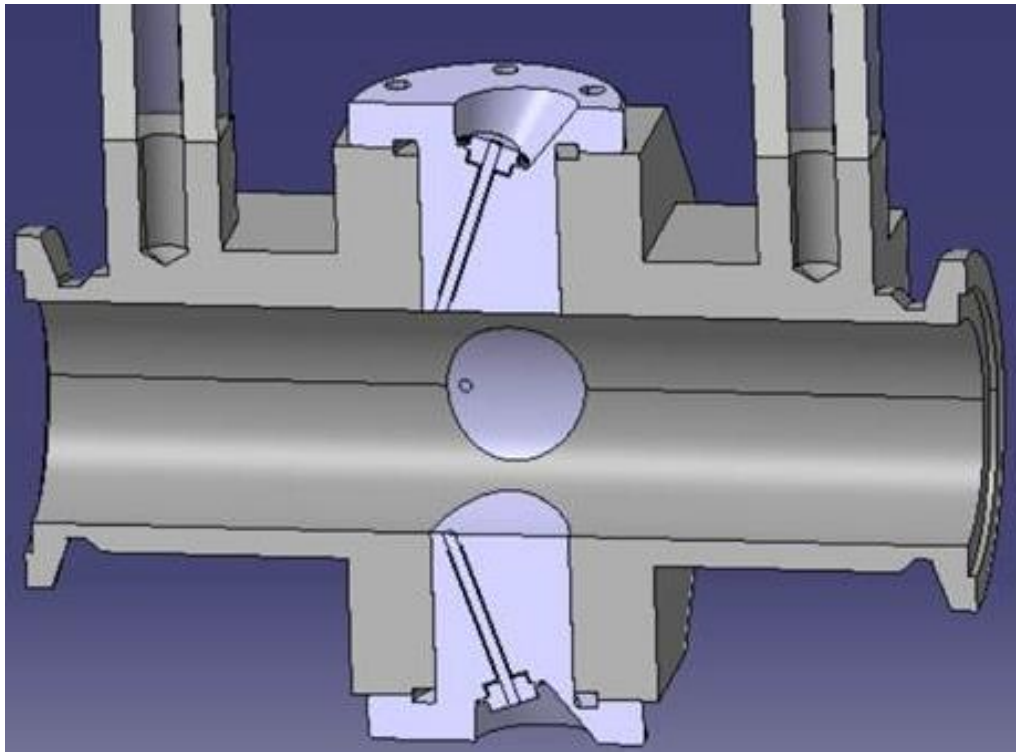
- Rectangular aluminum body
- To be mounted on movers
- 60 mm beampipe diameter
- Compatible to the final AWAKE buttons

Buttons:

- Non vacuum tight
- Alumina rods held in place by a bolt
- Alumina rods ordered for 4, 6 and 15 mm diameter

Diameter	f_{cutoff}
4 mm	14.5 GHz
6 mm	9.7 GHz
15 mm	3.9 GHz

Design, prototyping and R&D



AWAKE setup:

- Vacuum tight, brazed alumina
- Installed in the beamline

Body:

- Vacuum tight body
- Integrated on the beamline
- 60 mm beampipe diameter
- Option for adding also high frequency electrostatic buttons (20 GHz+) available on the market

Buttons:

- Vacuum tight
- Brazed alumina to a metallic collar, that is welded to the button

Detection system

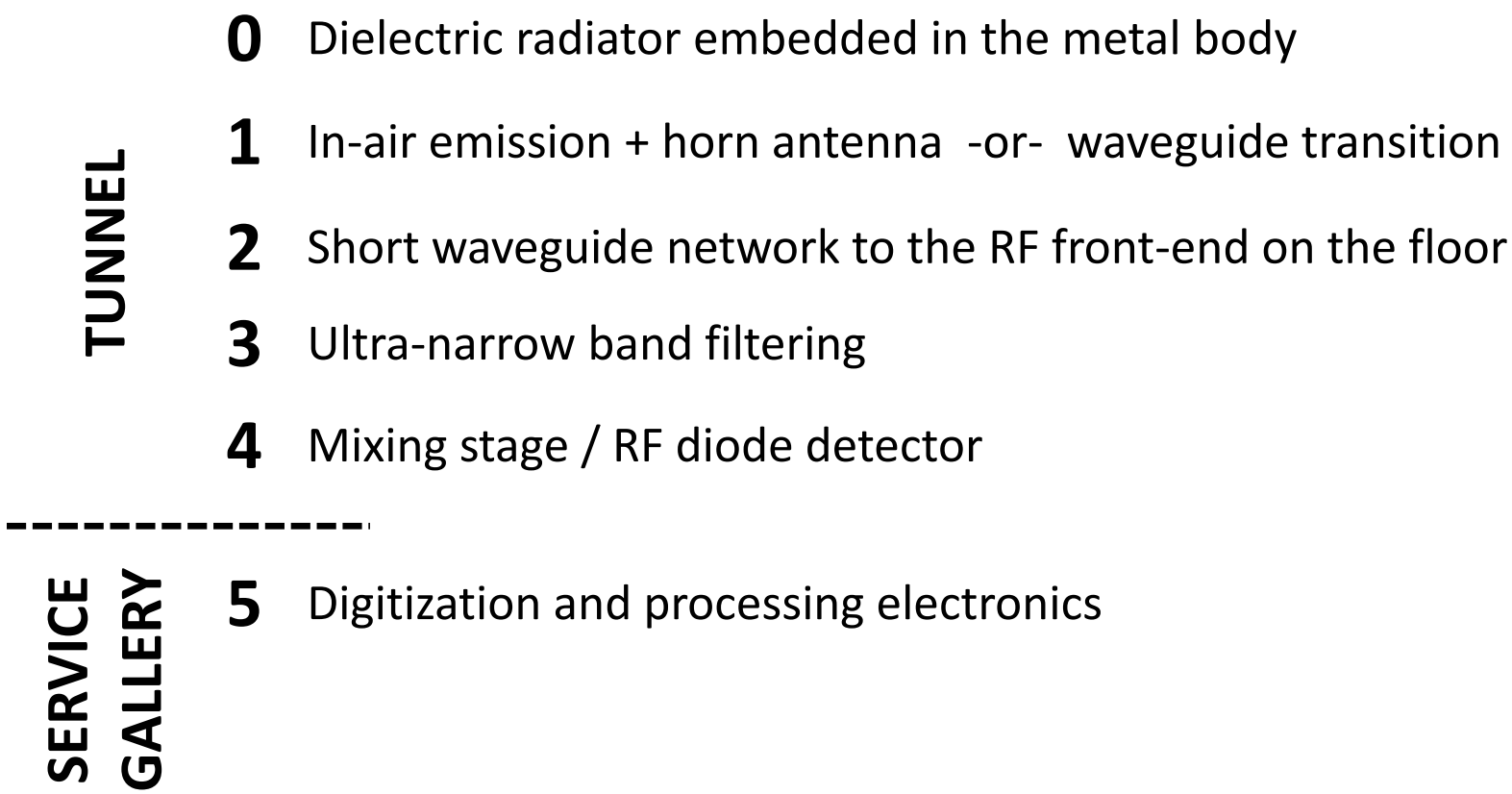
Sinergy with TRIUMF, which is interested in developing the electronics:

- Brainstorming on July 8th on possible system architectures
- Applying now for funding
- CERN will take care of the system up to a standard waveguide transition, then TRIUMF takes over

Detection system

Sinergy with TRIUMF, which is interested in developing the electronics:

- Brainstorming on July 8th on **possible system architectures**



Preliminary tests at CLEAR

Tests at CLEAR in the past 3 weeks with parts available and similar architecture (based on RF diodes)

WG network to the klystron gallery

Bandpass filter 46±1 GHz

Horn antenna

ChDR BPM 18 mm diameter PTFE radiators

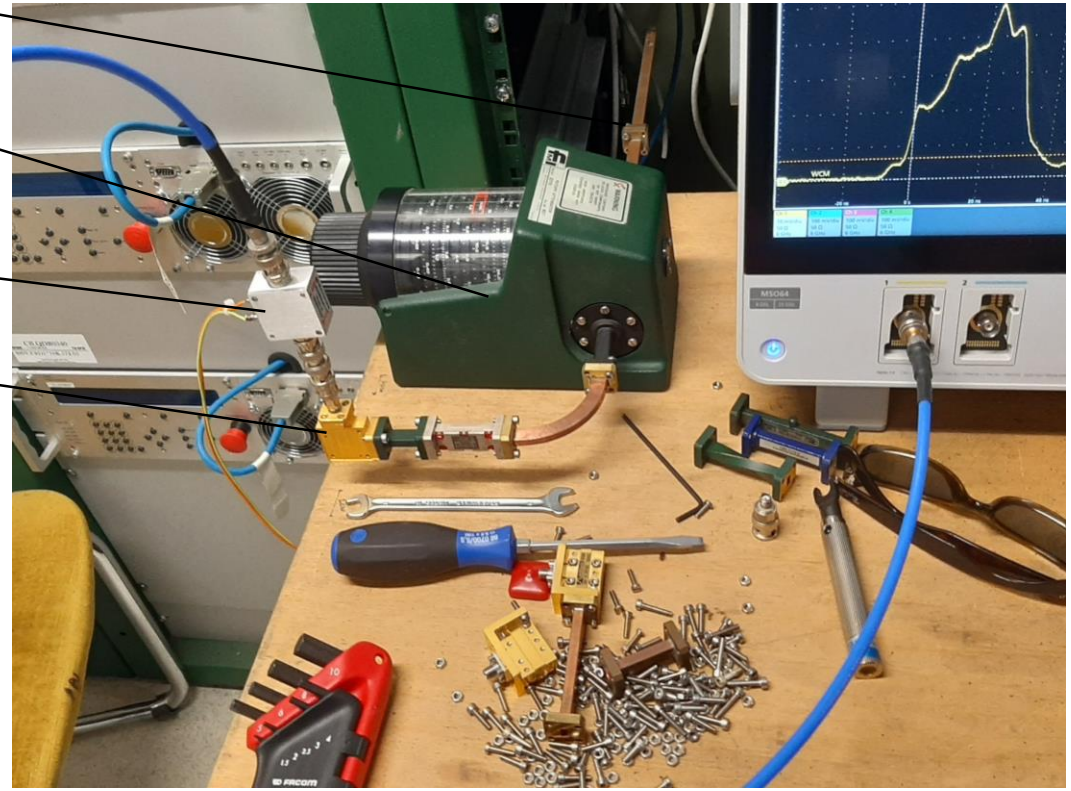
Preliminary tests at CLEAR

WG network from the tunnel

Precision rotary attenuator

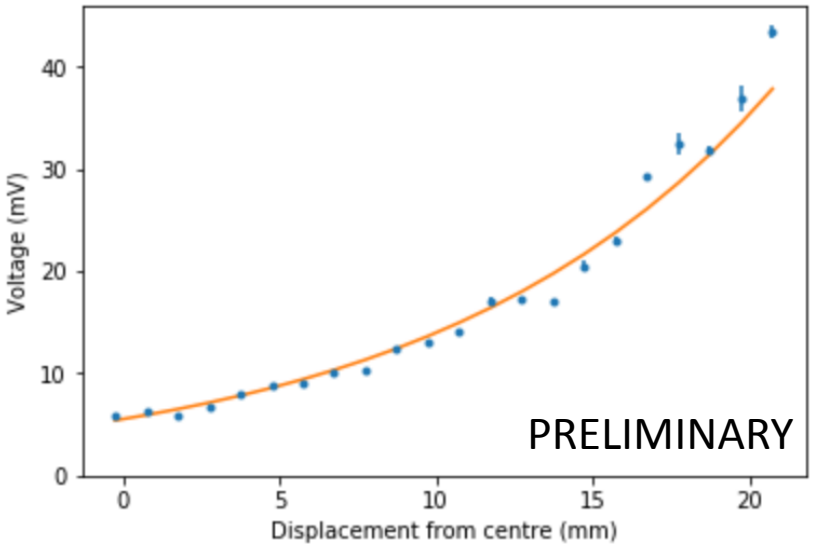
Amplifier

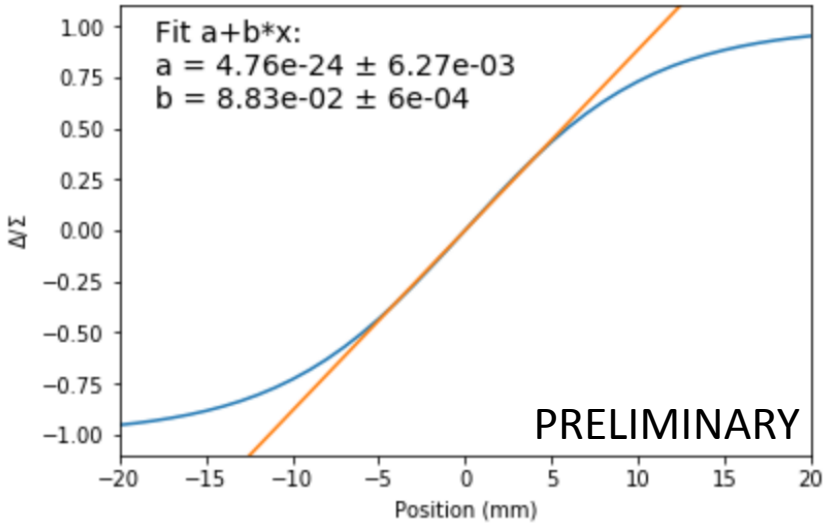
RF diode

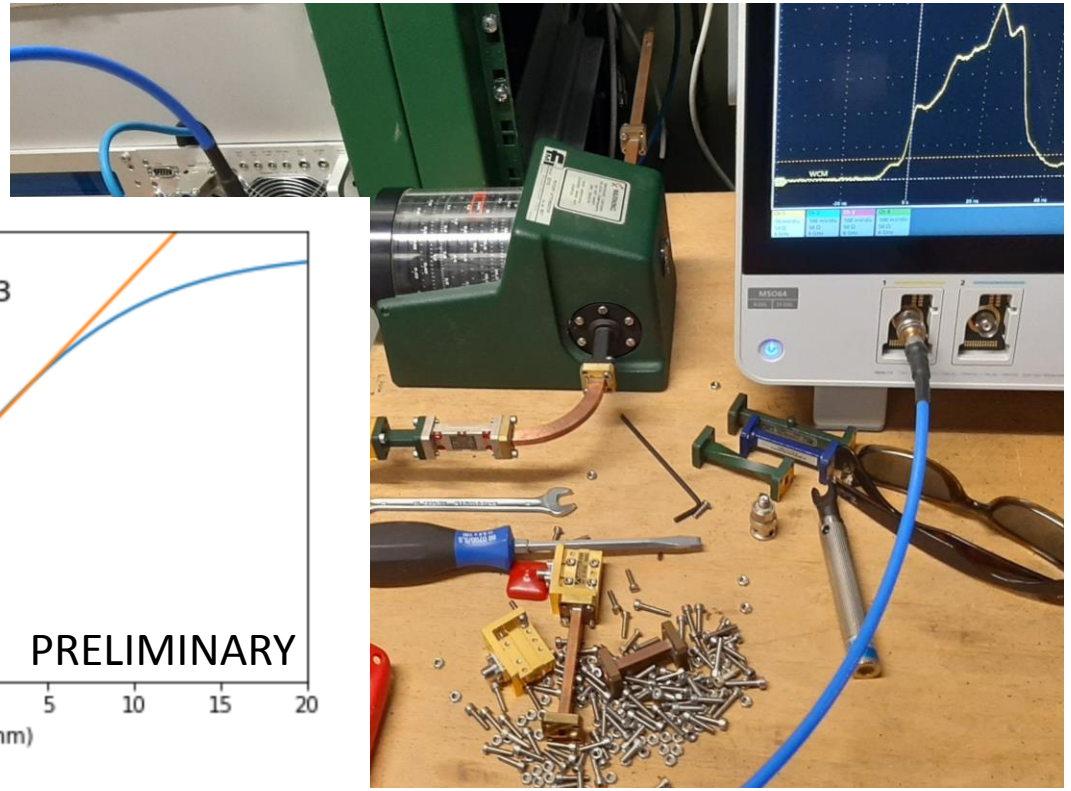


Preliminary tests at CLEAR

Key point: same power incident on the diode, that work always in the linear regime.



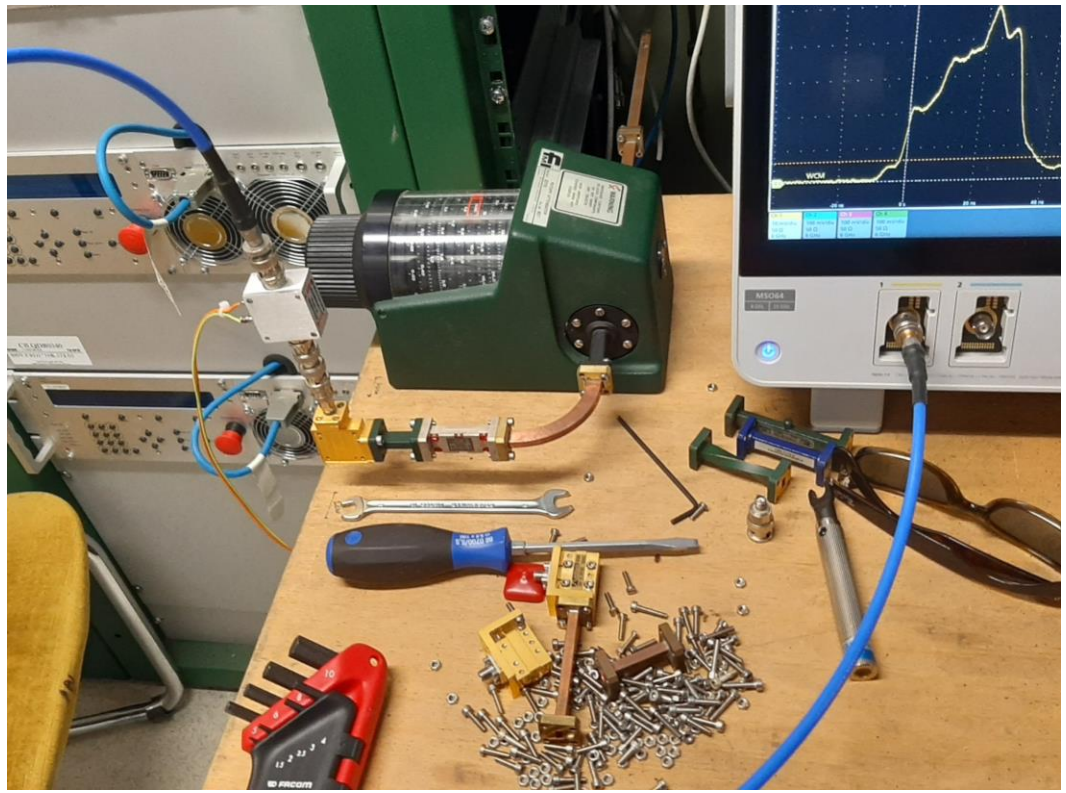




Preliminary tests at CLEAR

Main (preliminary) results:

- RF diodes qualification for short pulses
- Able to measure **up to 1 pC charge beams** (limited by long WG network and noise)
- Estimation of the position sensitivity with narrowband detection
- Radiated power estimation (still work in progress due to reflections)



Experience for tests with Alumina buttons at CLEAR this year

Conclusions

- These studies are the possibility to fully develop the dielectric button technology not only for BPM applications.
- So far tested PTFE inserts, this year we want to **test Alumina buttons at CLEAR** of various diameter
- **Collaboration of TRIUMF** on the detection system
- Preliminary tests to get experience at CLEAR on a more engineered detection
- Option for testing of high frequency electrostatic buttons in parallel and compare the technology

Open points

- In case of installation of a second BPM, is it ok to suppress the last proton BPM before the plasma cell ?
- For a mixing stage, we need to keep the LO oscillator in a low radiation area and transport the high frequency RF to the mixer.
  - Are CTR waveguides still in use ? Which is the frequency band ?
  - At least for the first BPM, can we use the trench to the laser room ? (it is an optical line, but will be in use ?)
- Installation timelines (4 weeks intervention from first estimates)

Thanks for your attention !