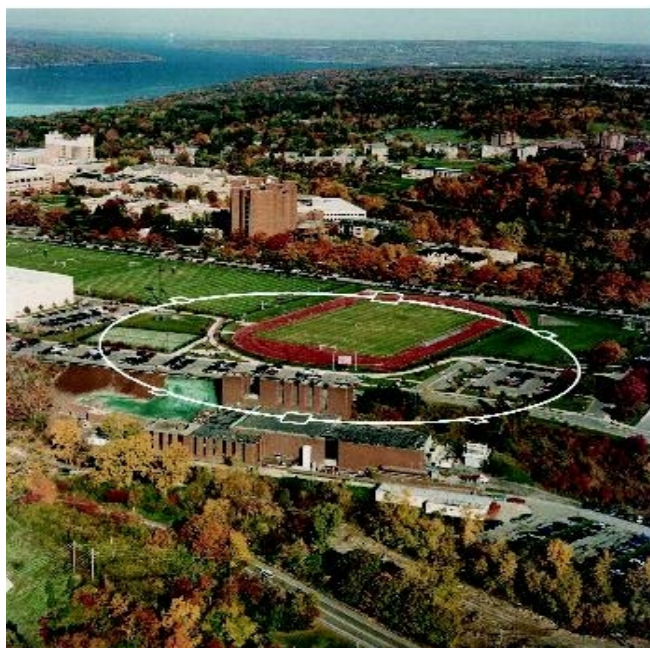


Cornell Laboratory for
Accelerator-based Sciences and
Education (CLASSE)

Design for Electron Cloud Detectors in a Quadrupole Magnet

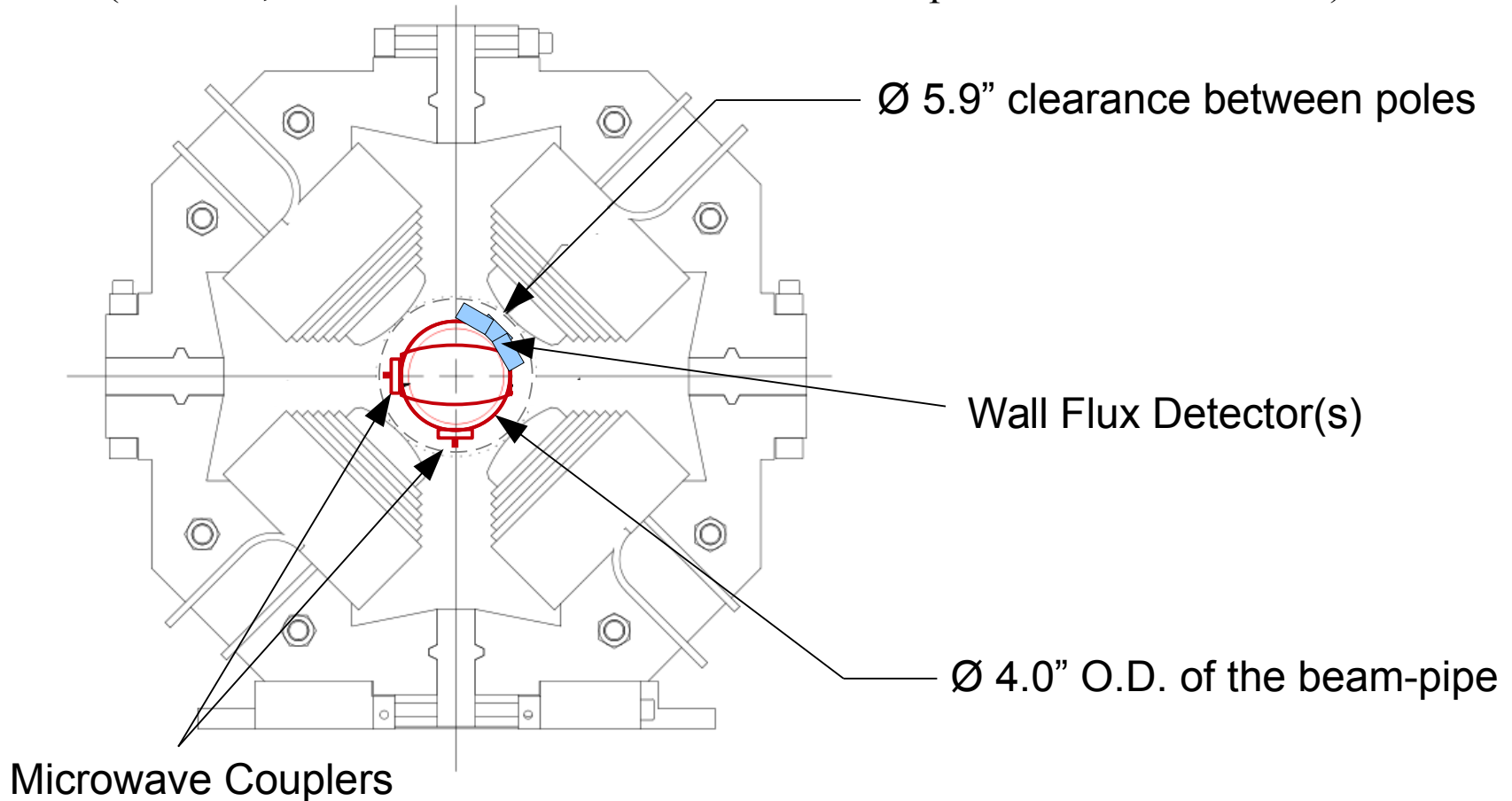
John Sikora (CLASSE, Cornell Univ.)

August 5, 2015



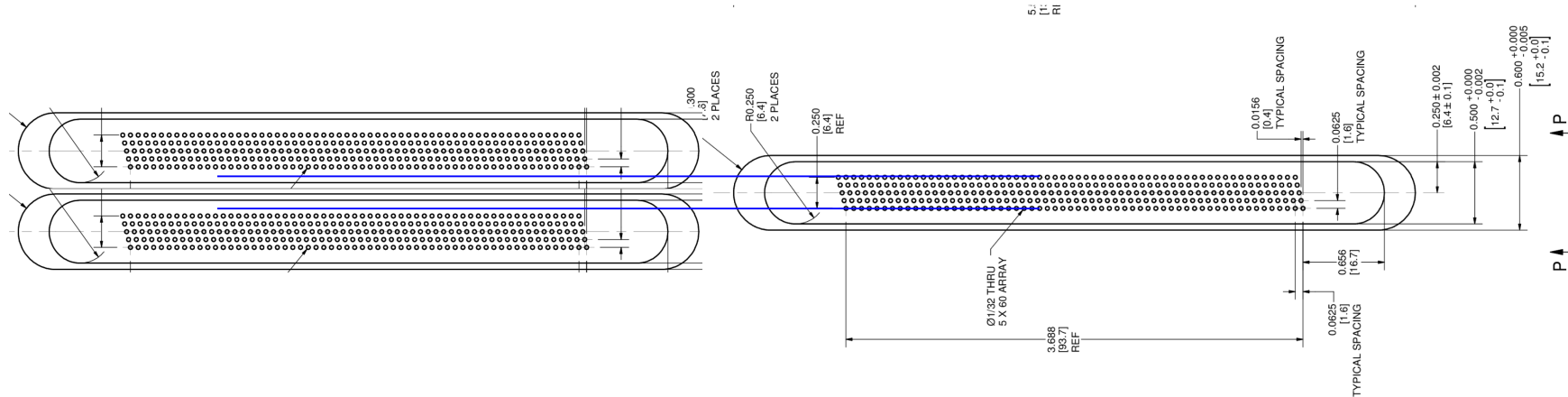
Available Space for Wall Flux Detectors

- If the quadrupole is modified in the same way as Q03W (2004), there is nearly one inch of clearance between the beam-pipe and the quadrupole iron. (~24 mm, so 20 mm tall detectors would have a pole clearance of 4 mm).



A Wider Detector in Three Sections

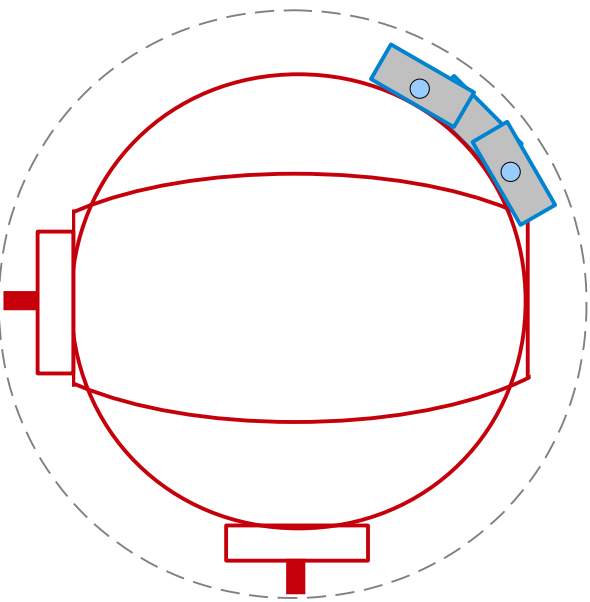
- Use hole plates as in the design of 6085-206 sheet 9
- Need a detector that is three times as wide (azimuthally) as the original.
- Use three plates: one with perpendicular holes the others with an angle of 9.18° .
- Hole angles to follow magnetic field lines (approximately).
- Hole plates can be staggered longitudinally as shown below.



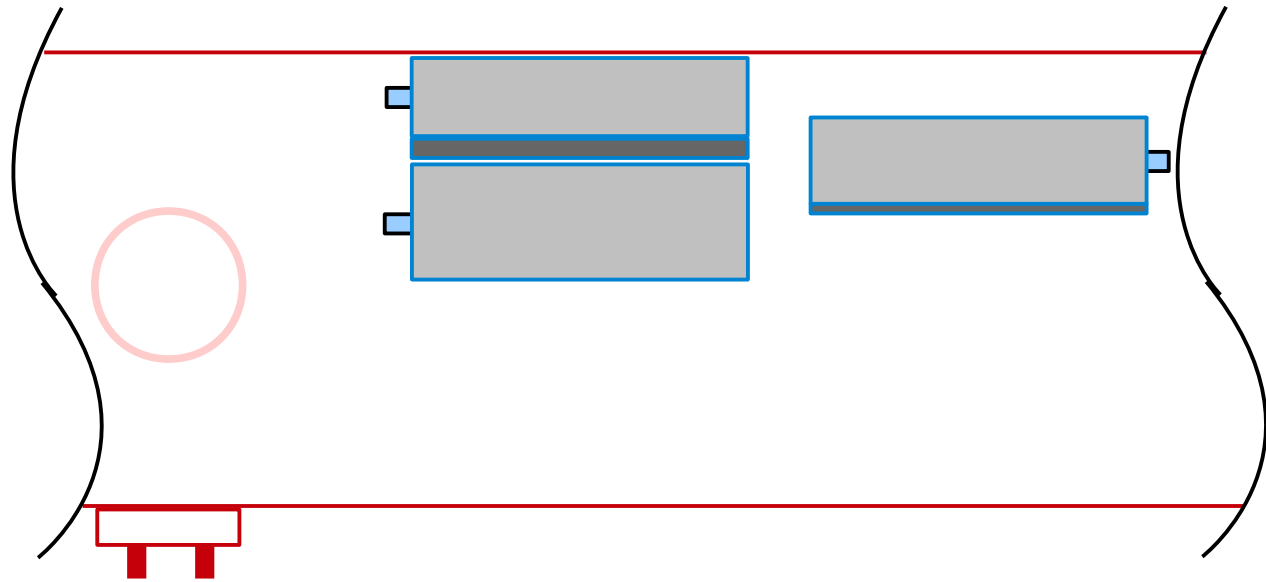
Effective Cross Section:



Relative Placement of Detectors



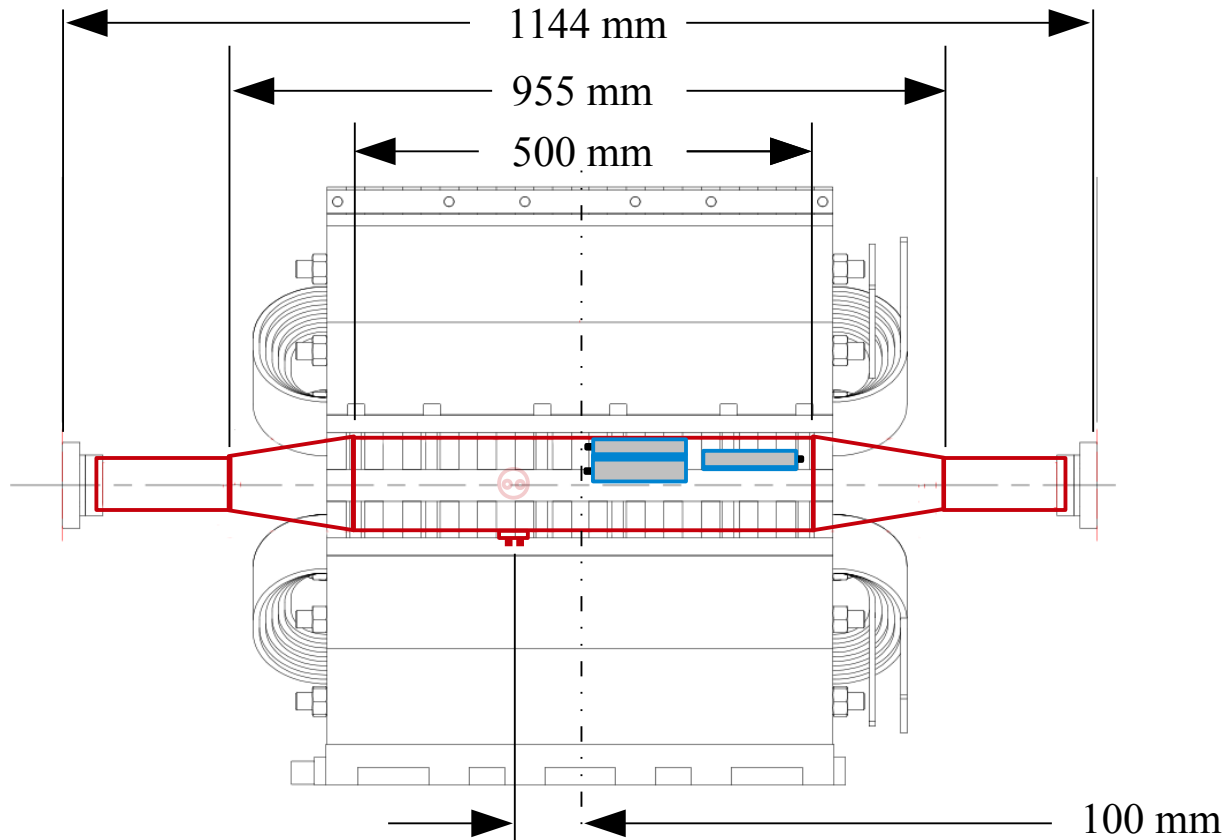
Outside of Ring

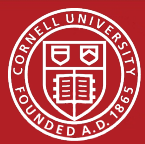


Side View

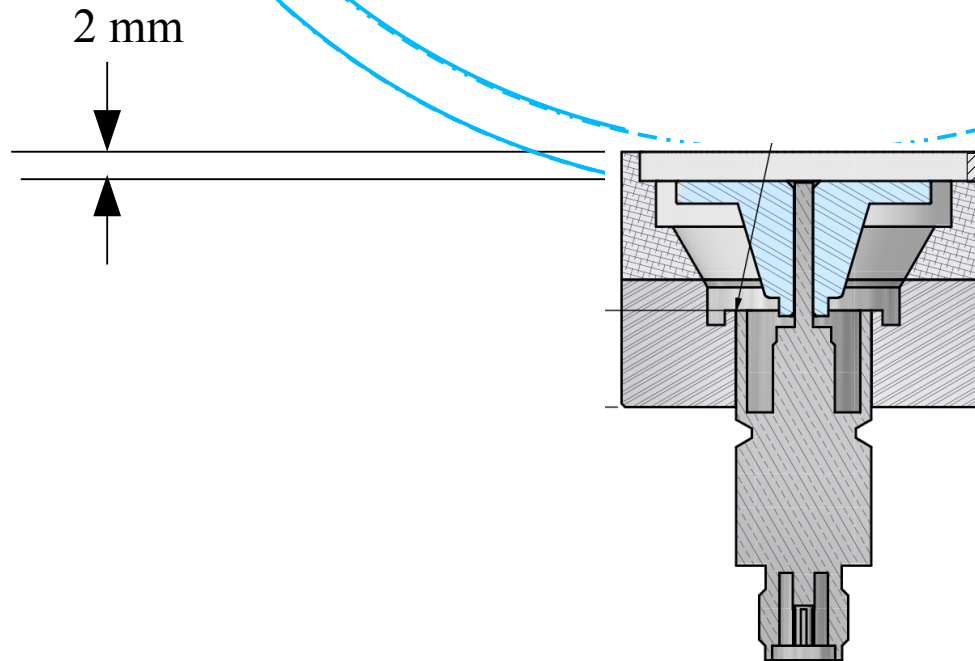
Overall Beam-pipe Shape

- Round beam-pipe with 95.5 mm I.D., 500 mm long (~19.7 inches)
- Round pipe tapers to standard CESR shape over approx 227 mm (~11.2 inches).
- Buttons 100 mm off center.

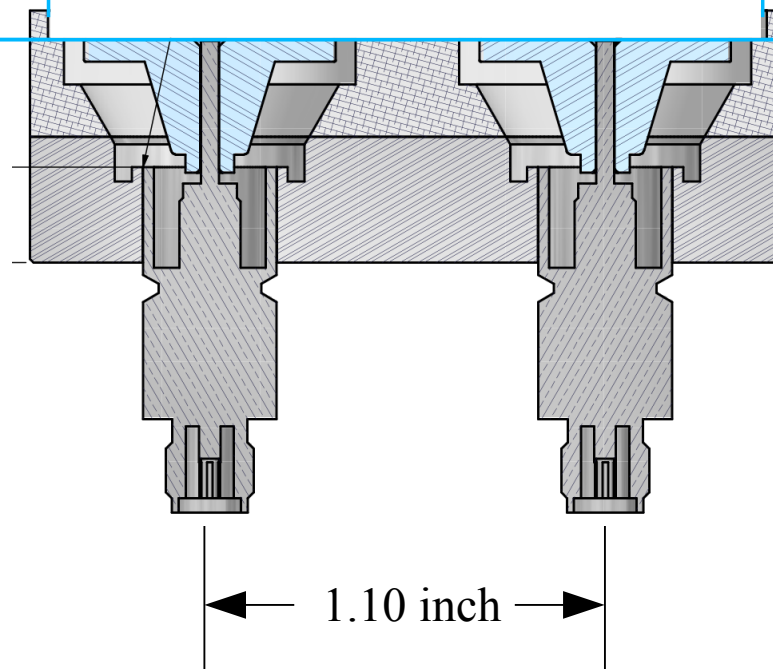




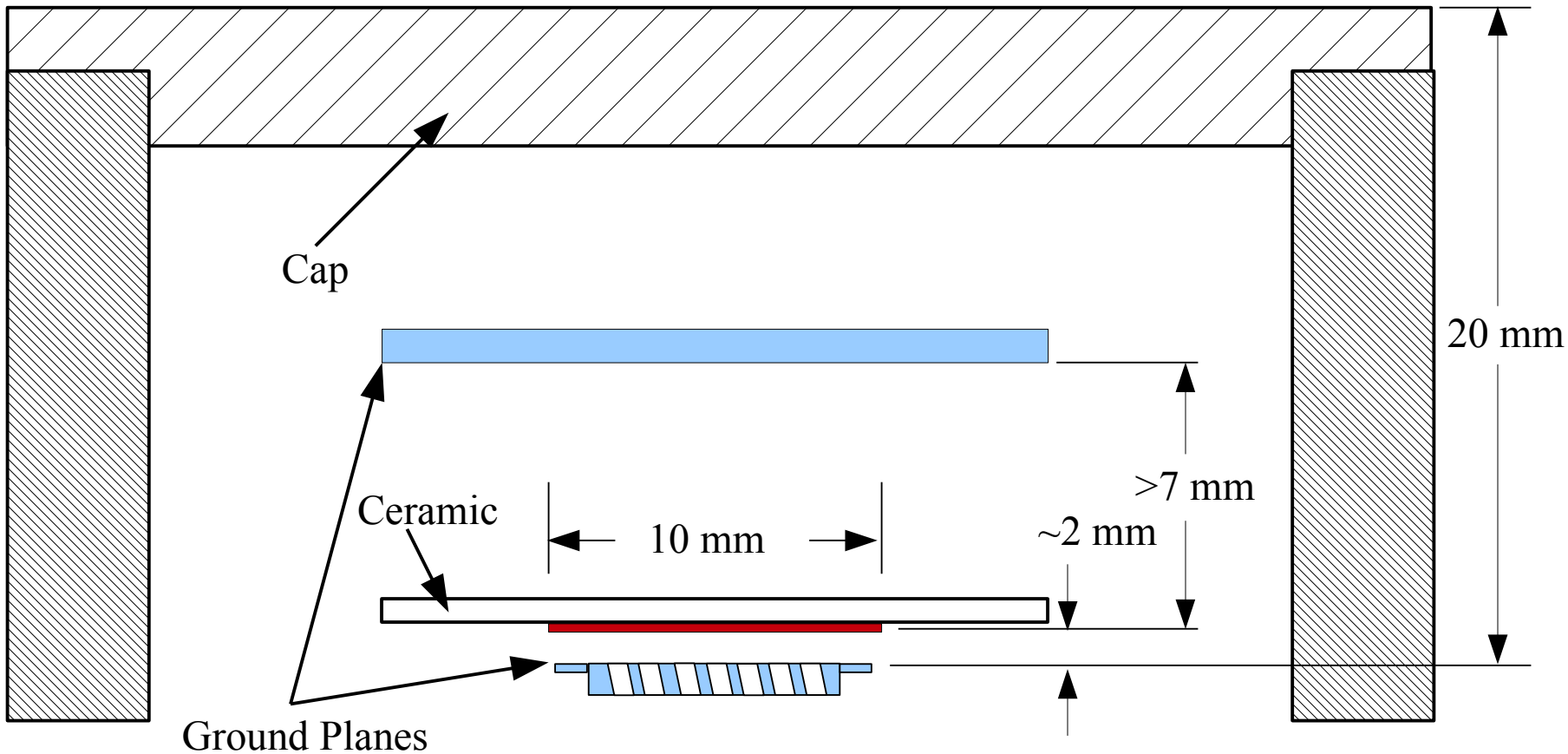
BPM Detail:
Button recessed 2 mm from
I.D. of pipe



BPM Detail: showing bottom button spacing

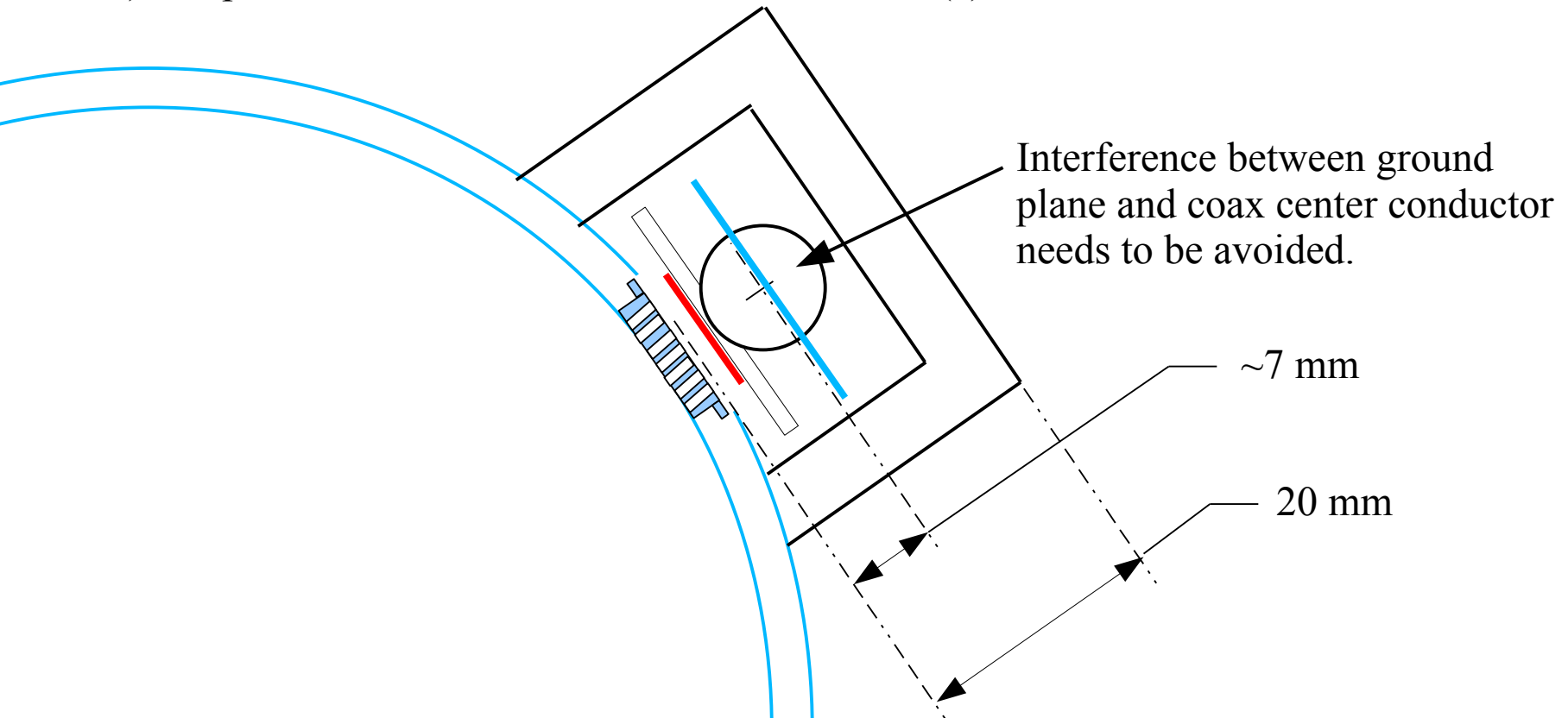


- 1) The distance from the holes to the collector should be 2 or 3 mm.
- 2) The impedance calculation must include both the upper and lower ground planes.
- 3) With NO dielectric the lower/upper gaps would be 2 mm and 7.1 mm (50 Ω)
- 4) Adding ceramic will give 50 Ω with larger gap to the upper ground plane.



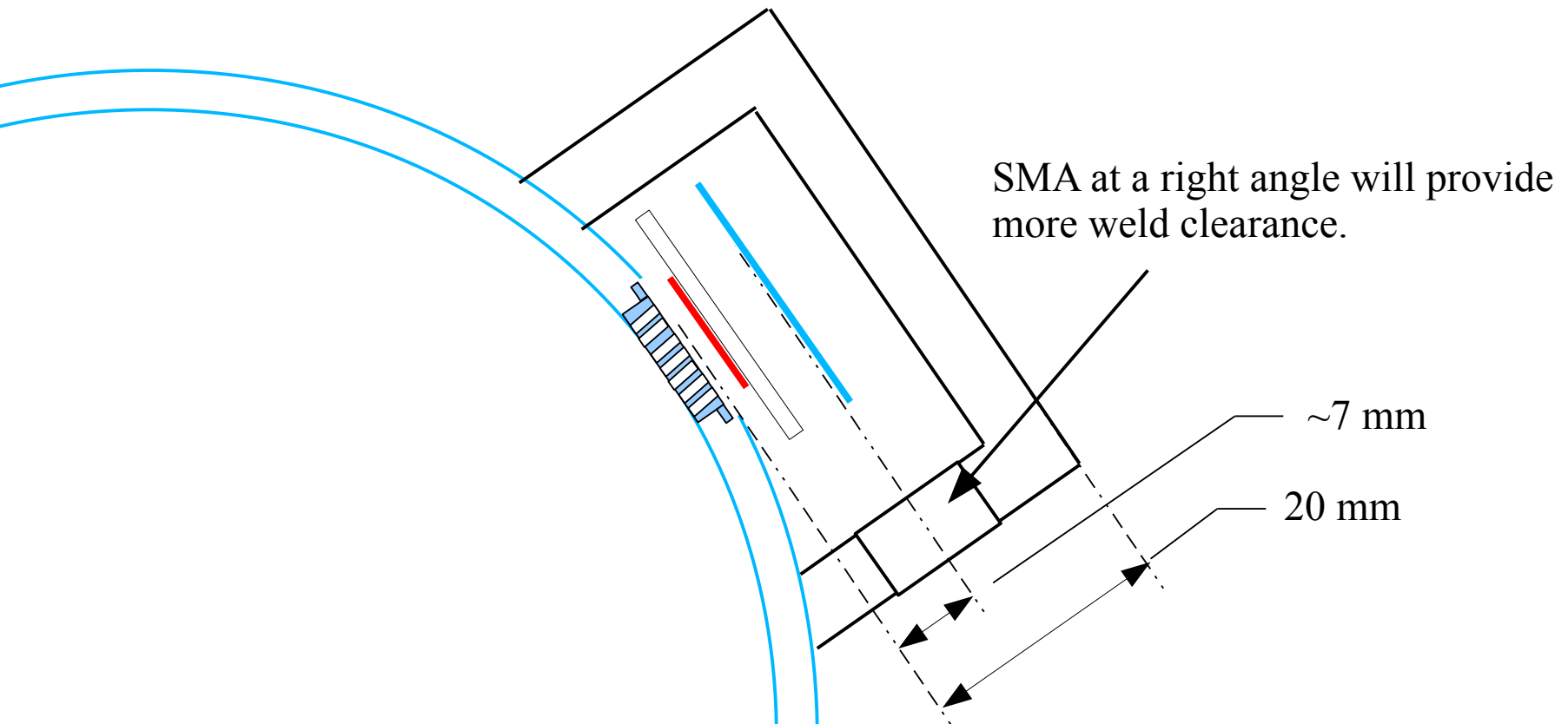
Physical Layout and Constraints

- 1) SMA Feedthrough 9.45 mm dia. (what is weld clearance?)
- 2) Detector height clearance limited to 20 mm from O.D. of the beam-pipe.
- 3) Wall thickness?
- 4) Stripline 10 mm wide; Dielectric 20 mm wide (?)



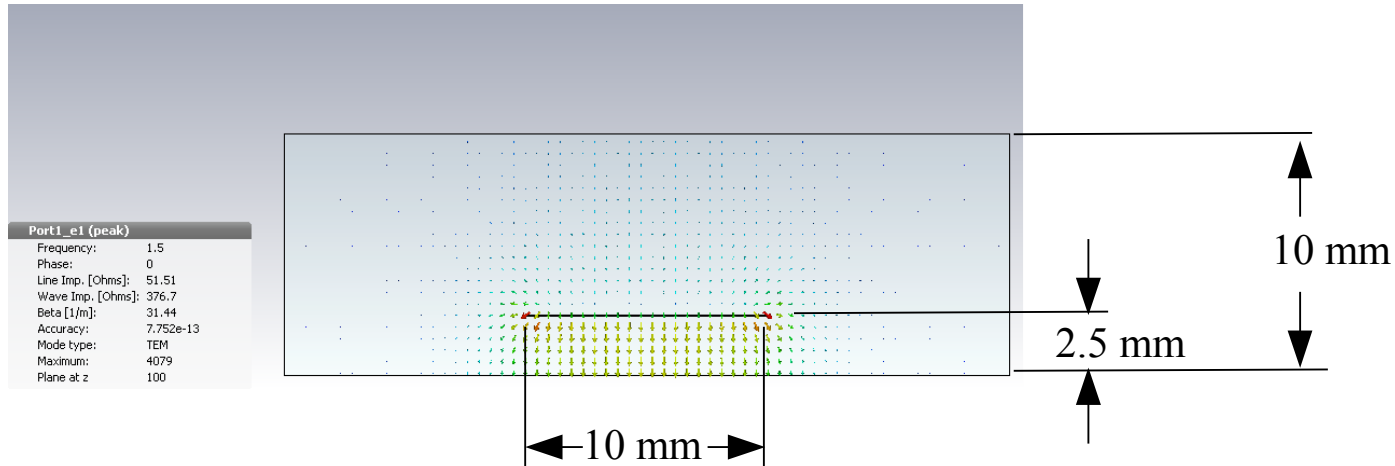
Alternative Right Angle Orientation of Feedthrough

- 1) The curvature of the beam-pipe can be used to obtain more weld clearance (and clearance in general).
- 2) The box would be extended on the side where the feedthrough(s) are welded.

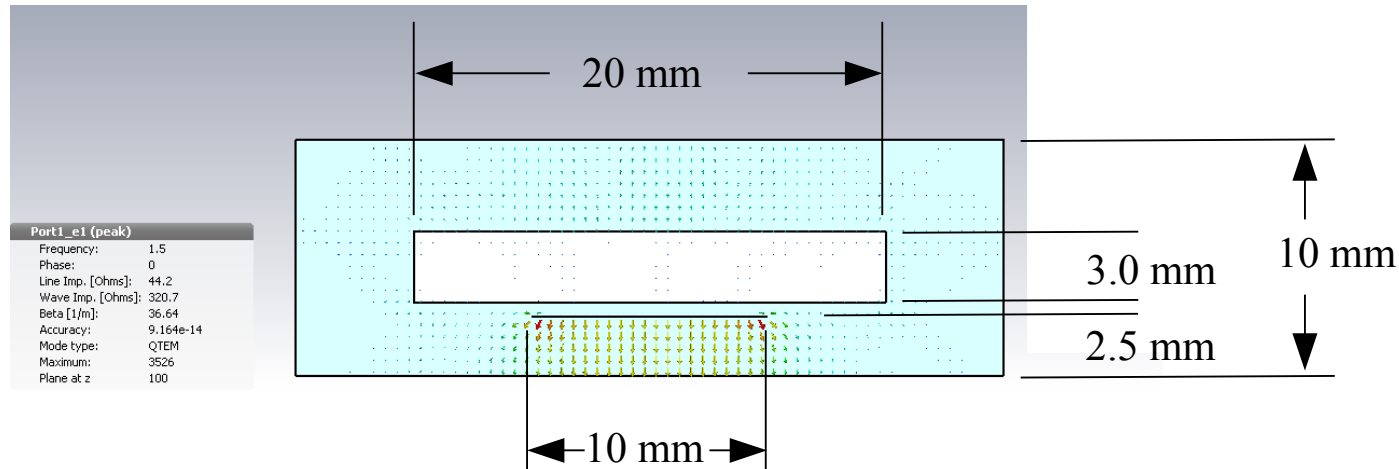


Stripline Simulations: 10 mm tall box

Without ceramic
51.5 Ω

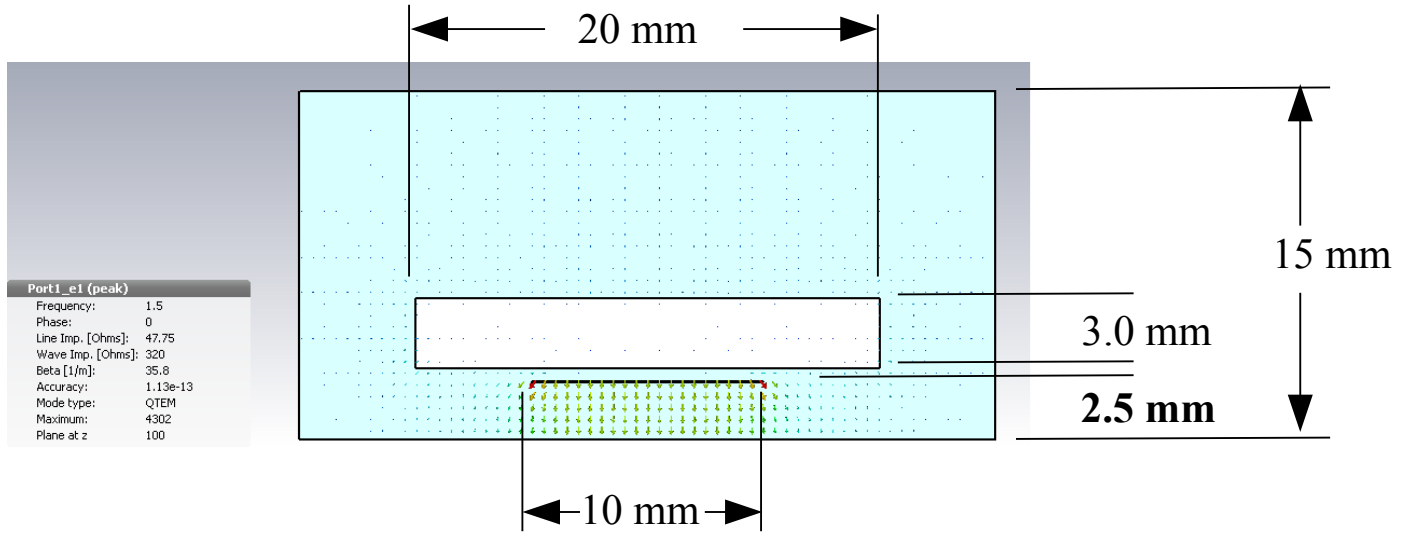


With 3 mm ceramic
44.2 Ω

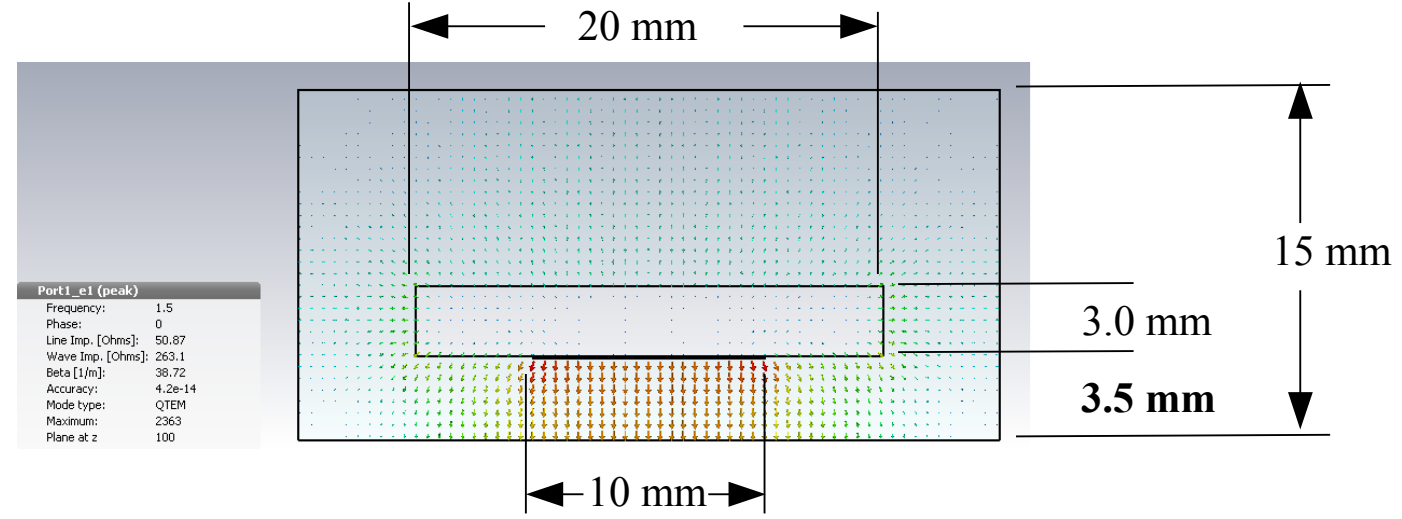


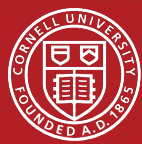
Stripline Simulations: 15 mm tall box

2.5 mm gap
with 3 mm ceramic
47.75 Ω



3.5 mm gap
with 3 mm ceramic
50.9 Ω





Summary

- Detector radial size is limited to about 20 mm beyond the O.D. of the pipe.
- The SMA feedthrough may not fit if aligned longitudinally. This will depend upon the required wall thickness and weld clearance.
- If the SMA does not fit longitudinally, a right angle may be needed.
- It is important to include both ground planes in the impedance calculation.
- If $\epsilon_r = 1$ is used, 2nd ground plane may interfere with SMA center conductor.
- Adding a ceramic dielectric 3 mm thick ($\epsilon_r = 9.6$), the overall height can be increased to 15 mm. This makes the inside of the box the second ground plane.
- Final dimensions will need to be optimized.