High gradient testing in magnetic field at CEA Saclay. 2023 status.

International MUON Collider Collaboration

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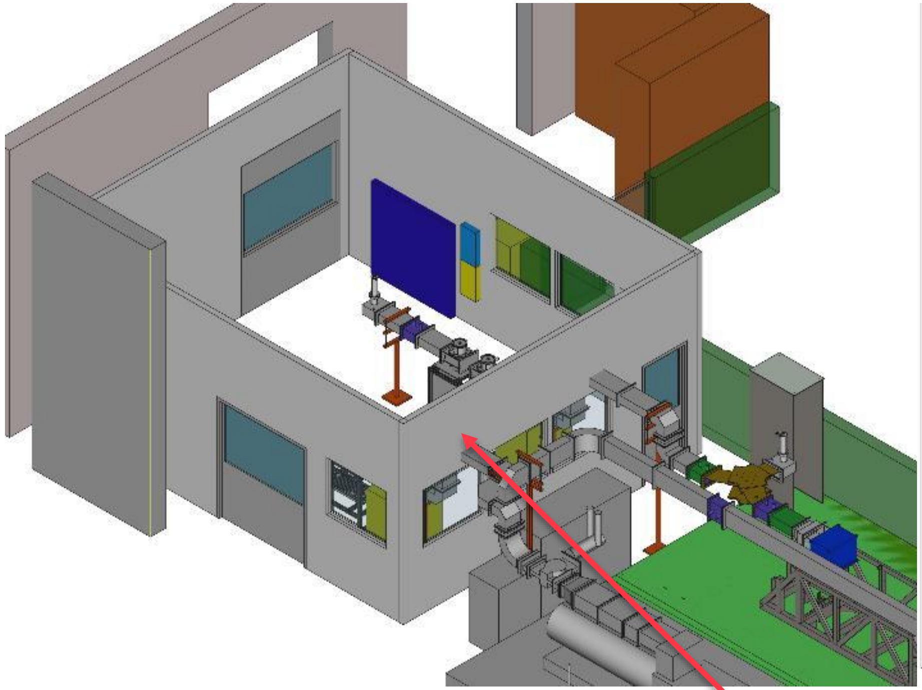
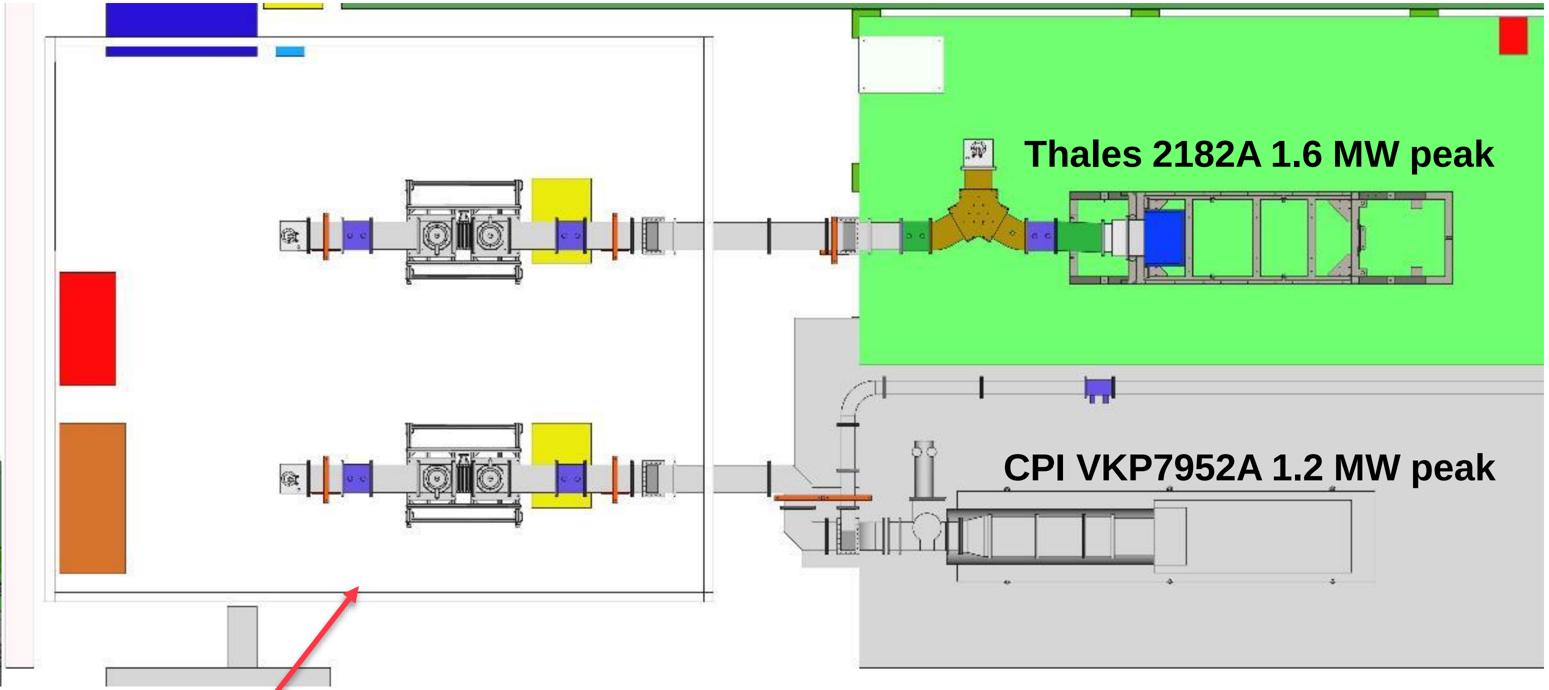
CEA 704 MHz test station for ESS FPC conditioning

3D view

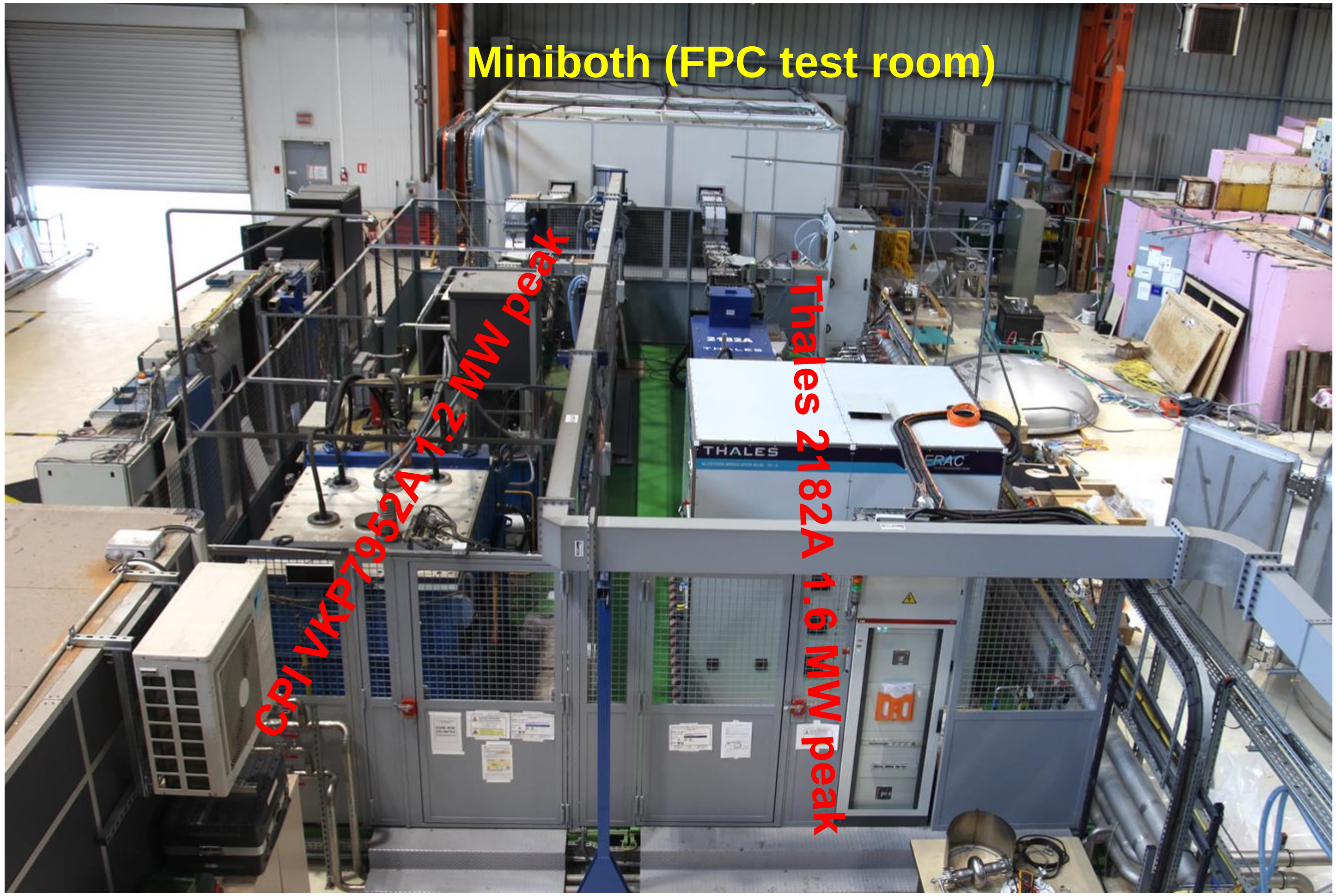


Top view

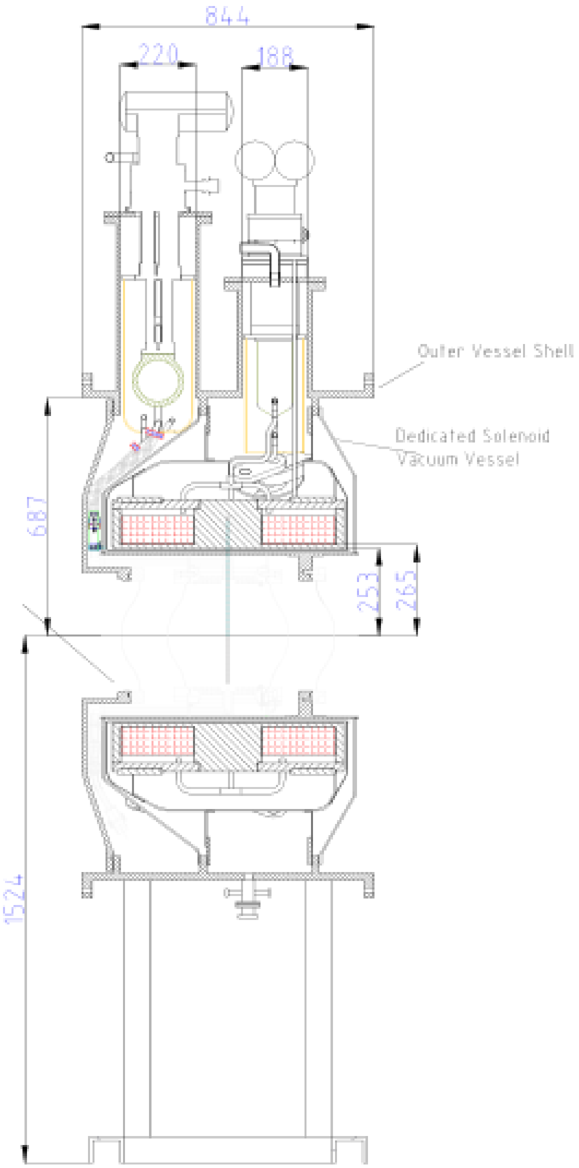


Miniboth (FPC test room)

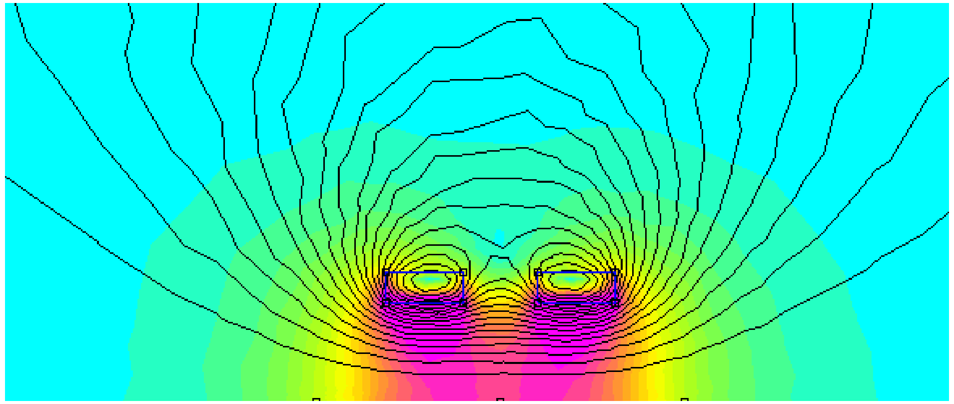
CEA 704 MHz test station for ESS FPC conditioning



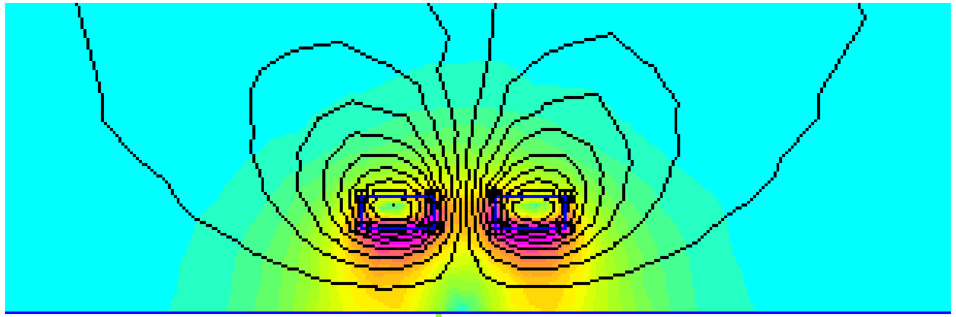
4T MICE magnet



- Two internal coils, // or anti // operation
- Modes: solenoid / cusp
- In solenoid mode ~ 4T
- Bore diameter ~ 470mm

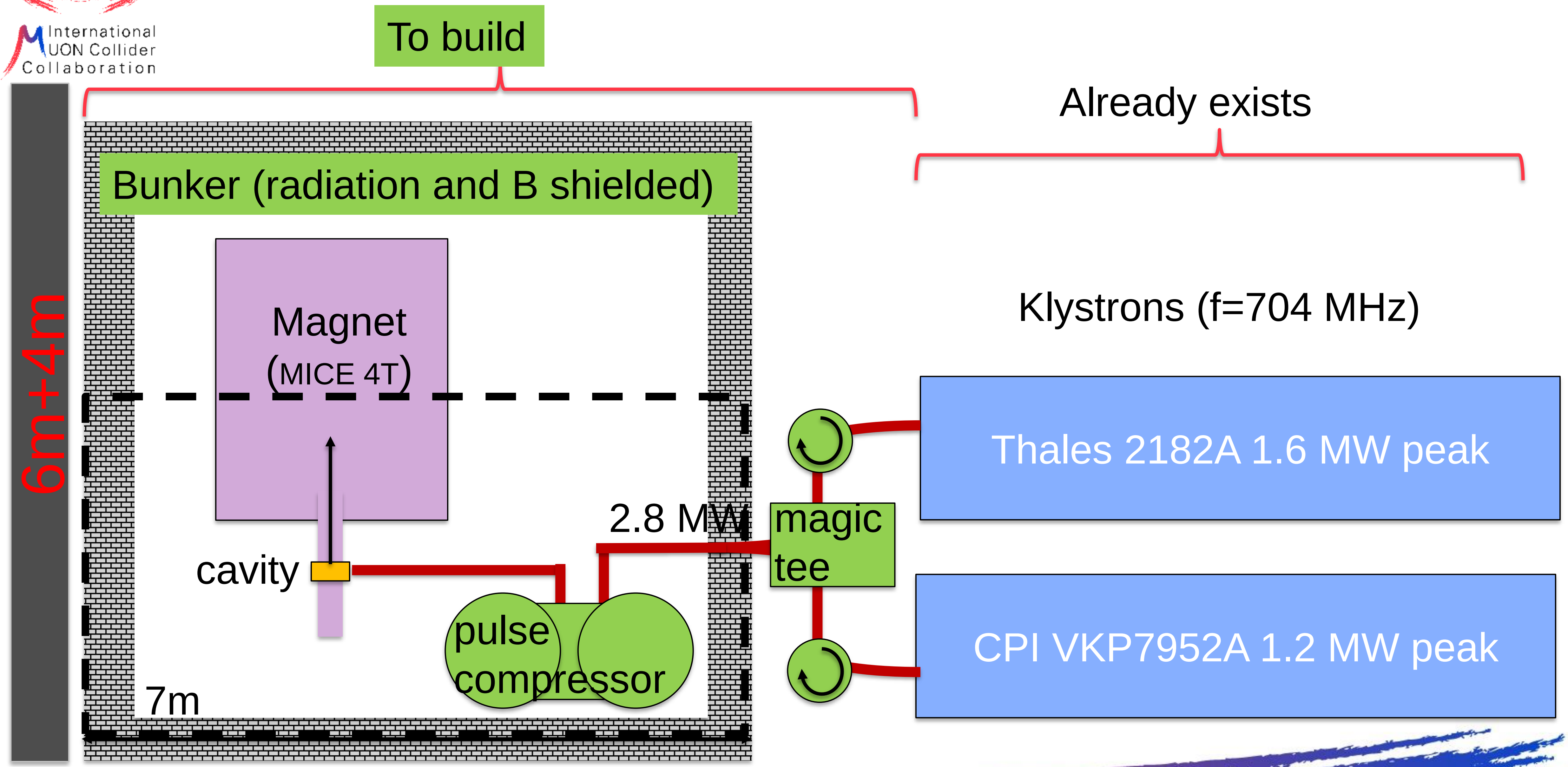


- Magnet in solenoid mode
- Centre flux density: 4T

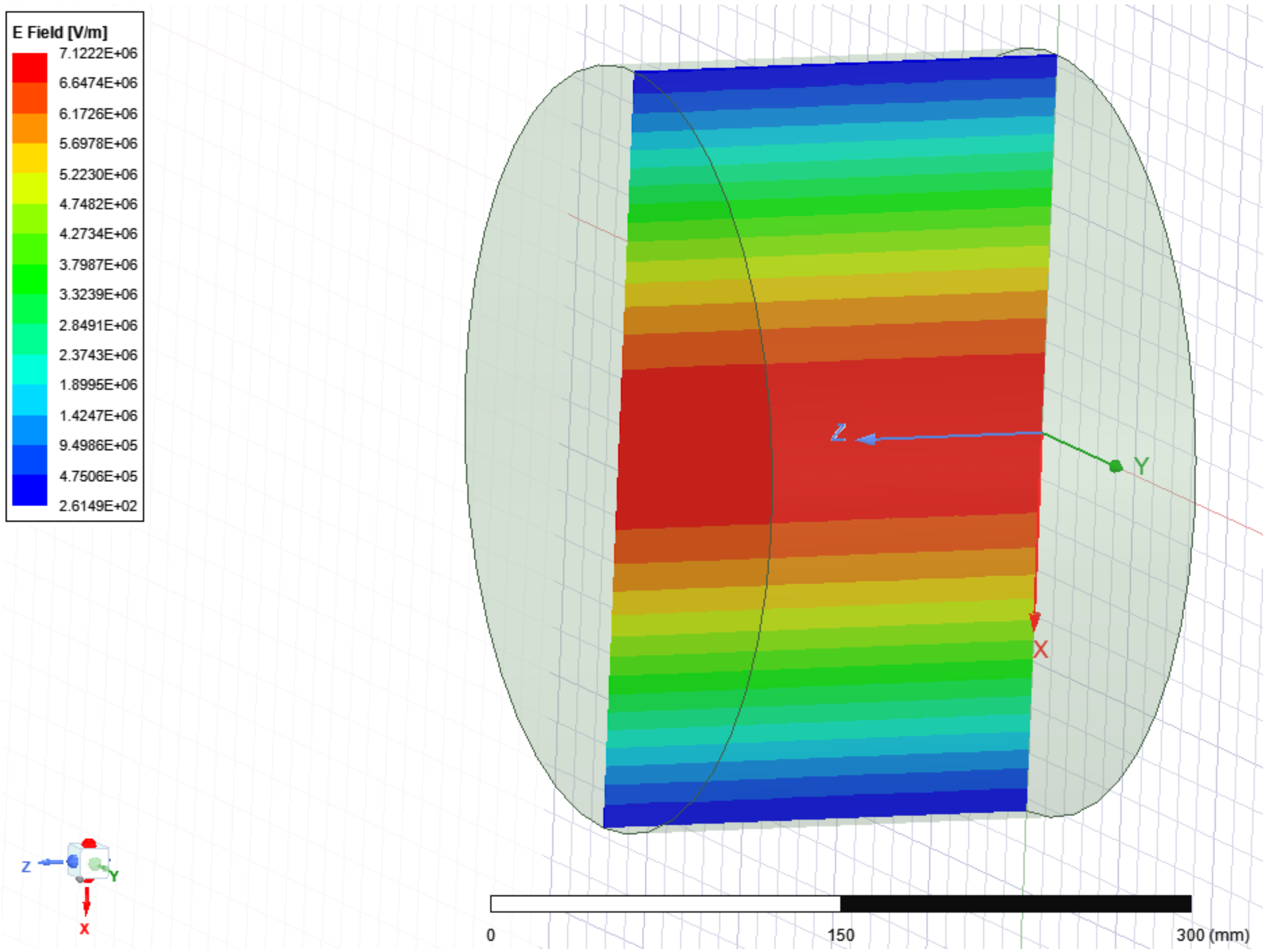


- Coils driven in cusp mod (anti //)
- Axial field lower (~2.5T)
- High radial gradient field

Possible upgrade for a RF breakdown test stand



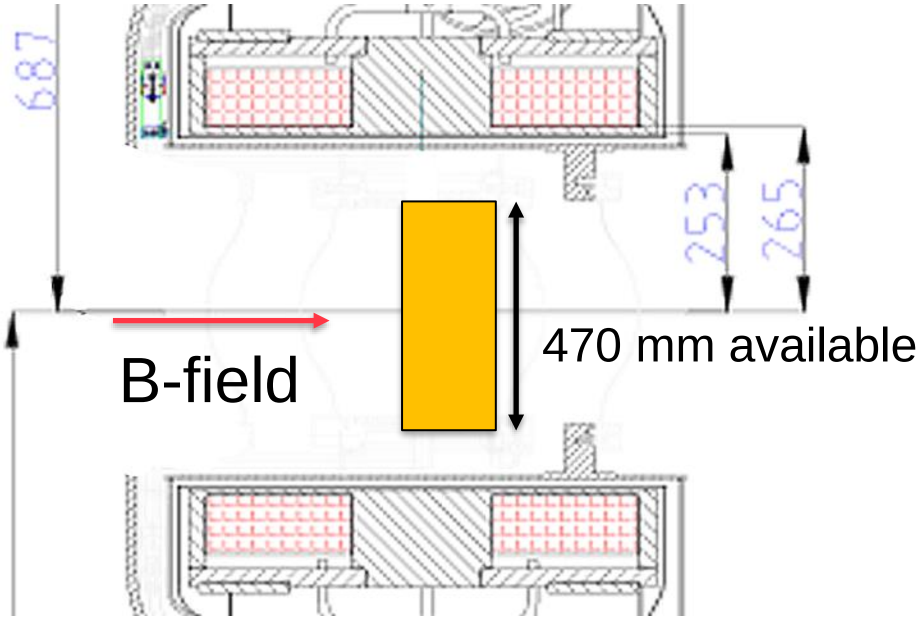
RF pillbox

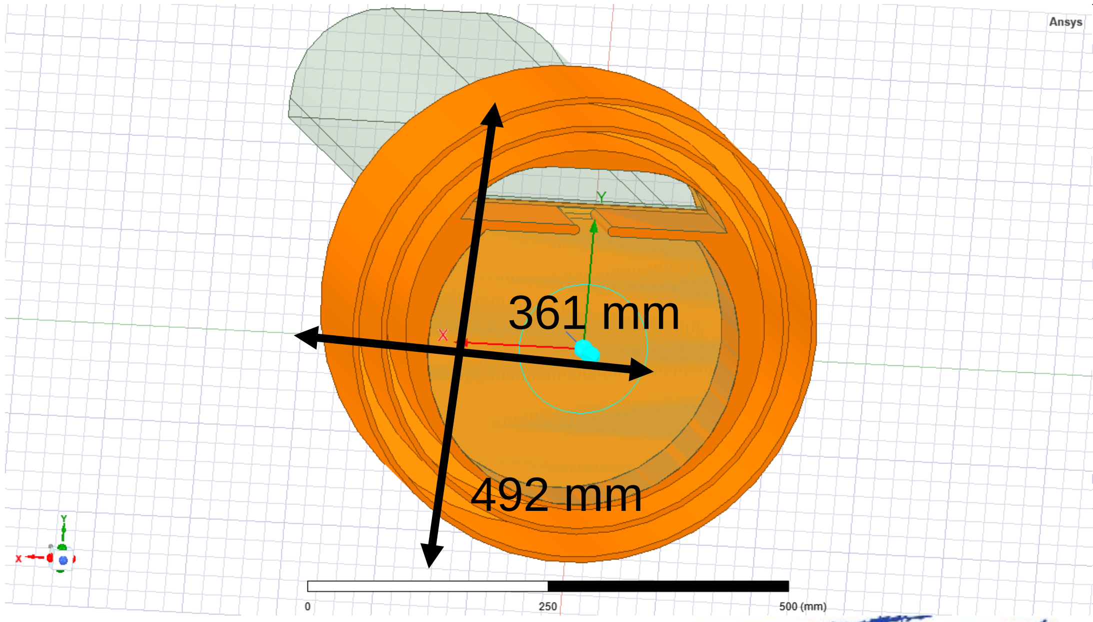


- The diameter of a « perfect » pillbox cavity is fixed by the frequency. The length can be freely chosen.
- At 704 MHz, the required diameter of the pillbox cavity is 330.5 mm.
- E_{field} reaches 35 MV/m with 2.8 MW (fully accepted).

Size of a tank for the cavity

- Available space is limited to 470 mm in the MICE magnet.
- With a cooling tank, the minimal required diameter is 490, including tanks, wall thickness, etc.
- Without tank, it is around 360, with a « small » power coupler.
- Consider auxiliaries: RF pick-up, vacuum ports, windows, etc.
- + Rails to insert the cavity.

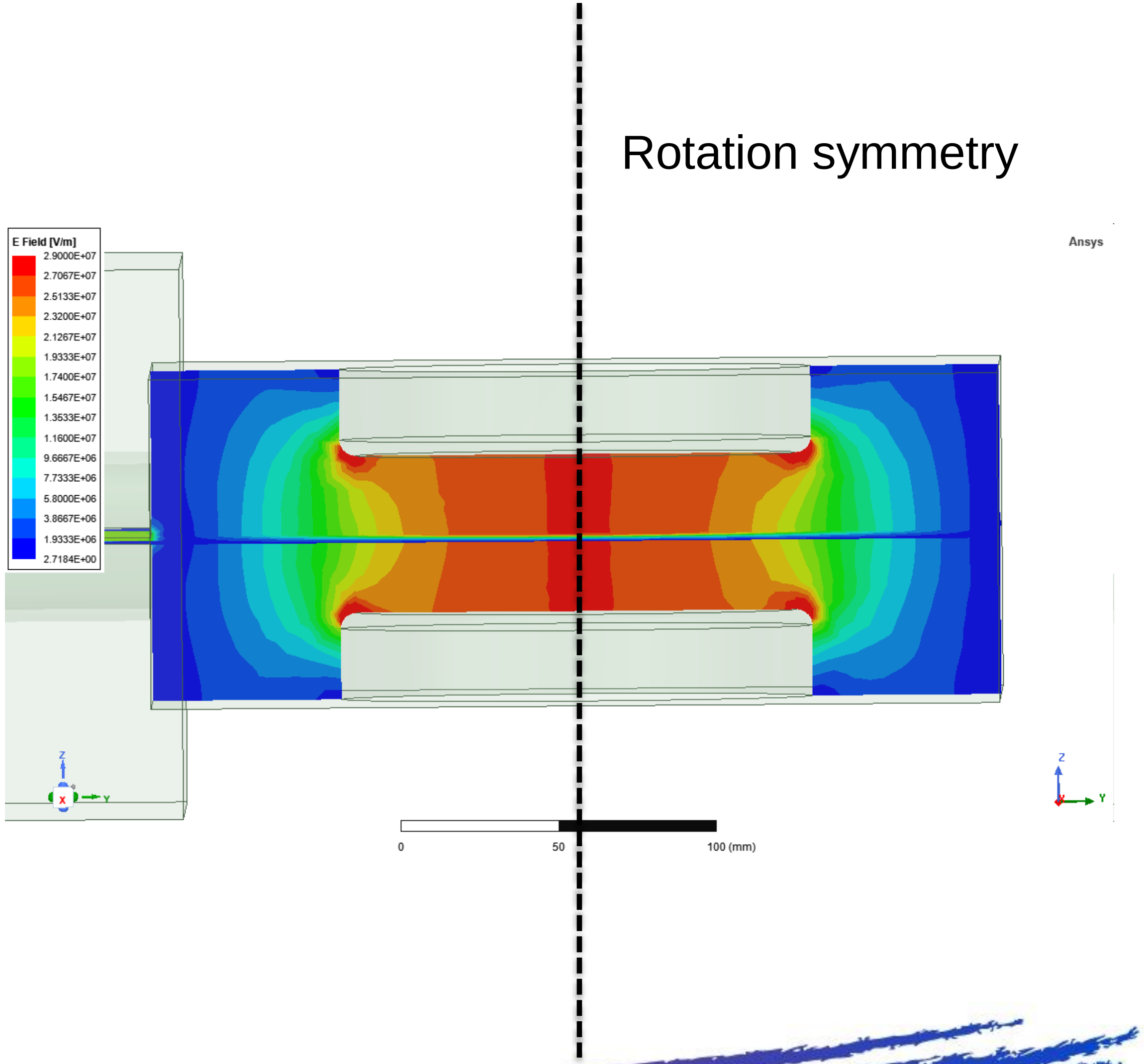




What about a compact RF cavity?

- For example, cavity with two « noses ».
- Increases the local electric field (requires less power).
- A bit smaller than a pillbox cavity, at the same frequency.

- Would it be possible to cool it to 70 K with only two small LN tanks on the noses?



Test plan for RF test cavities for MCC

1. Tests with existing 704 MHz klystrons, MICE 4T solenoid, gradients up to 28 MV/m
   - Ship the solenoid from UK and install at CEA Saclay
   - Build the magnetically shielded bunker
   - Build the waveguide lines
   - Design and fabricate the cavity (similar to modular cavity of MUCOOL)

2. Tests with an RF cavity with sub-μs pulses

3. Test different materials such as Al, CuBe, etc

4. Possibly 70K copper cavity. Requires cryostat design.

5. Adding a pulse compressor for testing at >28 MV/m (requires some compressor R&D as no compressors exist at <1 GHz)

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Thank you for attention