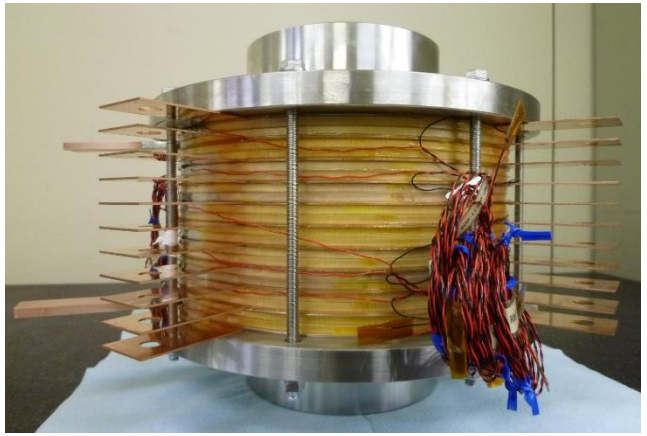
Superconducting Magnet Warm Bore

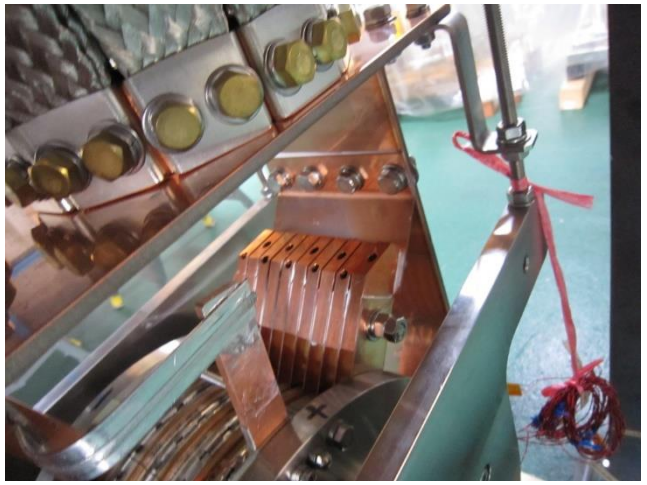
Wolfgang Schreyer

Requirements

1. Wall Fermi potential 212neV (NiP), polished surface
2. Min. 85mm warm bore
3. Polarization-conserving downstream of magnet
4. Leak rate to He vapor < 10^{-7} mbar l/s (from guide vacuum, magnet vacuum, upstream flange)
5. Foil exchangeable (without moving shielding, impact on room-temperature source guides?)
6. Foil should withstand pressure difference of 100mbar(?), bypass for higher pressures
7. Foil Fermi potential < 54neV (Al, thin Ti/PE would not necessarily be part of SCM)
8. Bakeable?
9. Transmission?

Superconducting Magnet from RCNP

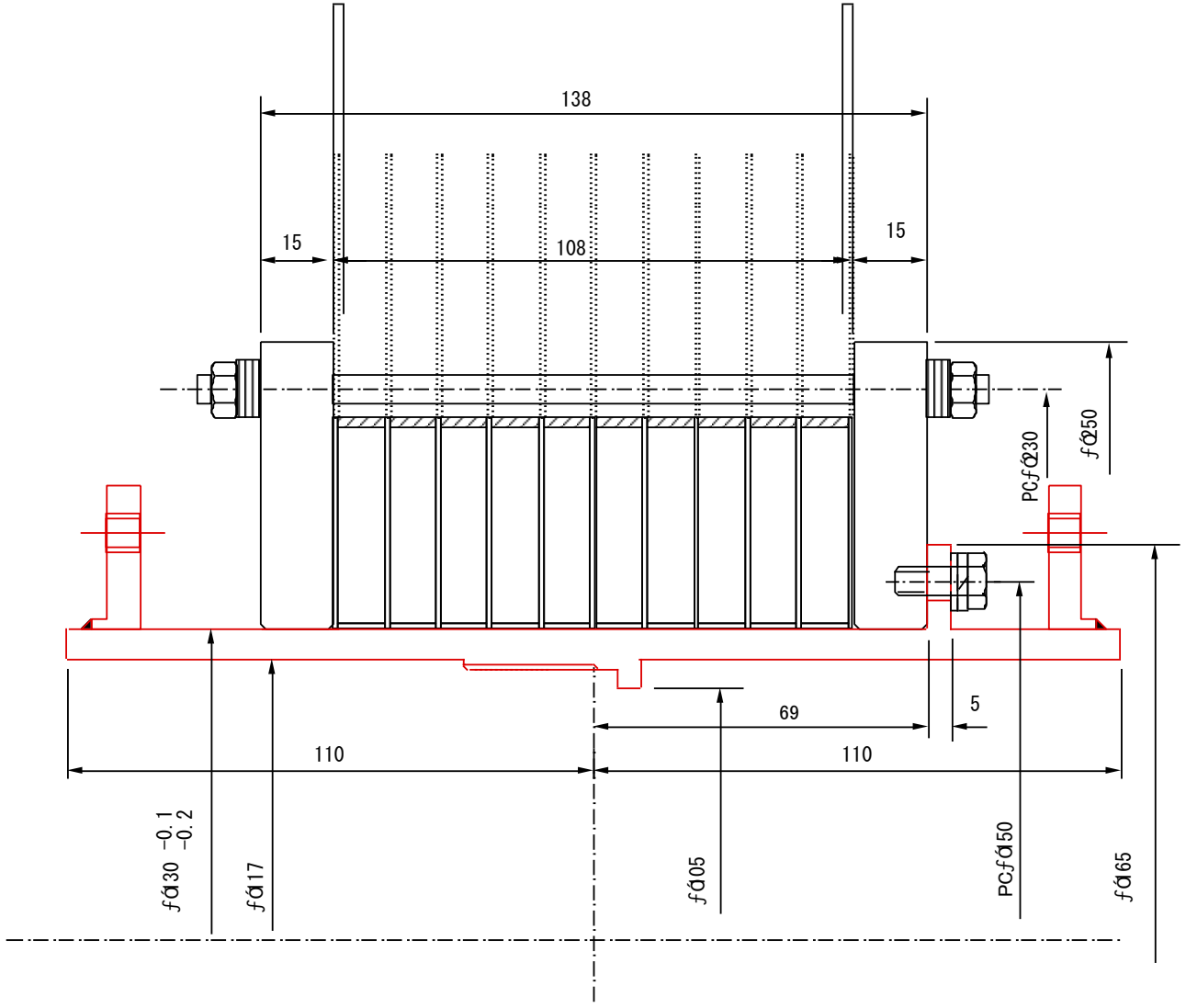




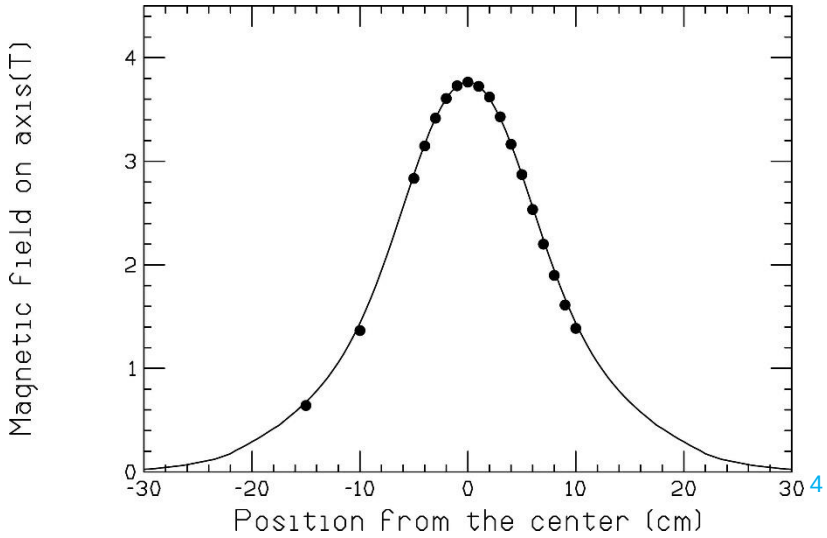
Coil and connection to current leads and cooling plates.

Connection to the 1st and 2nd stage of the pulse tube cryocooler.

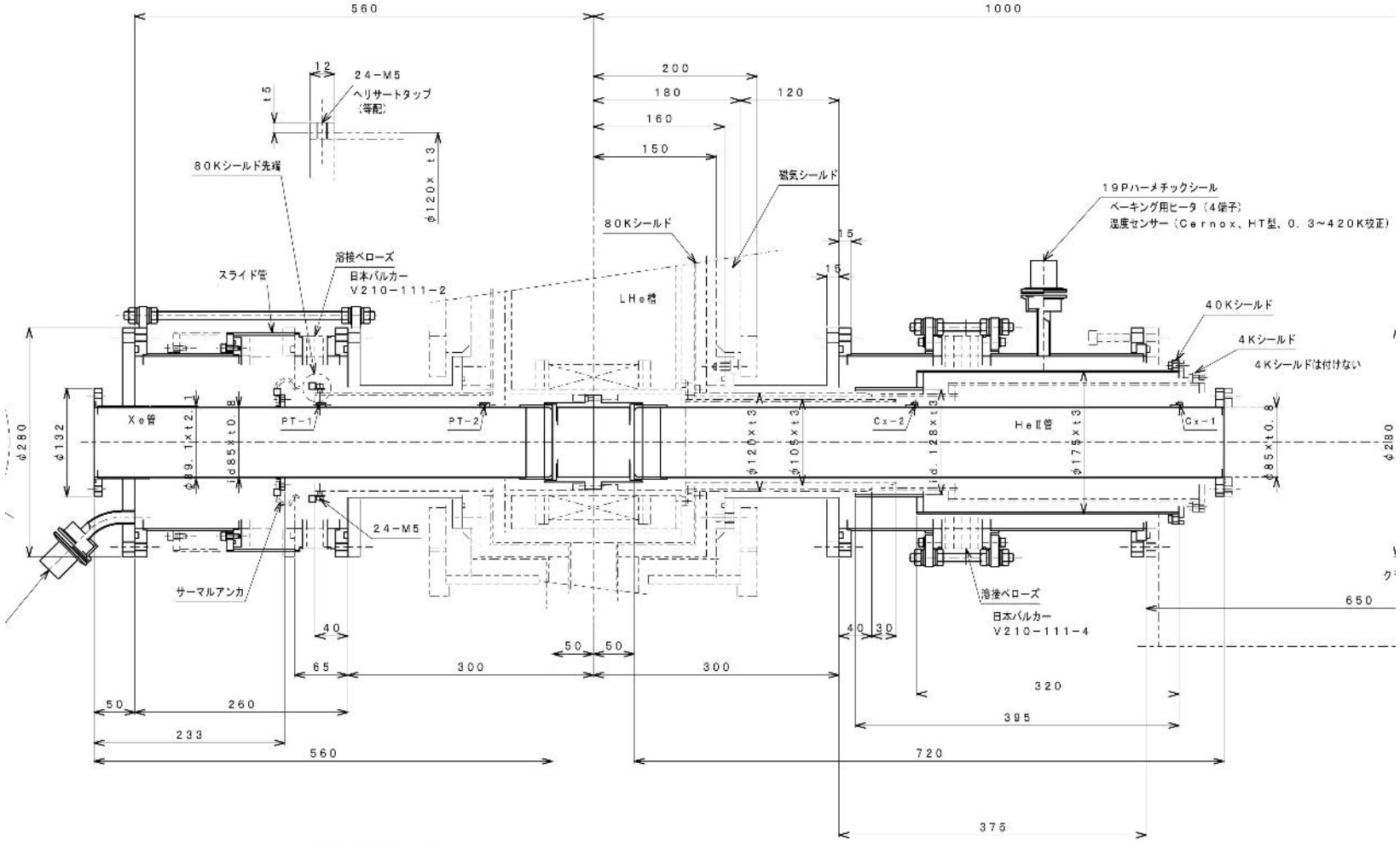
Superconducting Magnet from RCNP



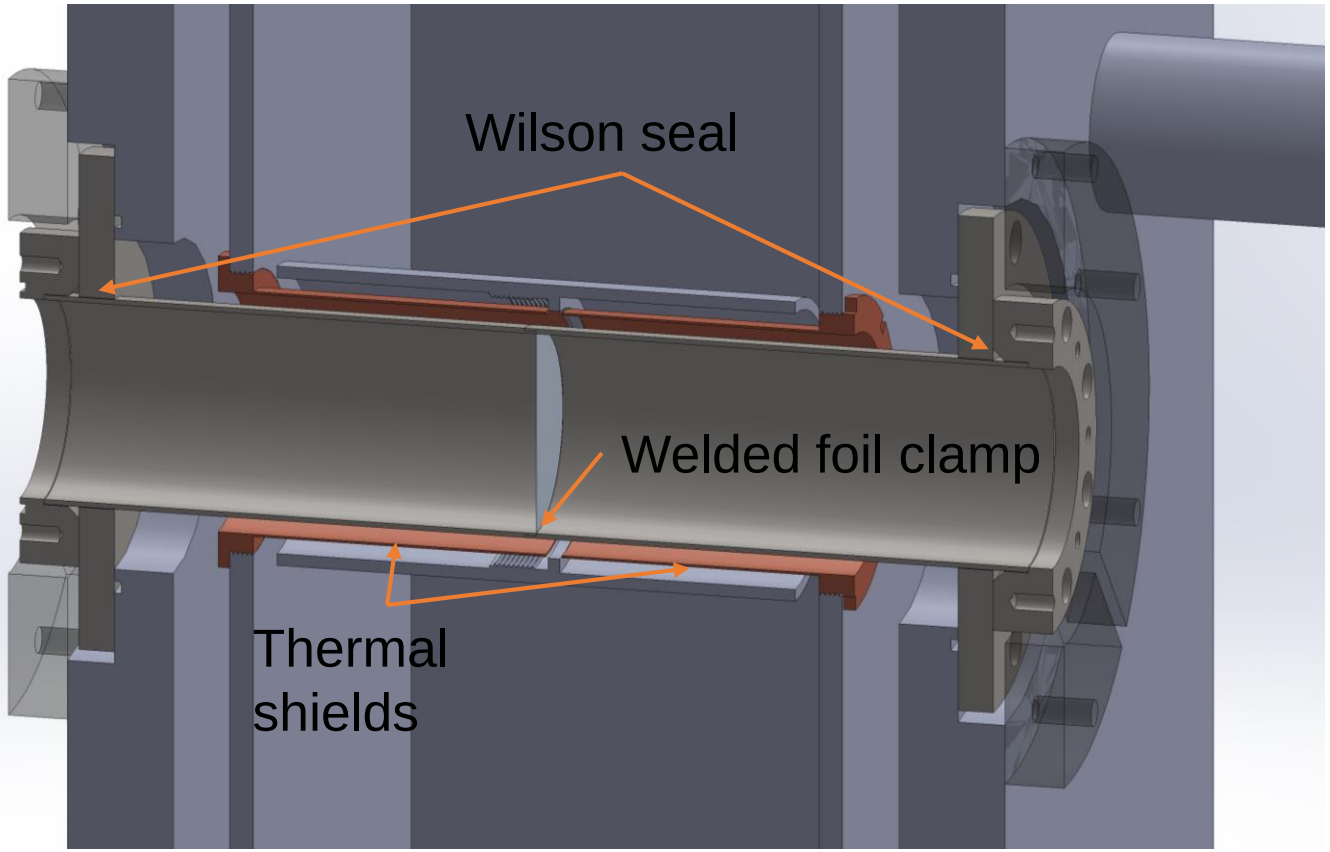
- High-temperature superconductor (20K)
- 105mm ID cold bore
- Thermal-shield temp. 60K
- ~35h for cooldown
- Max. field on axis 3.75 T (226 neV)



Triple-foil cold bore at RCNP

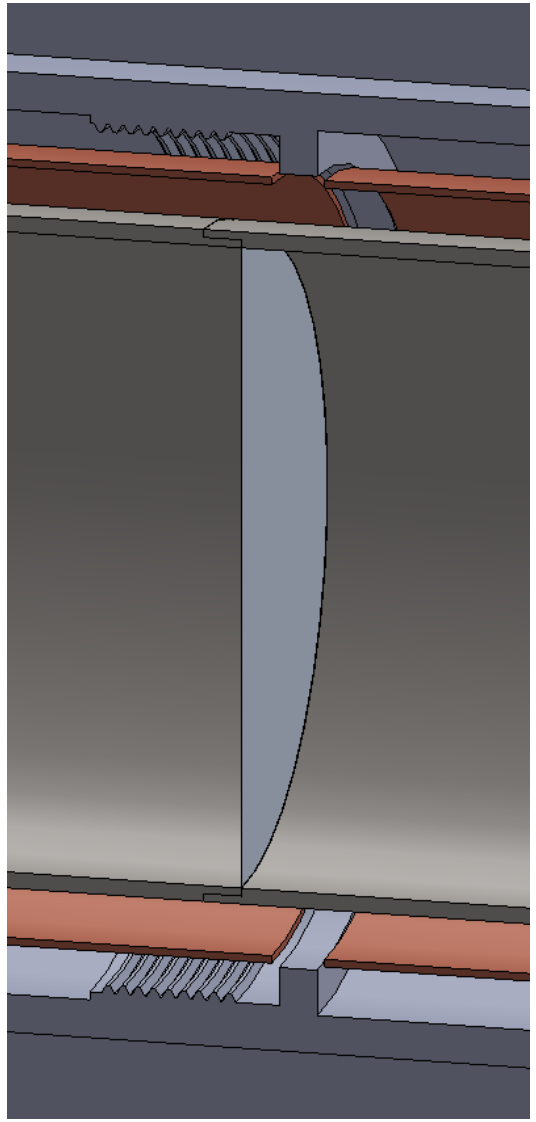


Concept for warm bore



- UCN guide: 88.9mm OD
- 8mm radial clearance
- Thermal contraction:
  - Cold bore + thermal shield move up < 2mm
  - Minimal relative movement between cold bore and shield

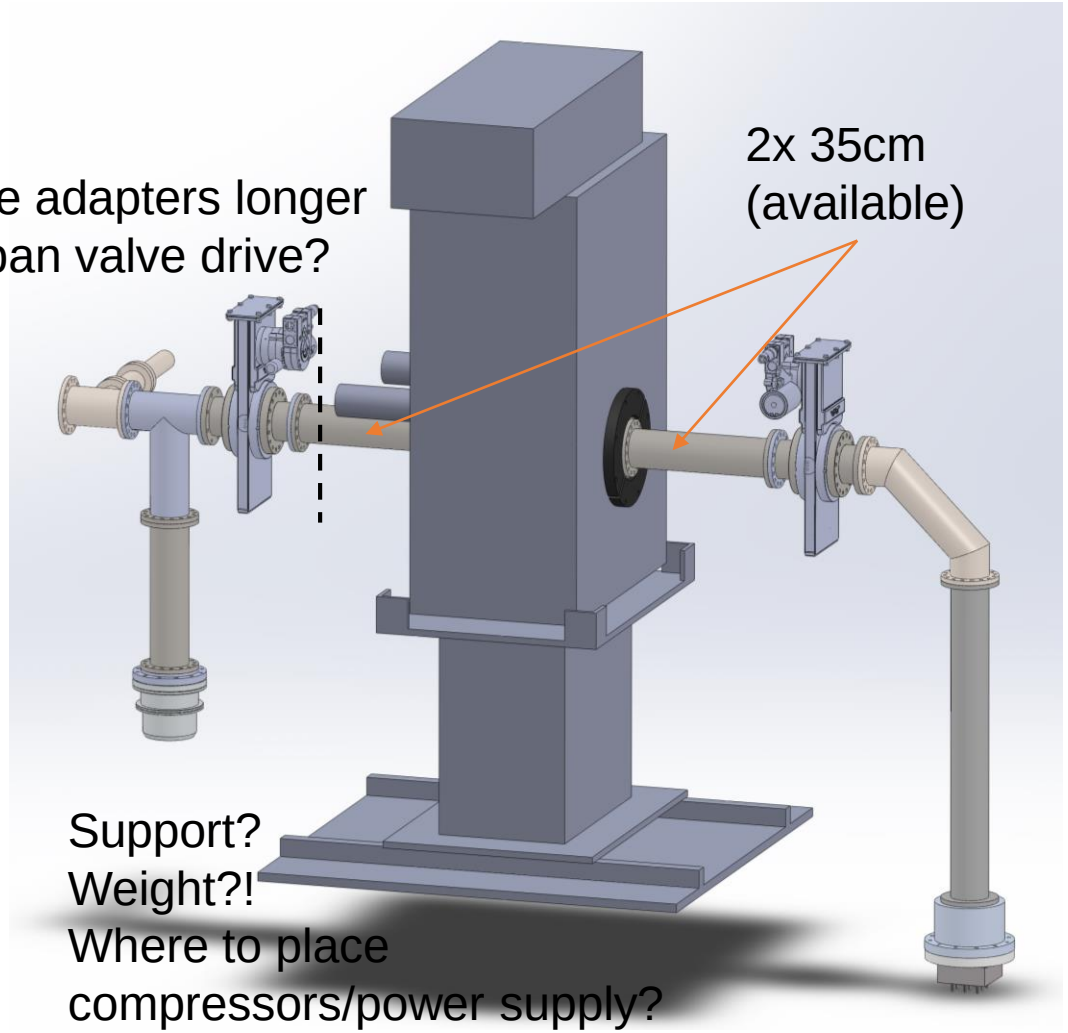
Concept for warm bore



Requirements

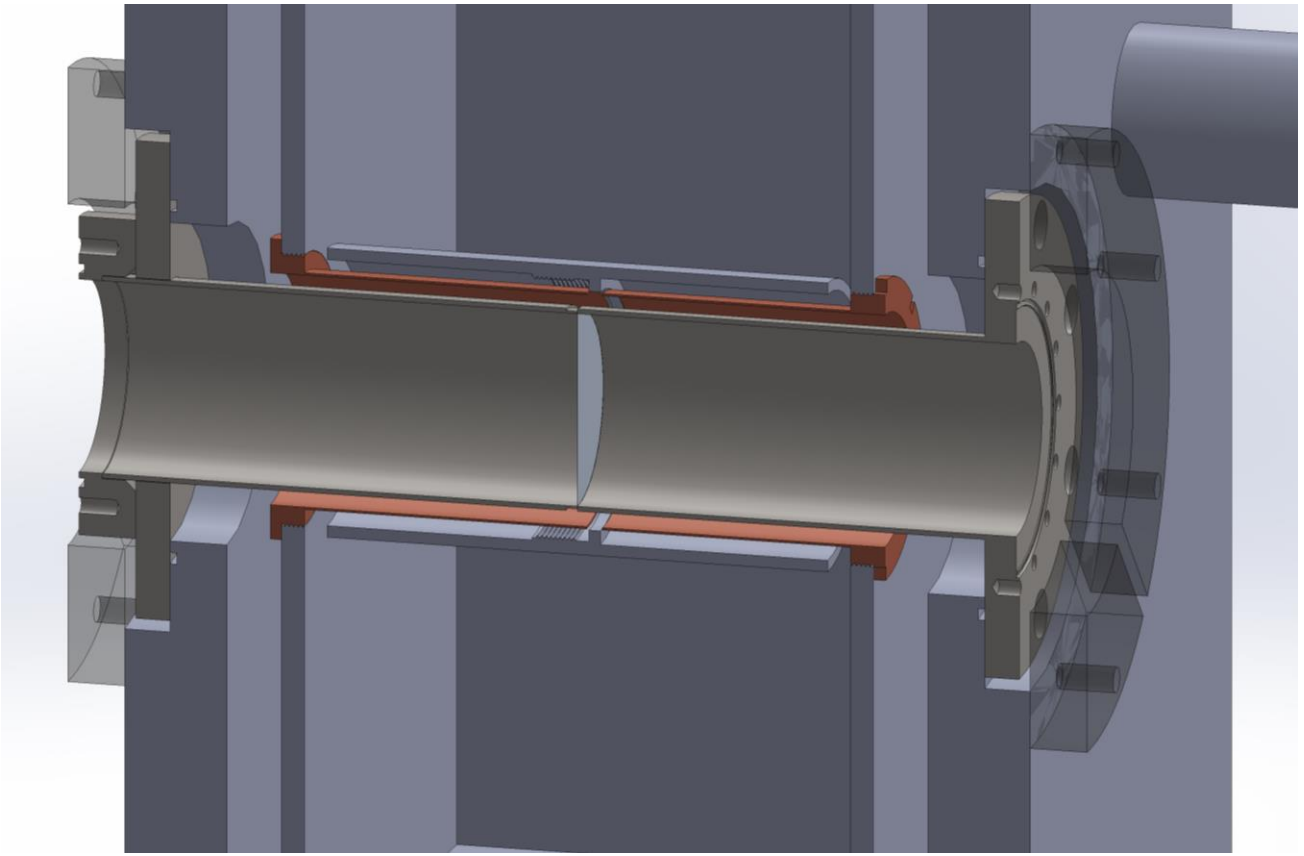
1. Polished SS, NiP-plated ✓ (will NiP survive welding?)
2. 84.7 mm warm bore ✓
3. Non-depolarizing NiP plating ✓
4. Vacuum-vacuum leak rate likely very small, upstream flange will need metal seals ✗
5. Space required to pull out ~420mm guide tube
6. Pressure tests, calculated burst pressure 8psi (550mbar)
7. Al6061 foil, 0.1mm (less?) ✓
8. Probably bakeable ✓
9. Transmission > 80%

Plan for fall run



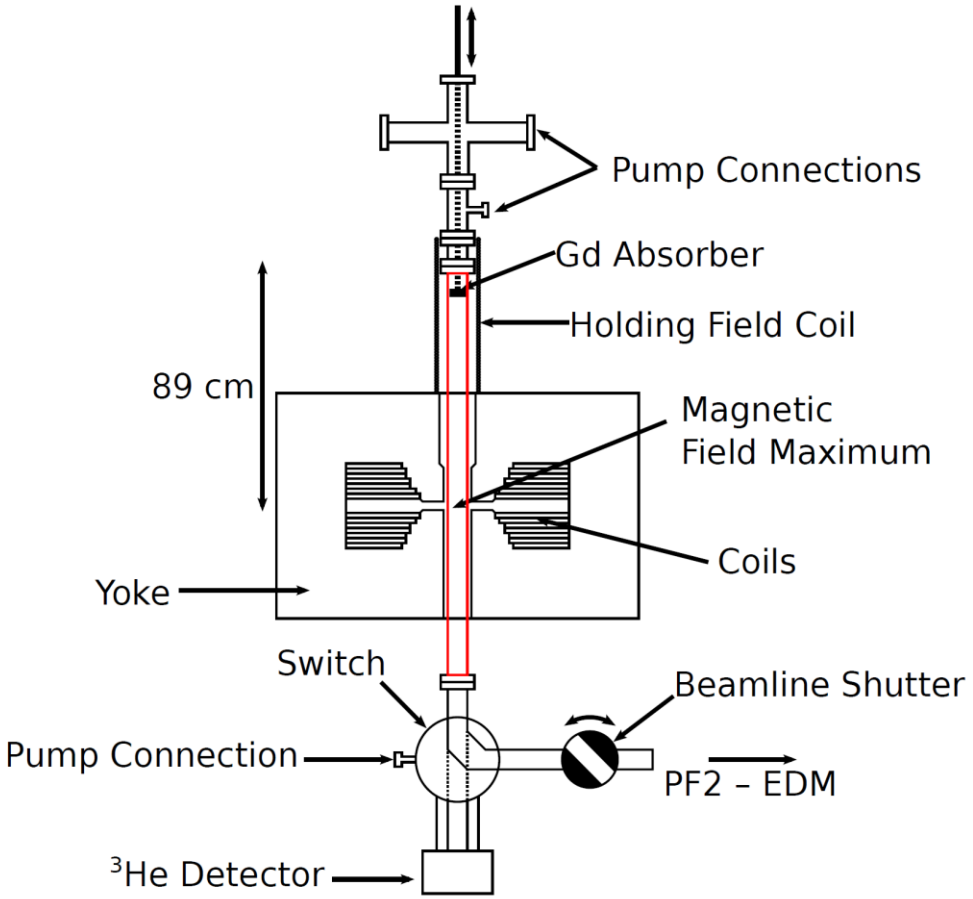
- August:
  - Pressure tests with unpolished tube
- September:
  - Cut two sets of prepolished tubes
    One for additional polishing
    One for polishing + plating
  - Cold test with unpolished tube piece
- October:
  - Machine + weld polished tube
  - Machine plated tube, test welding
- November:
  - Measure leak rate/transmission/storage lifetime
  - Polarization measurements?

Upgrade for metal seal



- One end with CF flange
- Bore can only be removed from upstream side

Future use



DEPOL-style experiments?

- Measure depolarization on wall bounce
- Fill – Partially close trap – Clean – Fully close trap – Store – Open trap
- Superconducting magnet ramp time? (I = 200A, L = 1H)

Thank you!