RIA Spoke Resonator Cryomodule Designs

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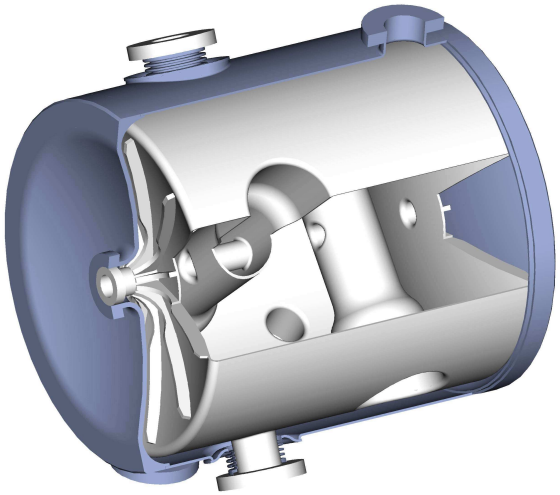
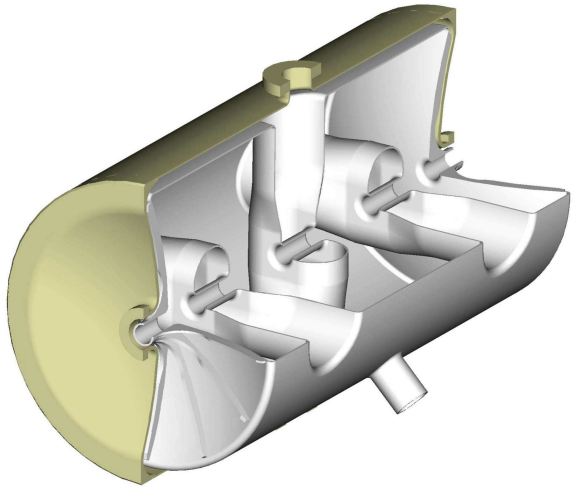
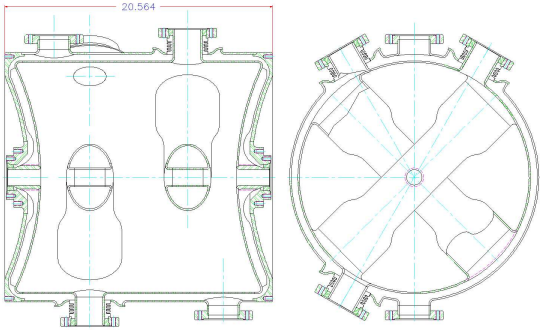
RIA Spoke Resonator Geometries

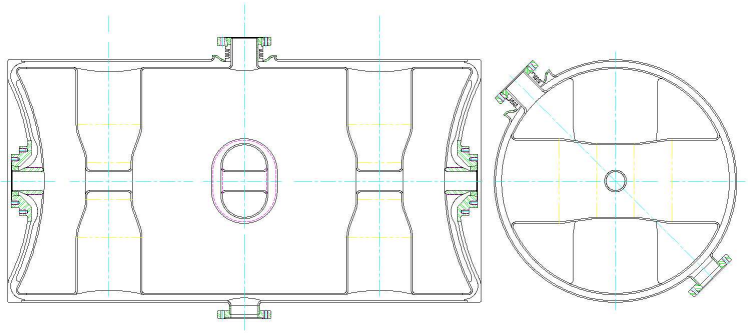


~63 3-gap cavities required for std. driver design (9 modules)

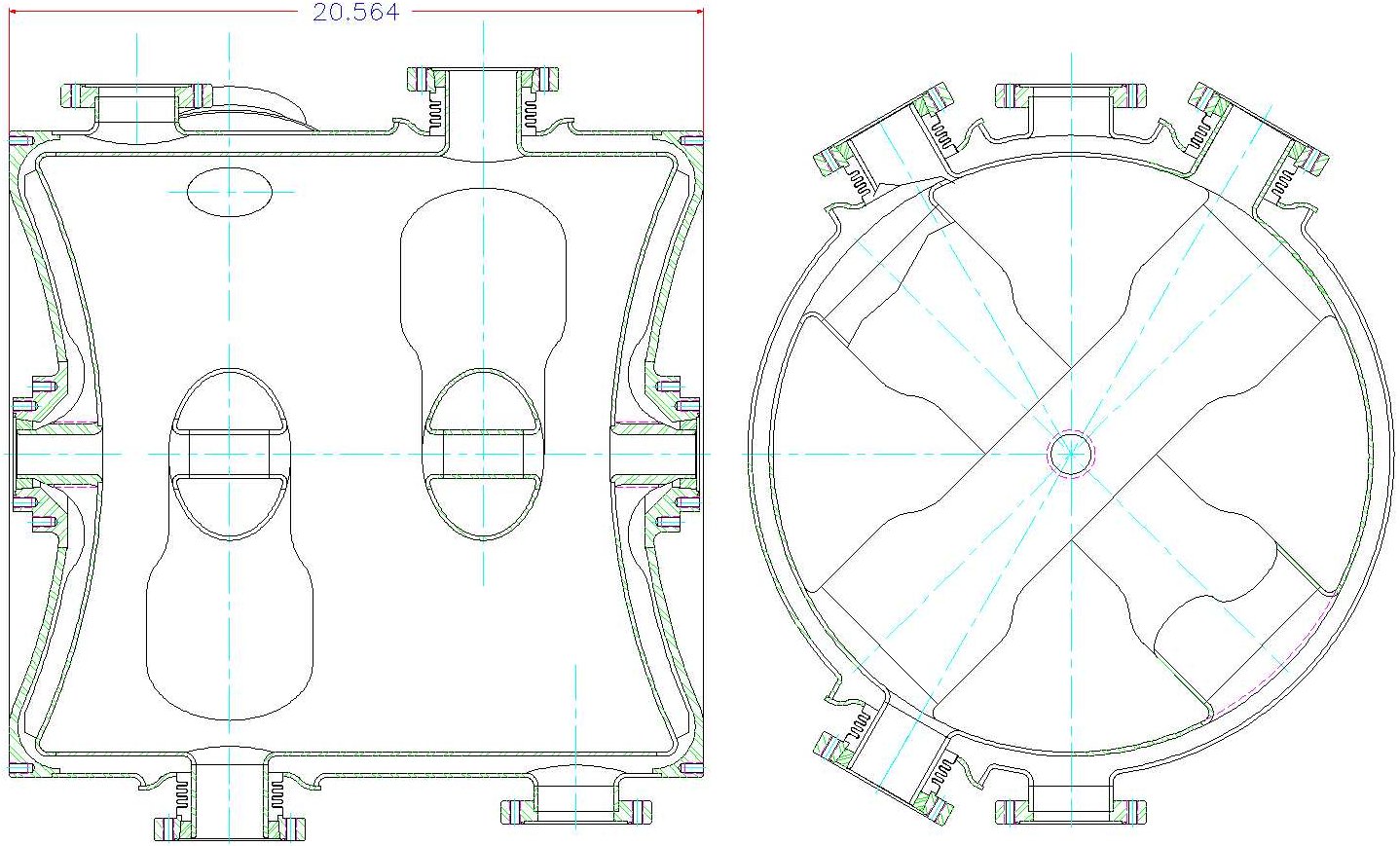


170 4-gap cavities required for alternative design (48 modules)





316L SS LHe vessel



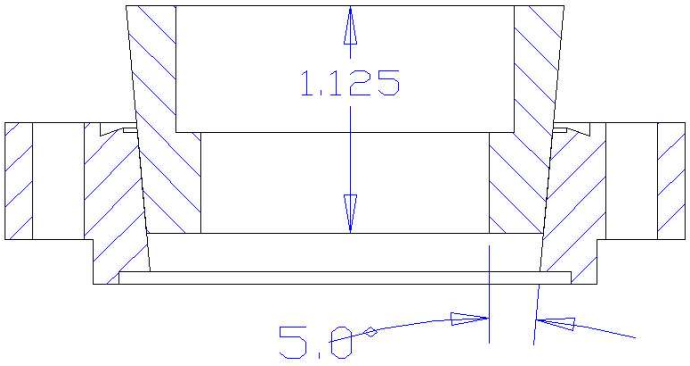
- SS shell with CF flanges using commercial Cu gaskets
- straightforward TIG welded shell

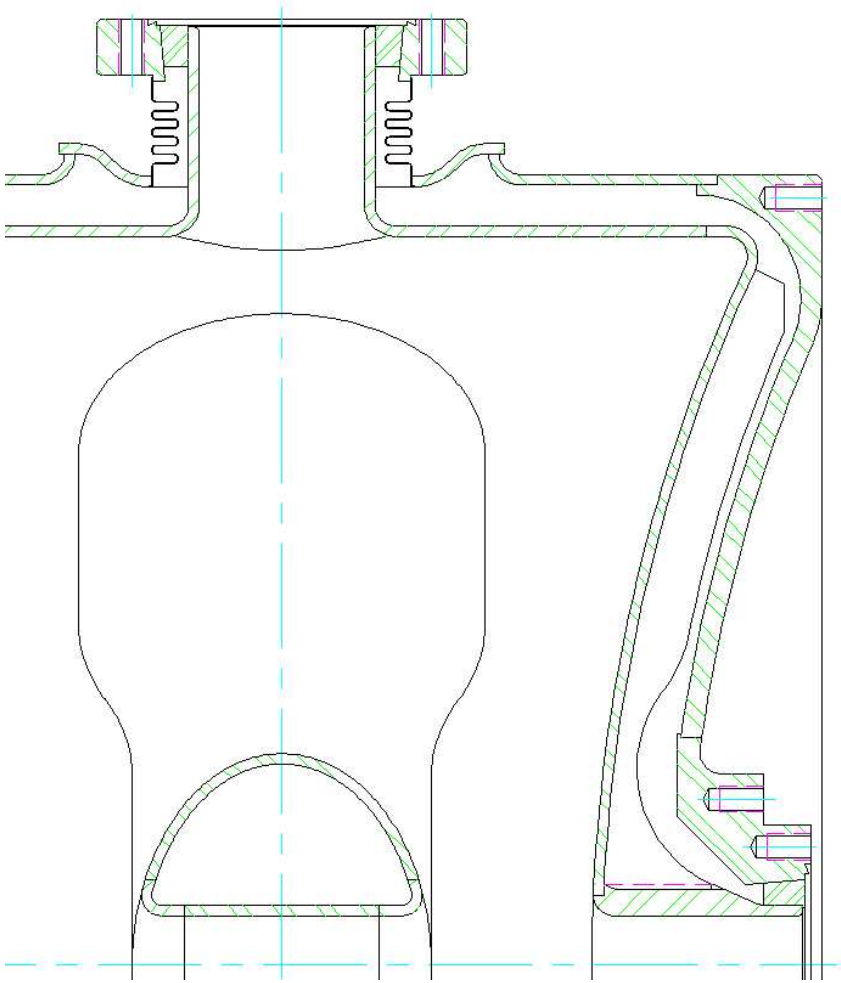
Flange Design

• each cavity has 2 beam flanges (3.37” or 4.5” CF) and 3 side flanges (4.5” CF)

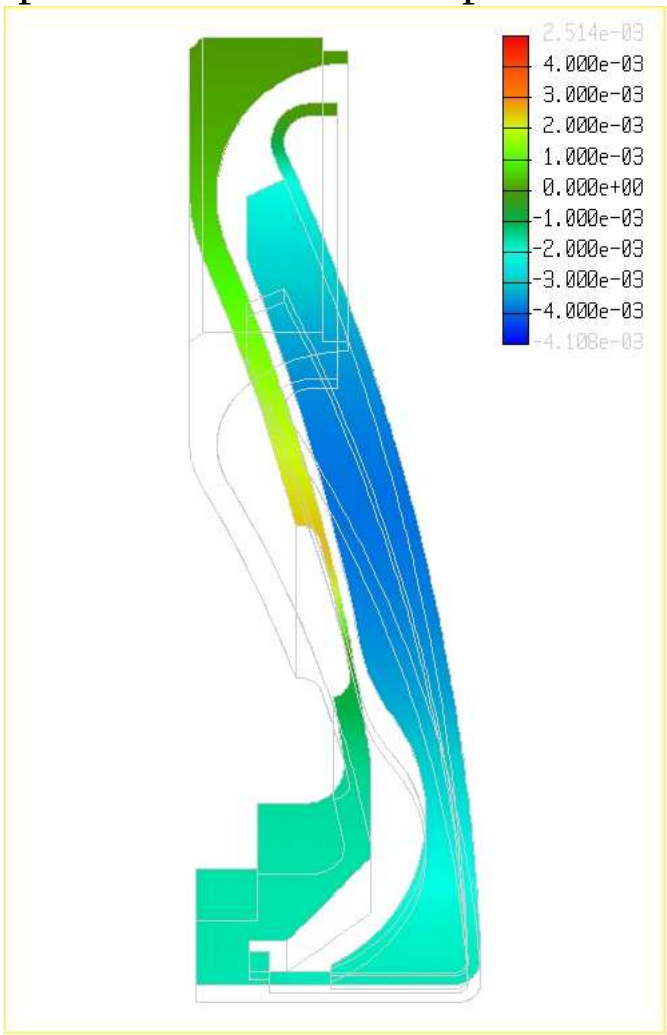
• 316L SS CF flanges brazed to Nb ring at 982 C using 82% Au, 18% Ni alloy (mp 949 C)

• excess Nb keeps temp below 700 C during ebeam weld, is machined away after welding





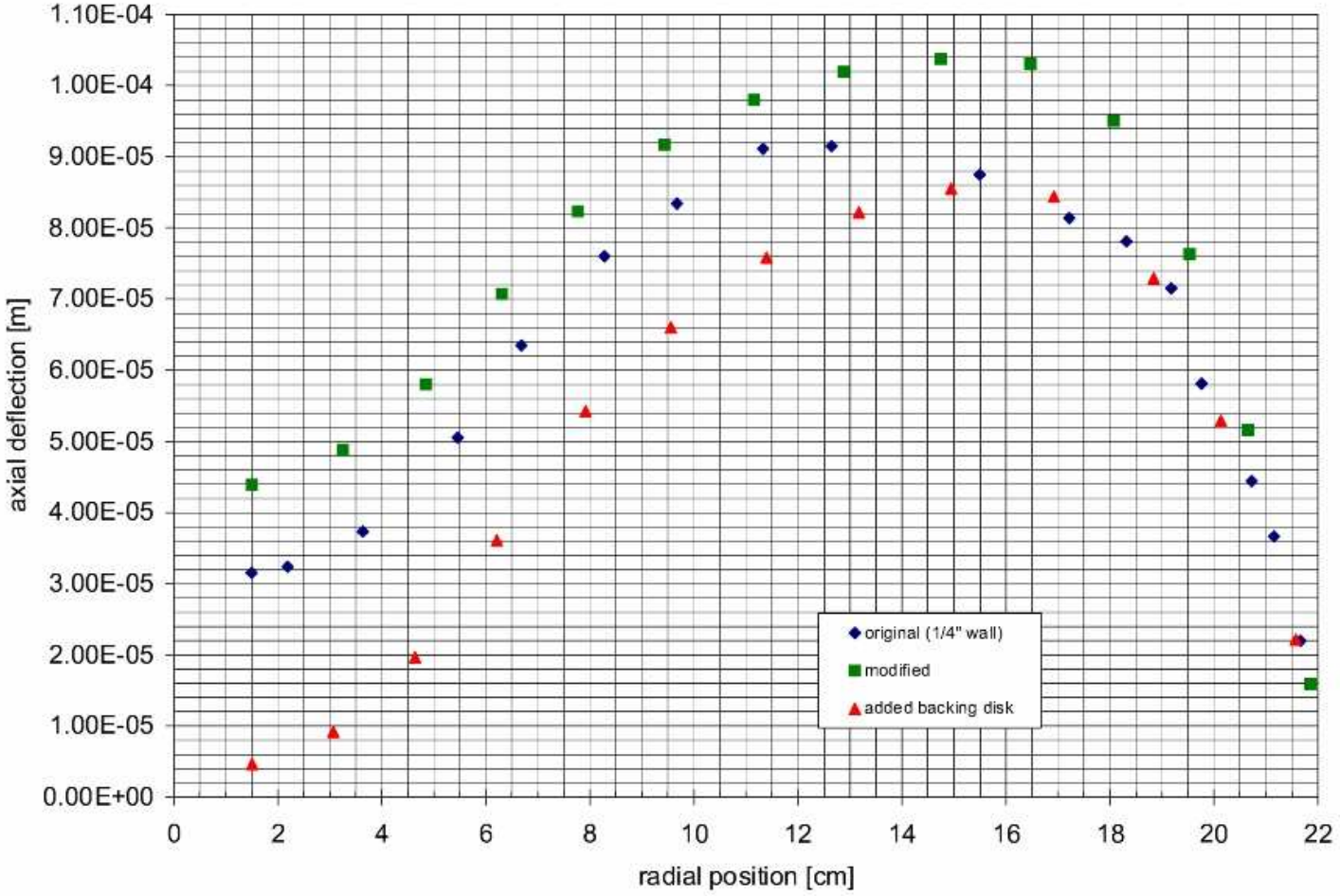
Displacement due to 15 psi load for alternative SS head geometries



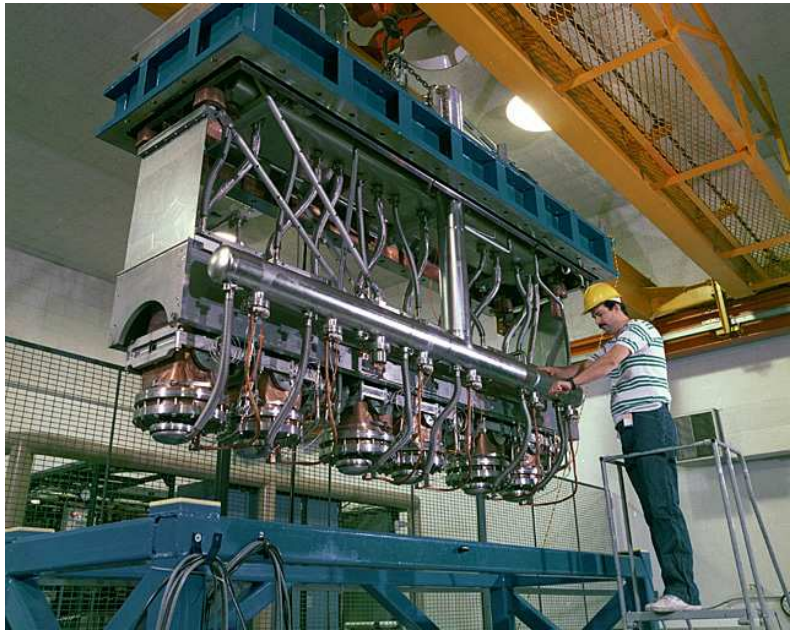
$\Delta f/f = -1.43E\text{-}5$

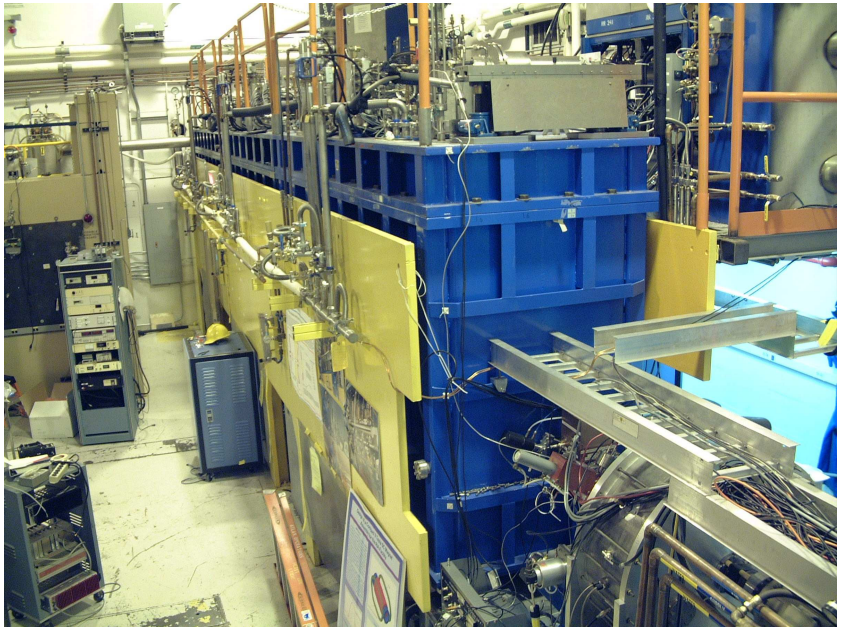
$\Delta f/f = 6.86E\text{-}6$

Endwall displacements



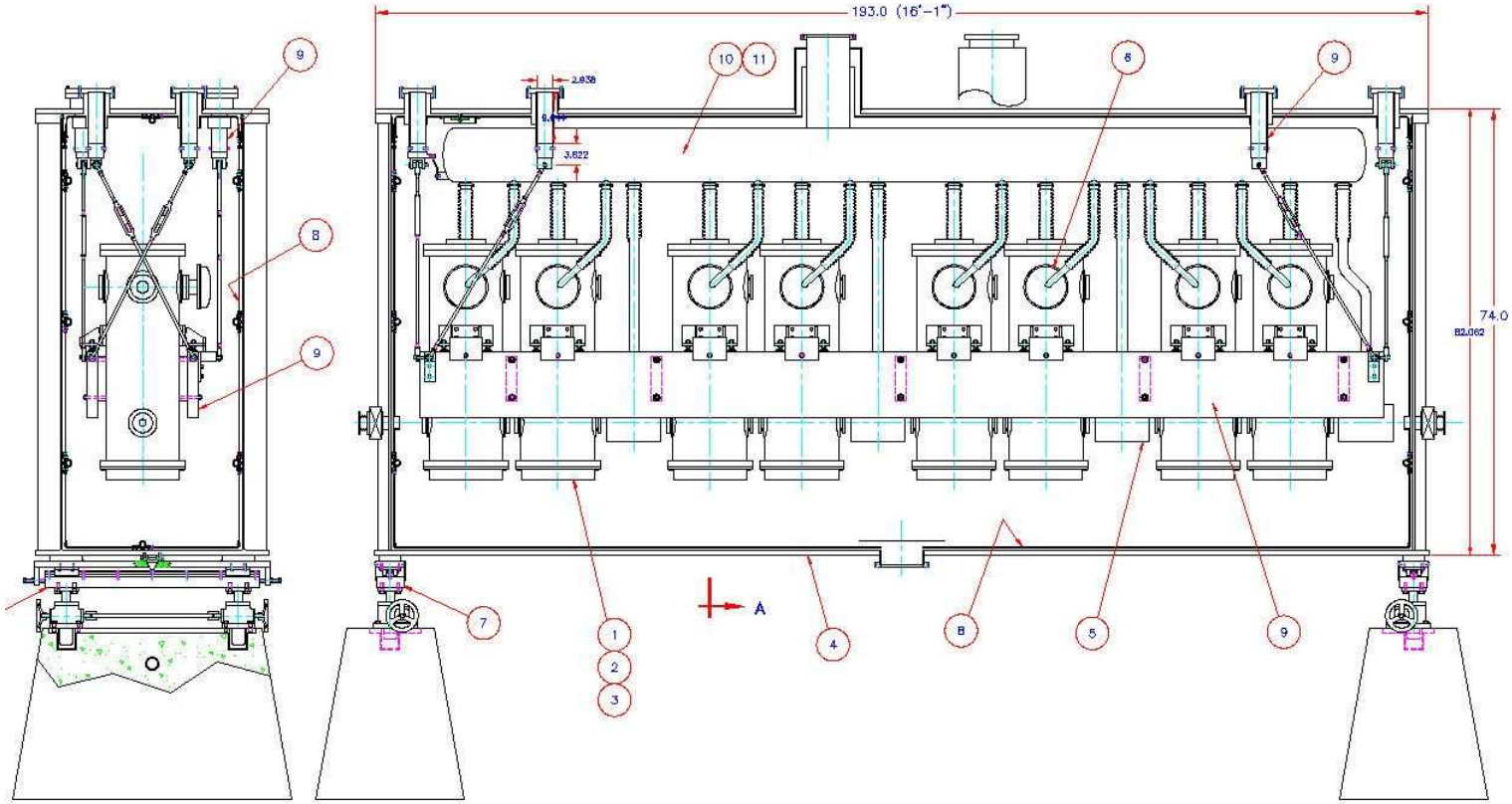
ATLAS Positive Ion Injector Cryomodule





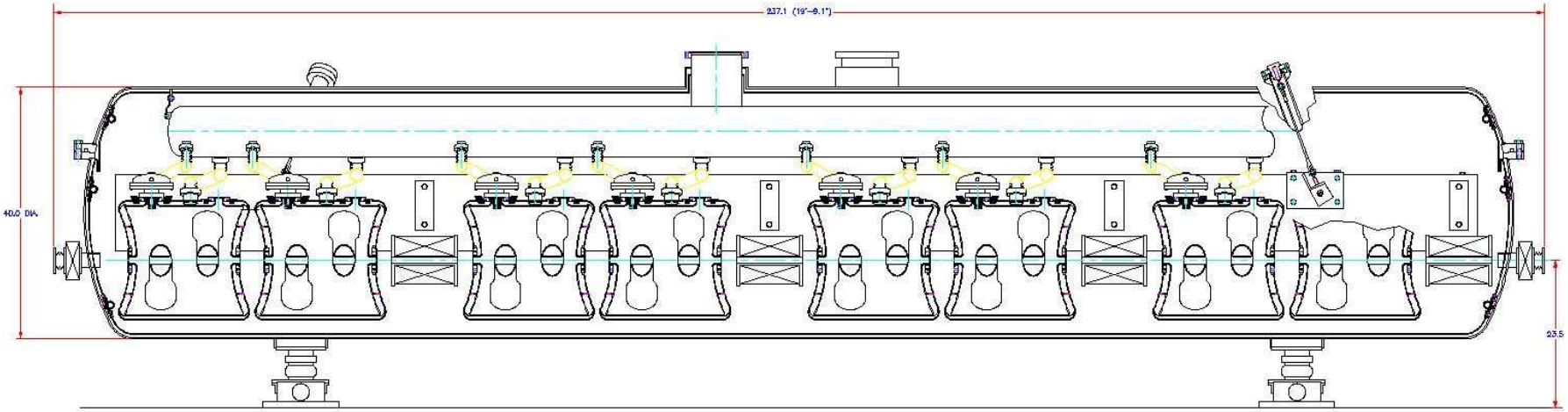
- Space efficient design
- Top loading
- Versatile
- Straightforward alignment capability

Design Evolution

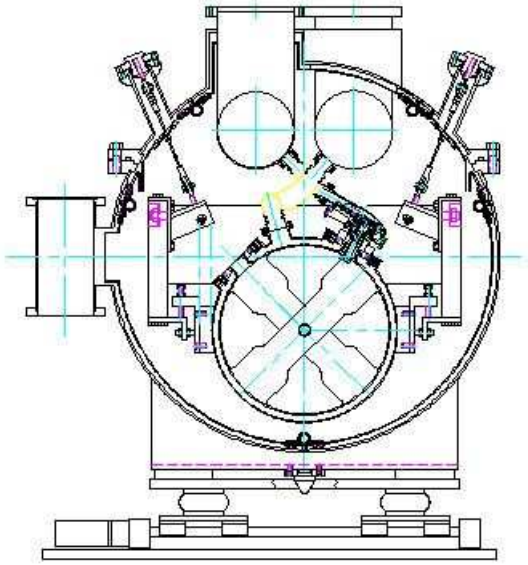


- Based on ATLAS PII cryomodule
- Top loading
- Common vacuum vs. separate vacuums: cleanliness
- Length is driven by cost, handling issues

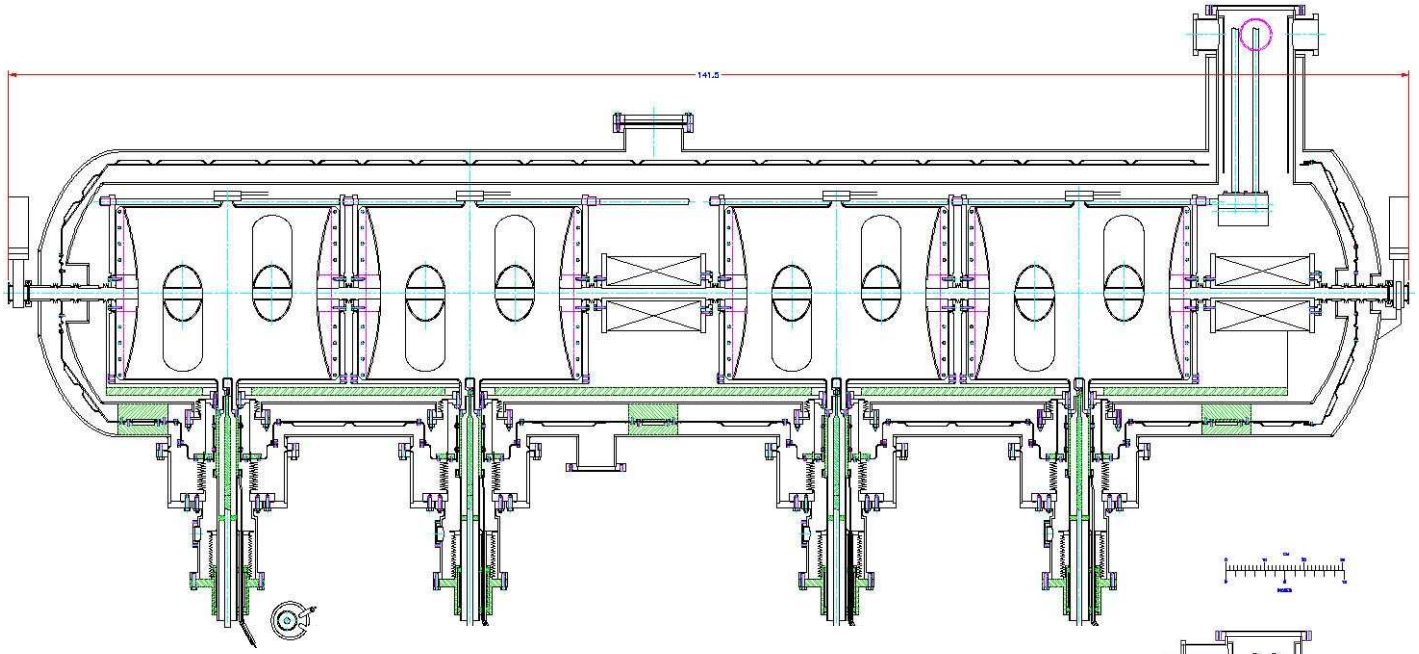
Design Evolution



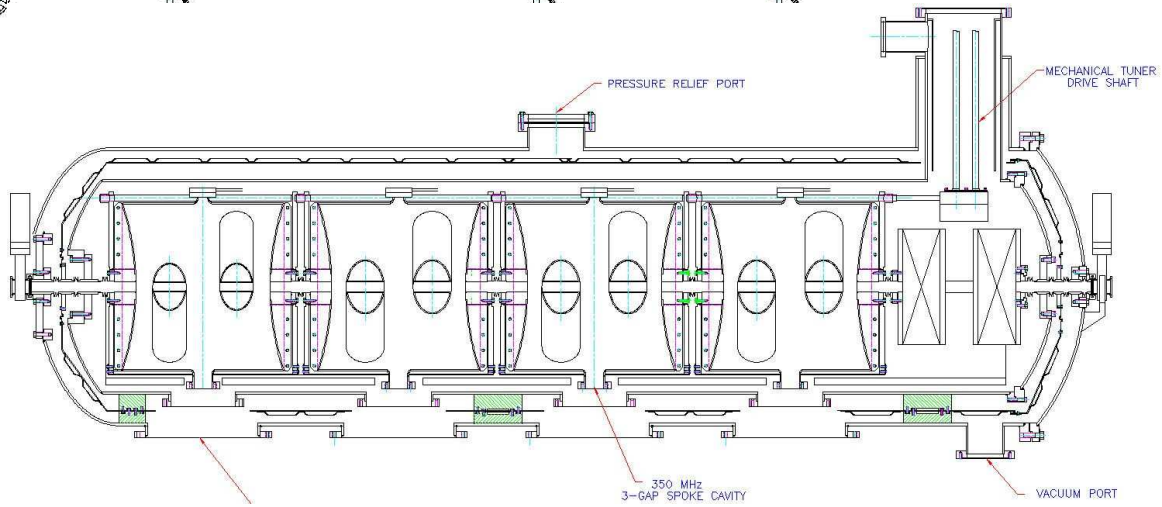
- Cylindrical
- Common vacuum
- Top loading



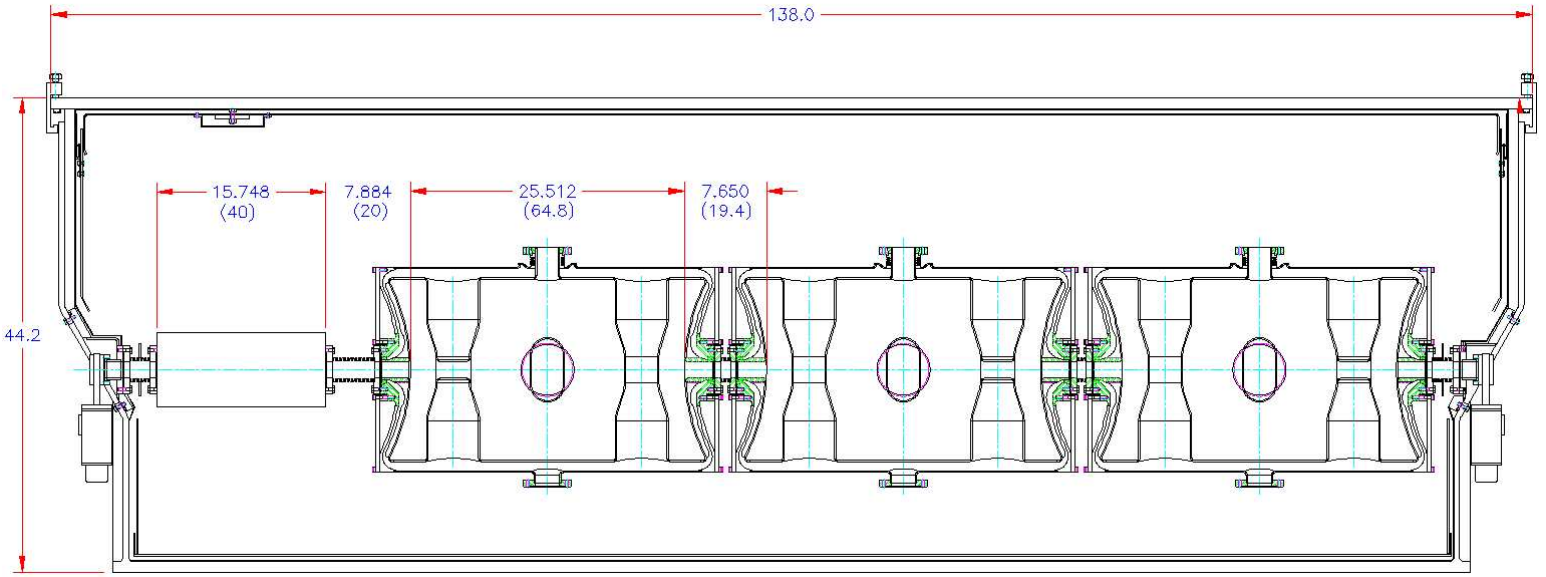
Design Evolution



- Cylindrical
- Separate vacuums
- End loading

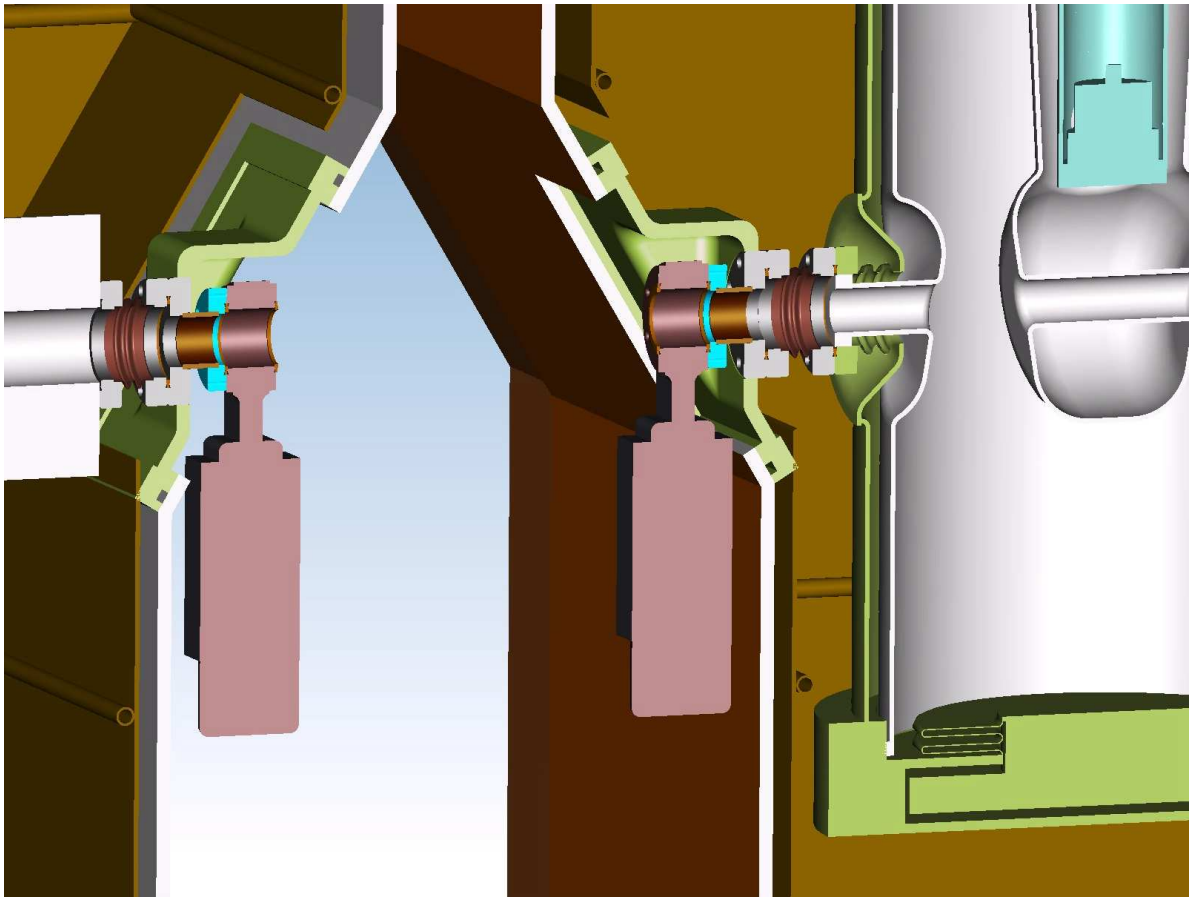


Box Cryomodule with Separated Insulating and Beam Vacuums



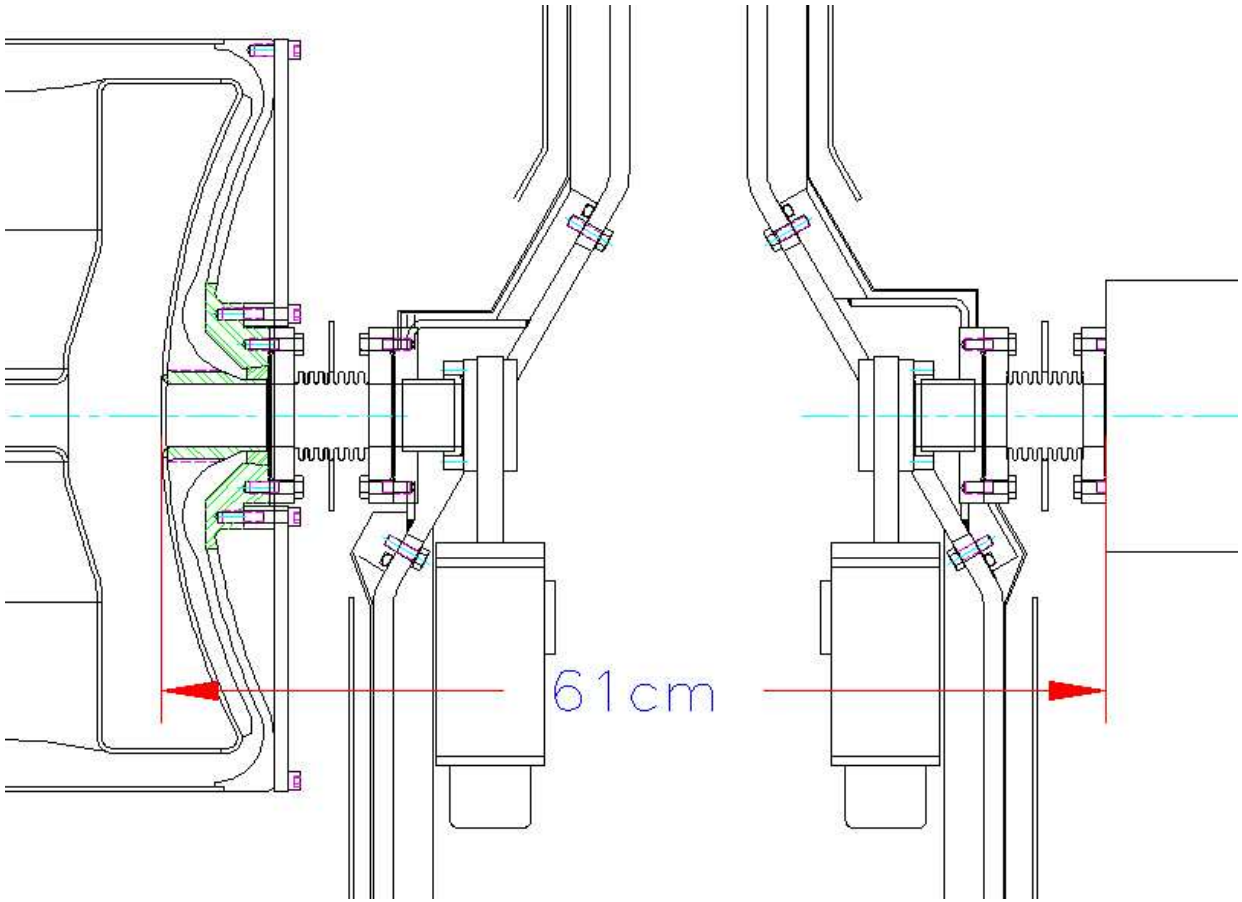
- Reconciles separate beam and insulating vacuum spaces with short module-to-module spacing
- Constructive feedback from JLab, DESY

Separate insulating and beam vacuums

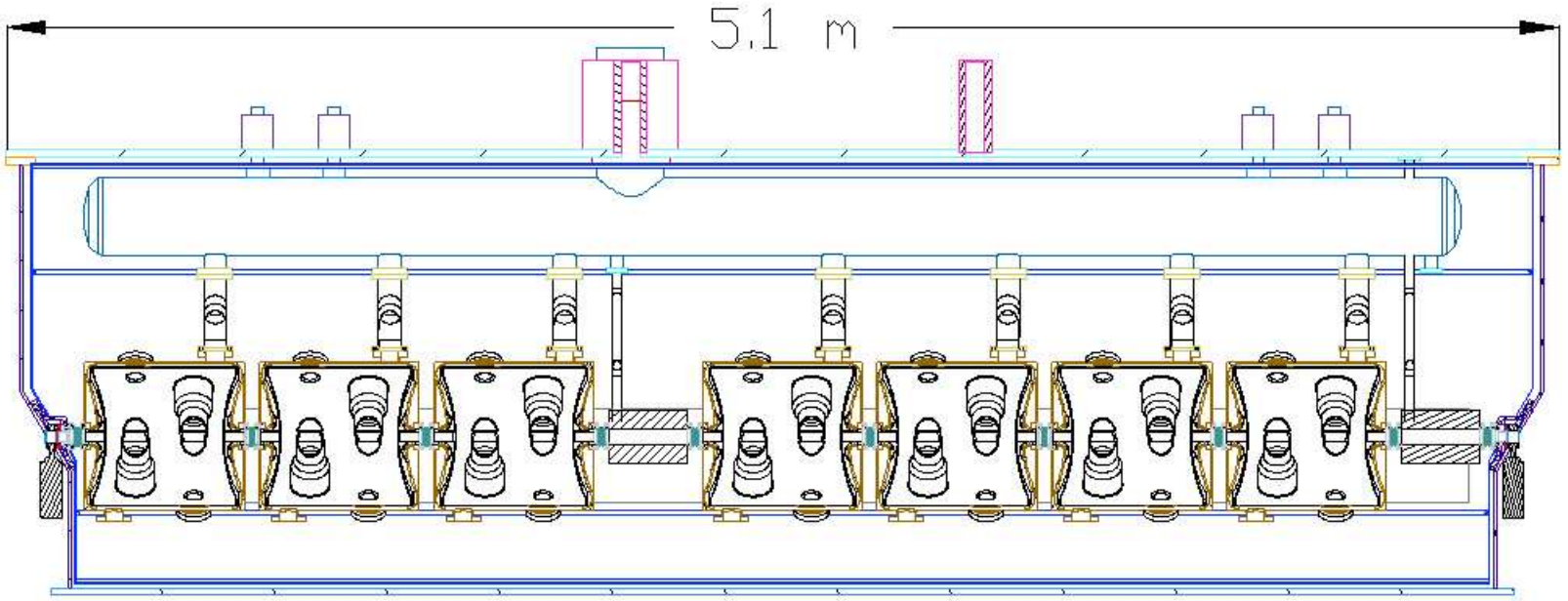


- Angled end walls permit drop-in installation
- Valves isolate clean components during final assembly
- Cleanliness requirements on vacuum vessel are relaxed
- Allows use of multilayer insulation

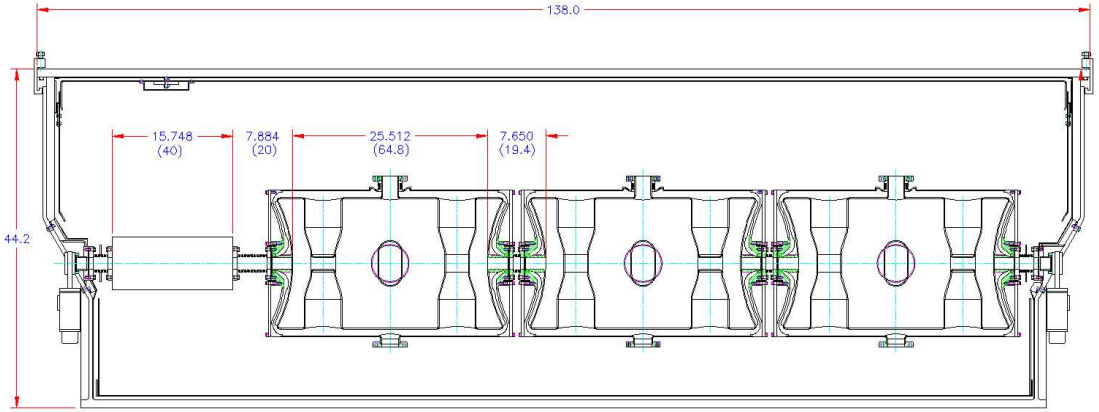
Module-to-Module Detail



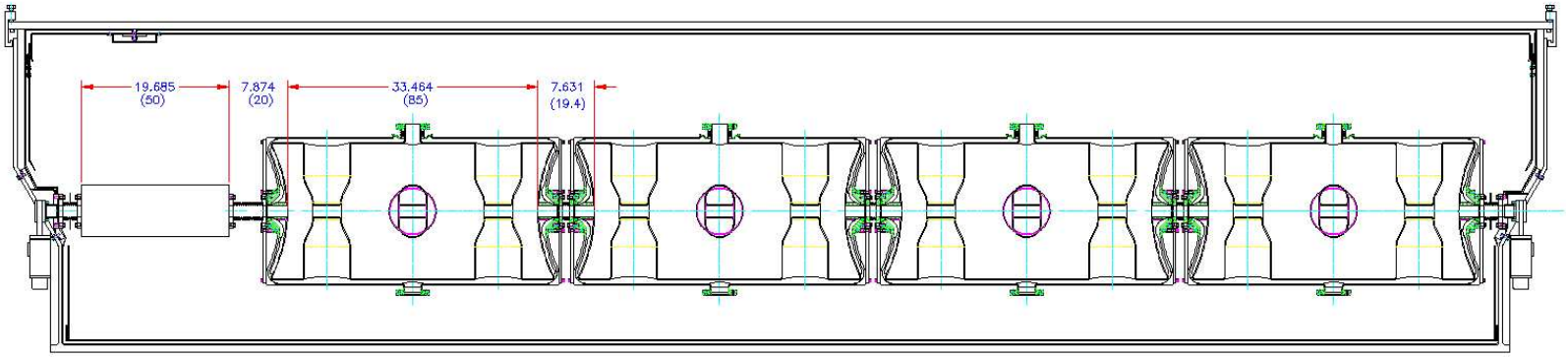
345 MHz β=0.36 Box Cryomodule



3-Spoke Cryomodules



$\beta = 0.50$



$\beta = 0.62$

Conclusions

- Box cryomodule concept builds on successful ATLAS PII design, end-loading cylindrical designs are proven at TTF, JLab, SNS, etc.

- Although rectangular shape is a good fit for a variety of drift tube cavity geometries, cylindrical may be more appropriate for spoke cavities

- Addresses gradient issue with separate beam vacuum and clean assembly techniques

- Preserves tight module-to-module spacing in a top- or end- loading design with separate vacuum systems