

NEXT-100 Mechanical Overview

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Lawrence Berkeley National Laboratory

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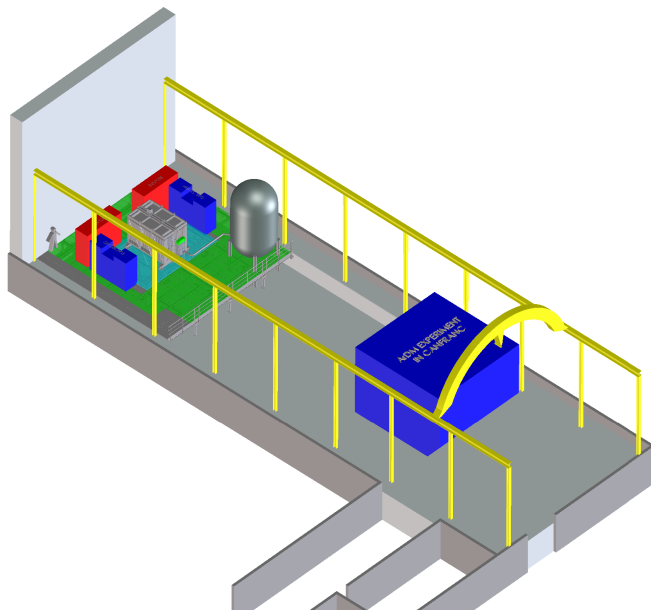
Mechanical

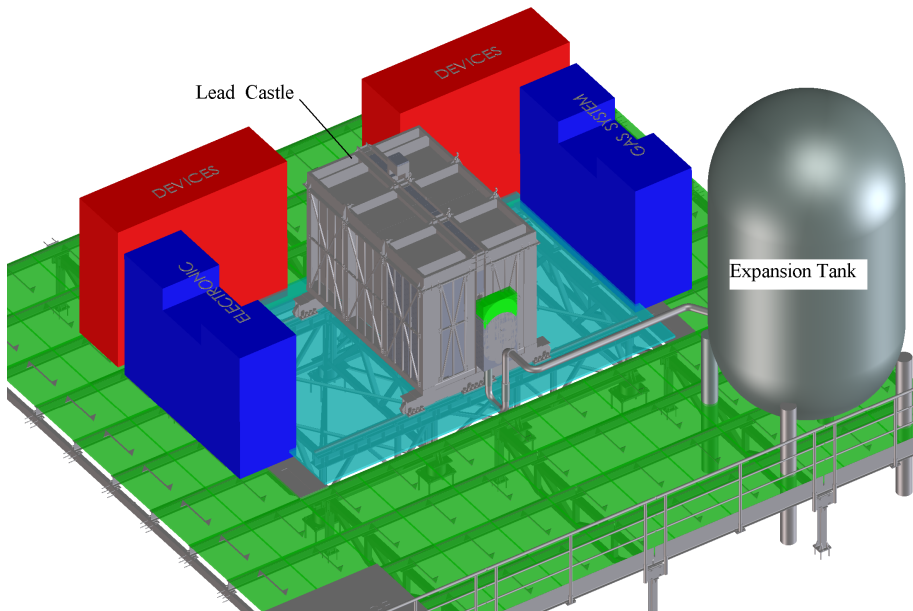
- Derek Shuman LBNL (lead, past)
- Sara Carcel, IFIC (lead, present)
- Alberto Martinez, IFIC

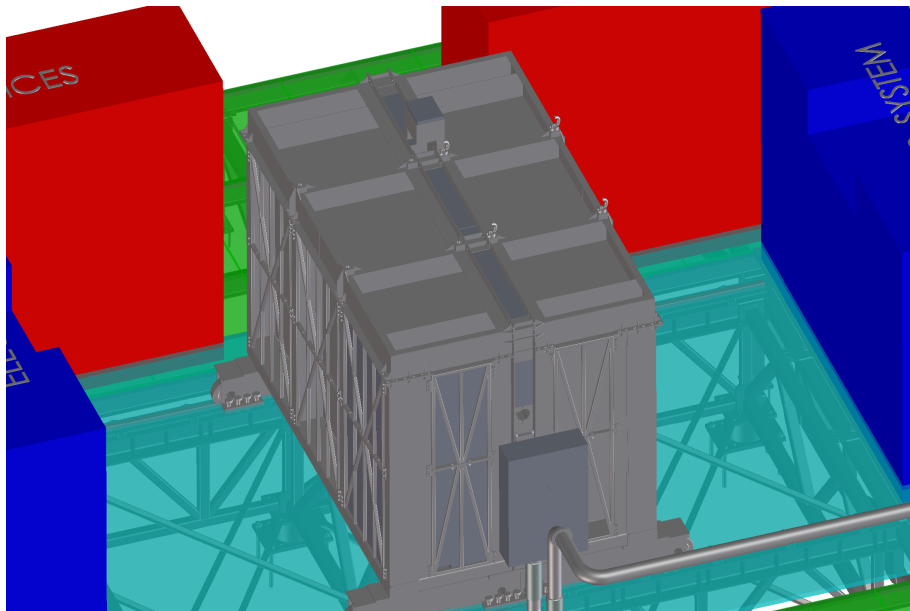
Civil

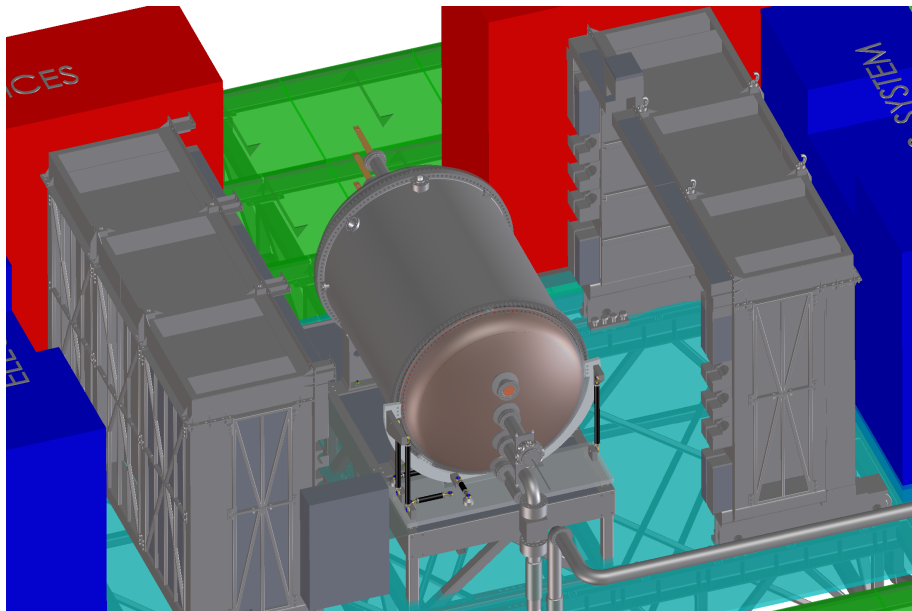
- Jose Luis Perez Aparicio, University Polytechnica de Valencia (lead)
- Jordi Torrent Collell, Escola Politecnica superior, University de Girona
- Roberto Palma, UPV

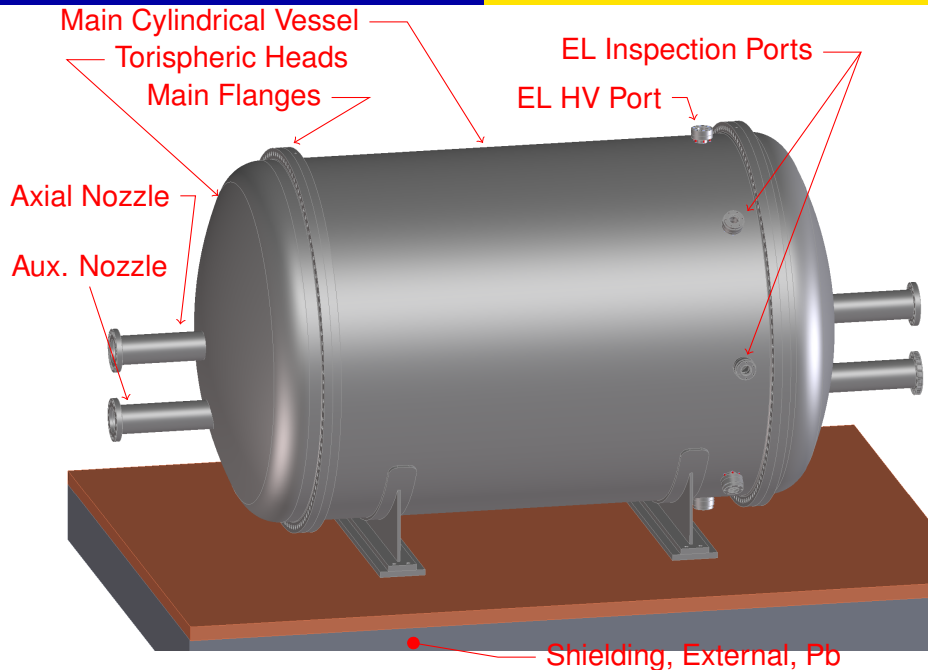


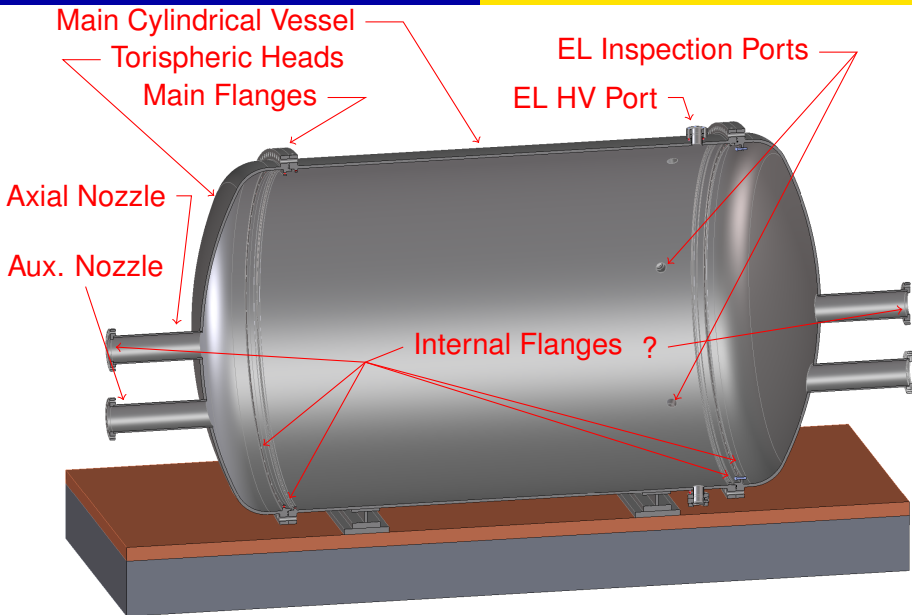


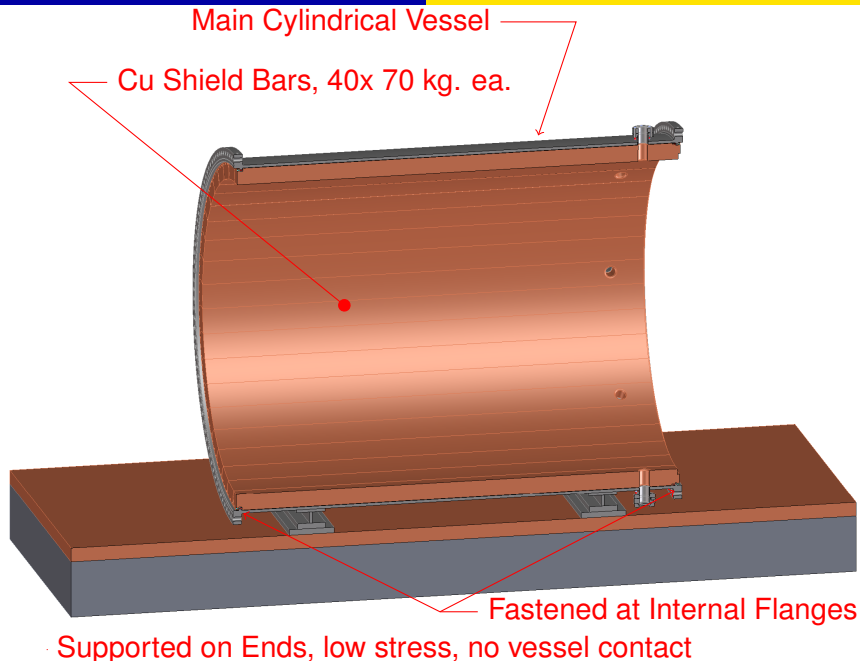




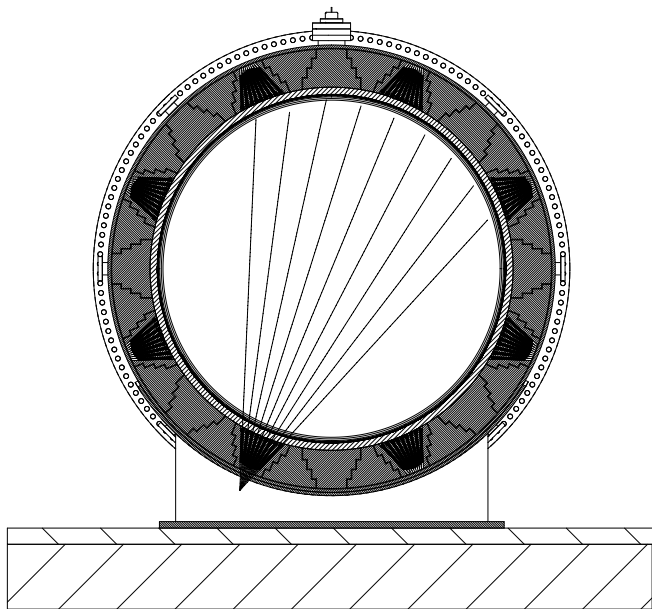








End view of ICS bars showing possible external source collimators

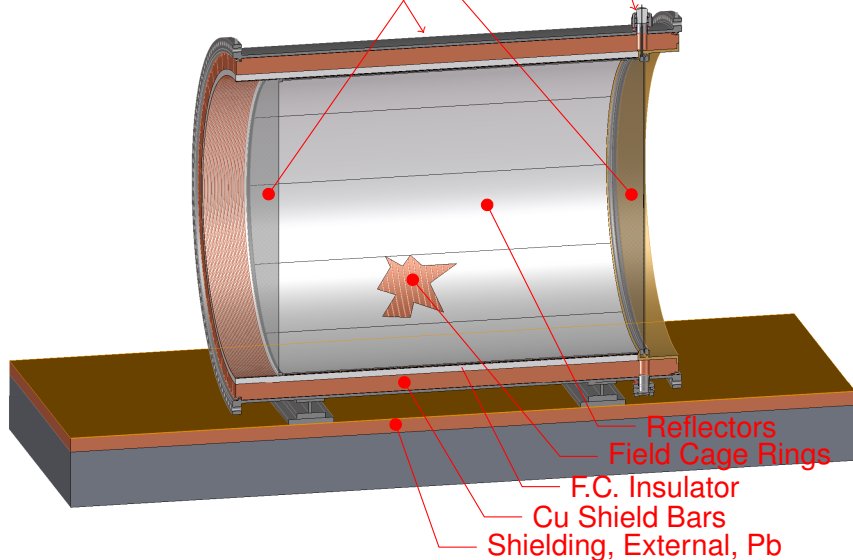


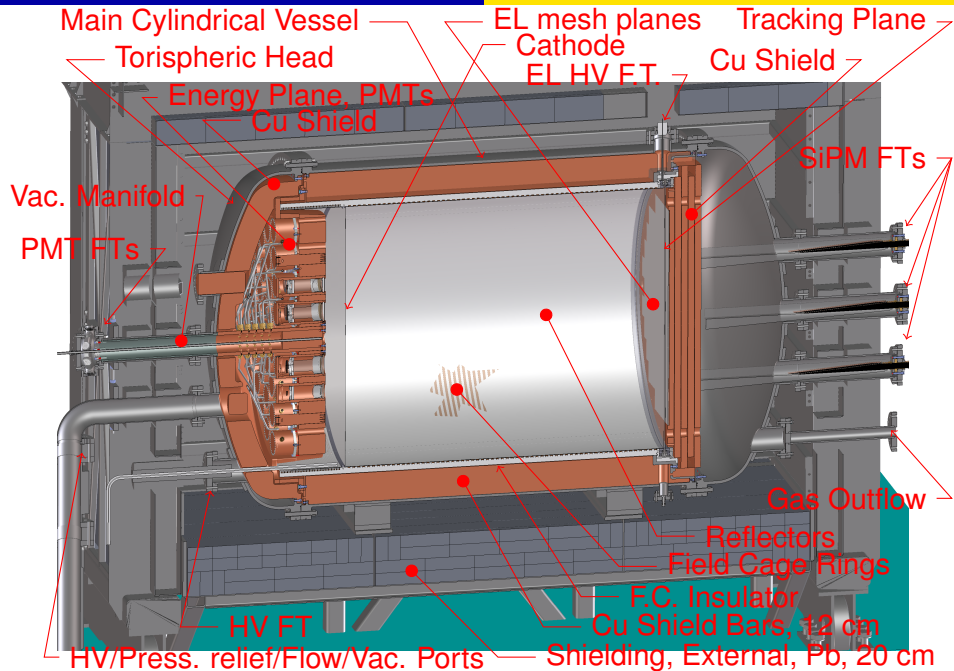
Main Cylindrical Vessel

EL mesh planes

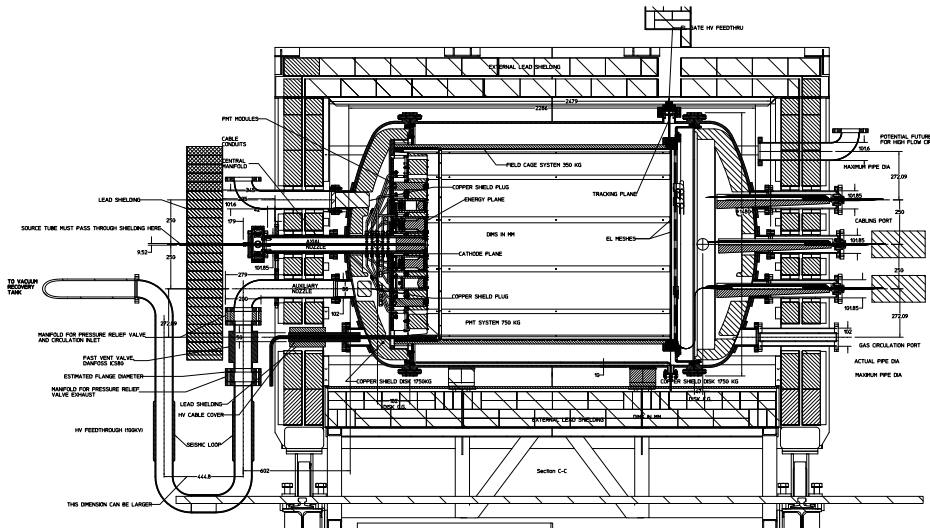
Cathode

EL HV F.T.

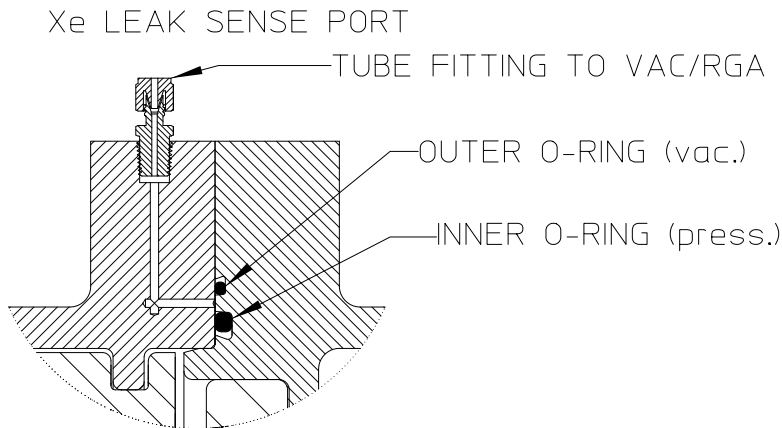




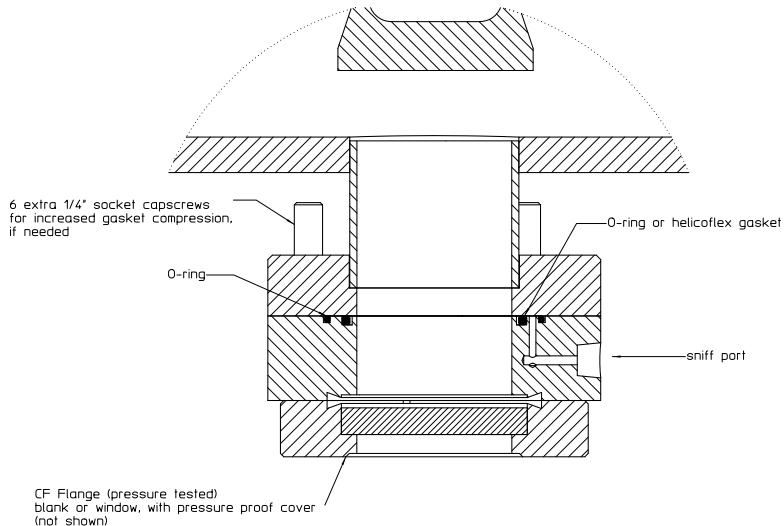
Parameter	qty	units
Maximum Operating Pressure (MOP)	15.0	bar (abs)
Maximum Allowable Working pressure (MAWP)	16.4	bar (abs)
Minimum Allowable Pressure (external)	1.5	bar (abs)
Material, stainless steel, alloy	316Ti	
Inner diameter	136	cm
Outer Diameter, Flanges	148	cm
Length, inside shielding	2.22	m
Vessel and head wall thickness	10	mm
Flange thickness, head to vessel (both)	4.1	cm
Bolt Diameter (Inconel 718), head to vessel flanges	16	mm
Number of Bolts, each head to vessel flange	132	
Mass, Vessel and both heads	1100	kg
Mass, Internal copper shielding	8500	kg
Total Weight	12000	kg

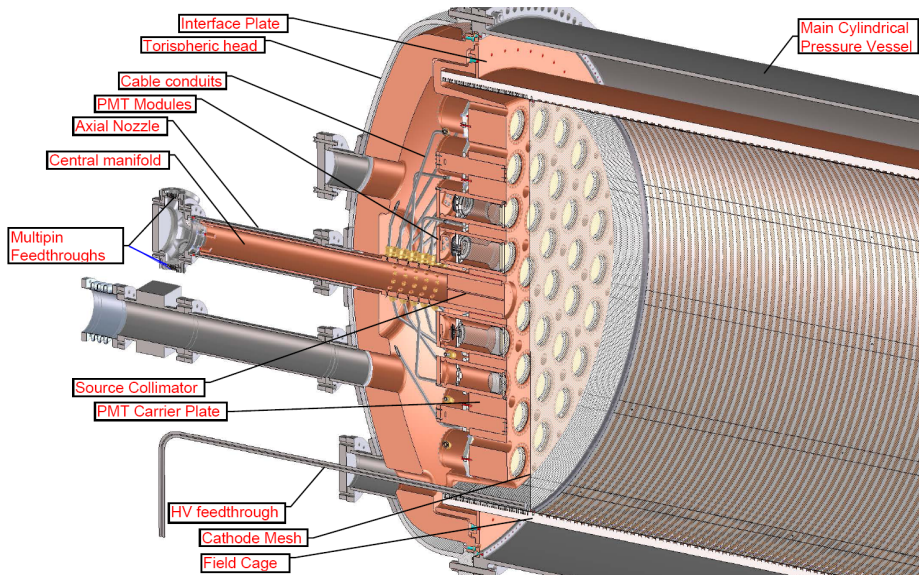


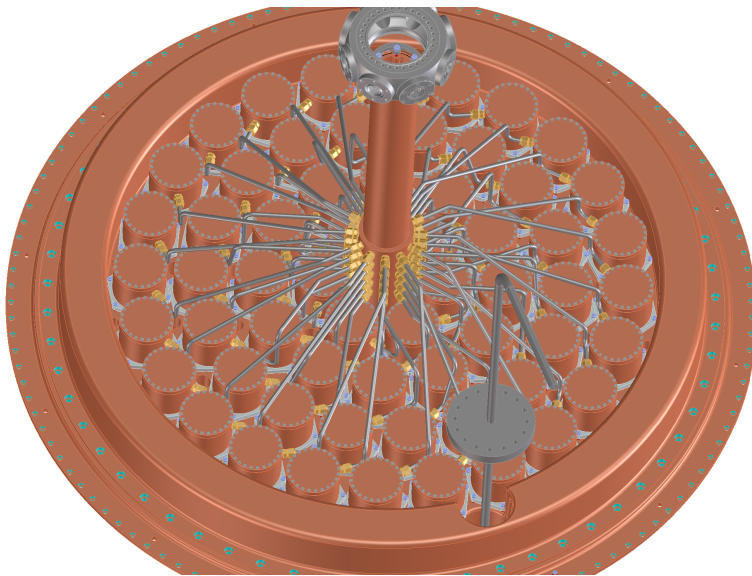
Double seal detail with leak sense port

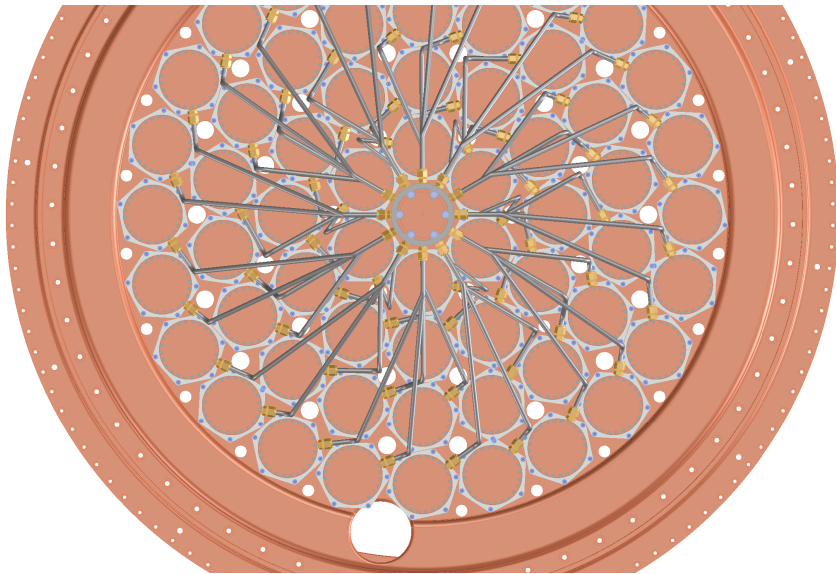


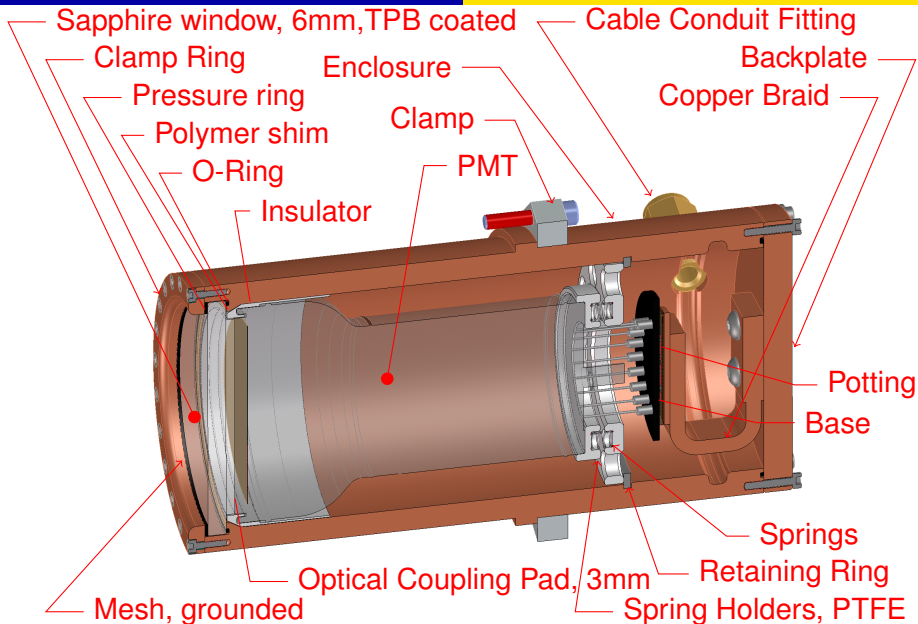
Interface flange detail





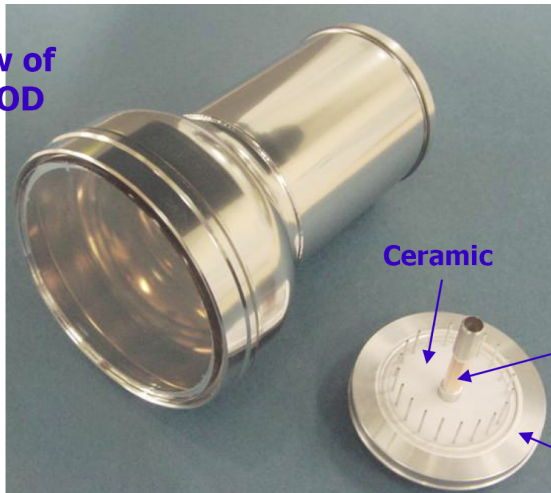






Hamamatsu R11410-10

Front view of R11410MOD



Ceramic

Cu Pipe

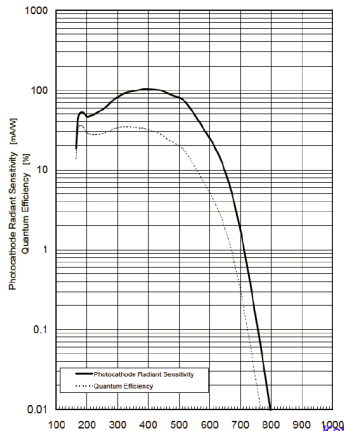
Kovar Metal

Typical quantum efficiencies, as measured, from [arisaka]

Spectral Response Characteristics

Tube Type: R11410-10
 Serial No.: 2K6346
 Date: Aug. 24, 2011
 Tested by: H.OISHI
 Note:

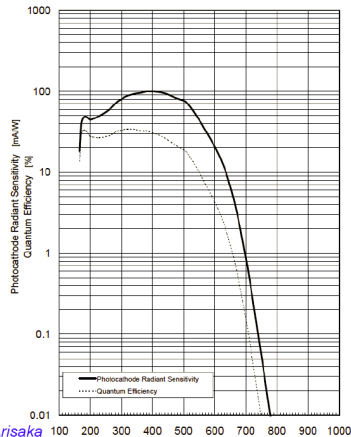
Max. Q.E.: 34.9 %
 Wavelength of max.: 320 nm



Spectral Response Characteristics

Tube Type: R11410-10
 Serial No.: KAD001
 Date: Aug. 24, 2011
 Tested by: H.OISHI
 Note:

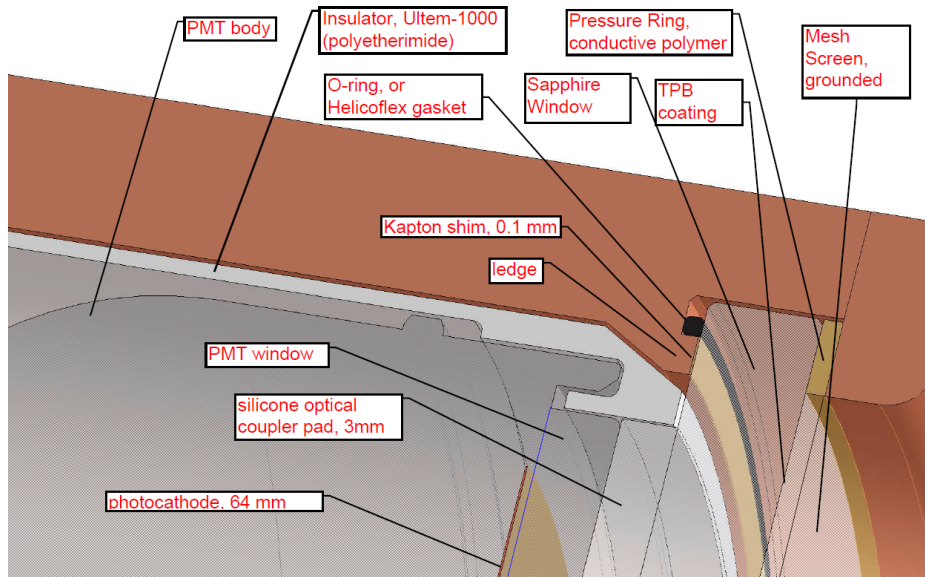
Max. Q.E.: 34.8 %
 Wavelength of max.: 320 nm



Katsushi Arisaka

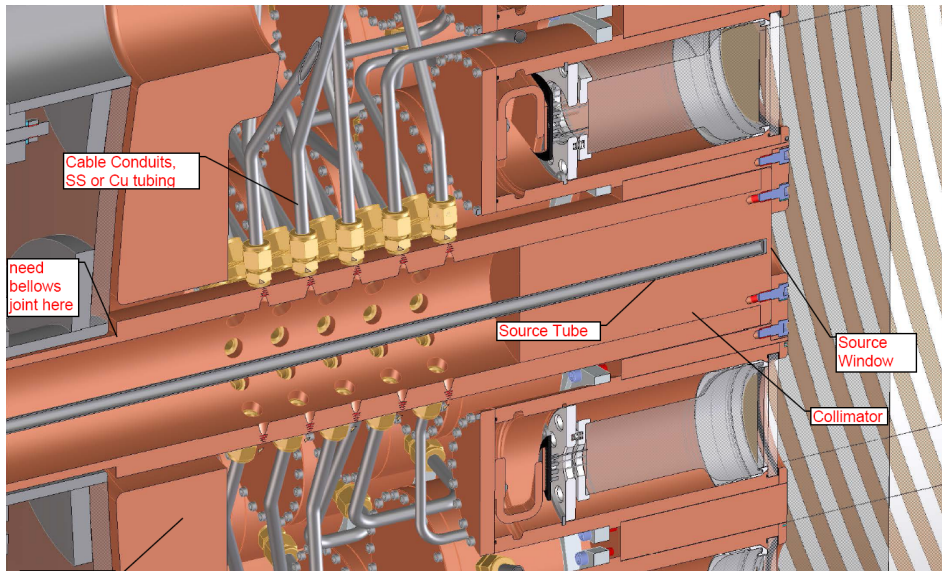
Window strength assurance

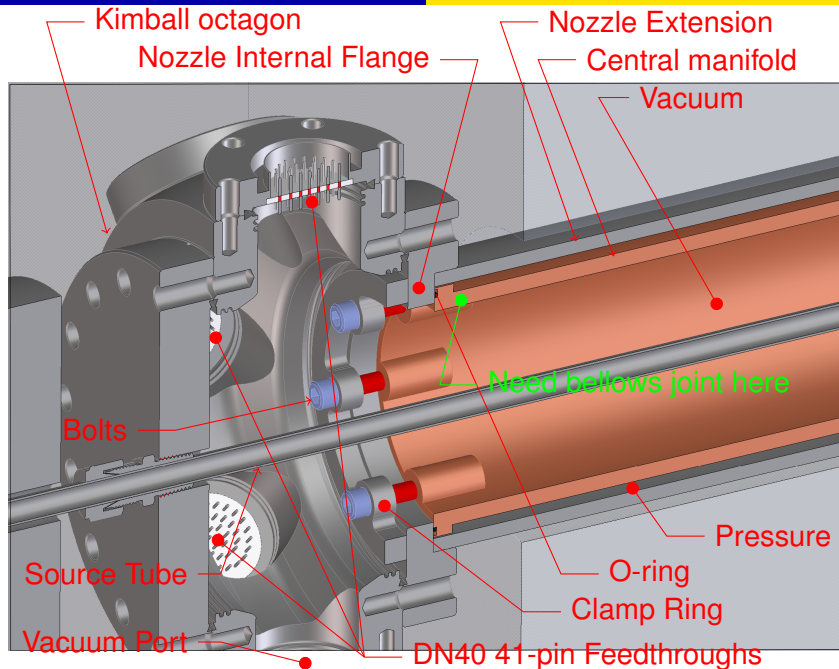
- Strength is a strong function of area and finish (as well as intrinsic strength)
- Weibull distribution: failure probability vs. stress-area function
- Sapphire and quartz have well characterized Weibull parameters (moduli and characteristic strength)
- Choose thickness, finish to give low failure probability (5% or less) at a TEST pressure
- Test pressure set to assure: if no failure under test then no failure under fatigue (cyclic or static)
- Pressure Test all windows

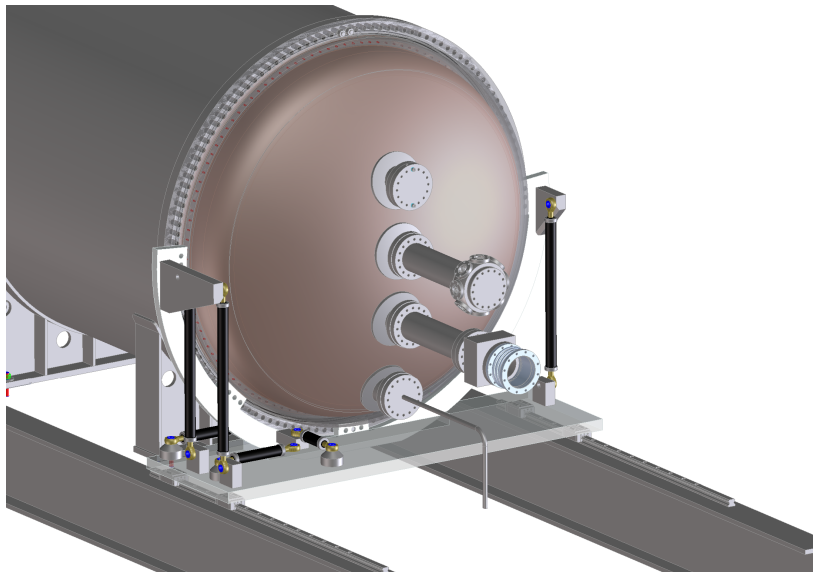


(Temperature Drop, Base to ambient @1750V, 3.5MOhm)

Section	deg. C
Potting Compound, 1mm (1W/(m*K))	2.38
Kapton MT insulation, .05mm	0.33
Cu braid, 259 kcmil x 7.5cm	1.34
Contact, into backplate	0.04
Contact, into enclosure	0.02
Enclosure to Clamp	0.17
Contact into Carrier Plate	0.02
Carrier plate to convolution	0.22
Convolution to Vessel flange	0.48
Vessel flange	1.32
Total Temp Drop	6.3







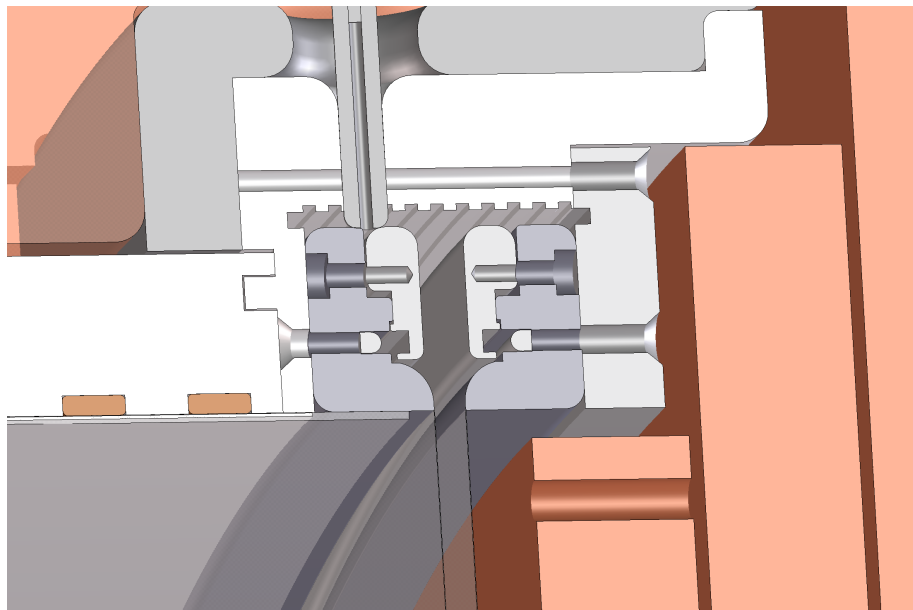
Basic Description of Energy Plane System

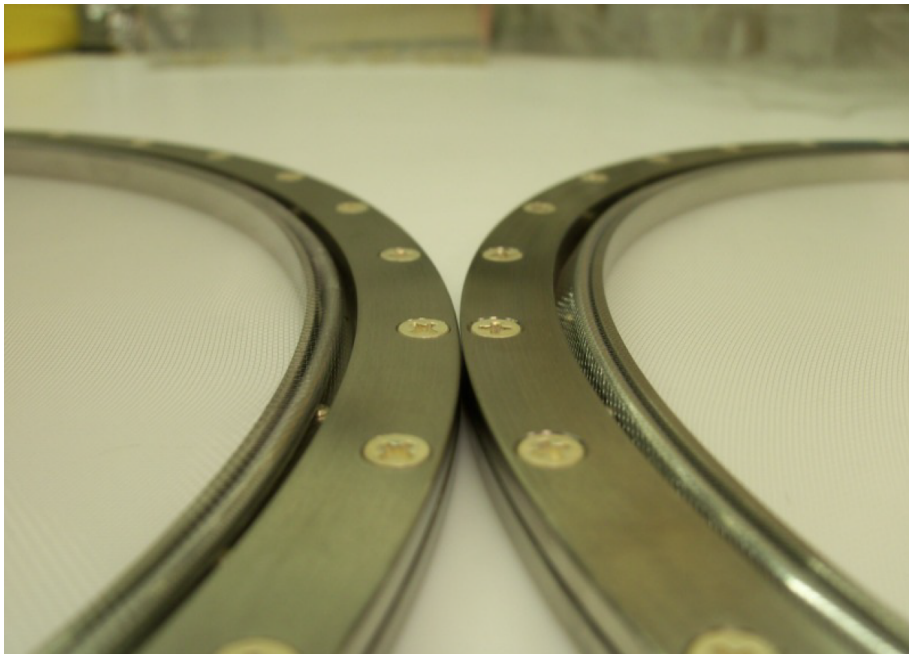
- PMTs (R11410-10) sealed into individual pressure resistant, vacuum tight Cu enclosures (PMT Module).
- PMT's operated at +HV (grounded body/photocathode). Body insulated from enclosure.
- Base design is a zener stabilized differential output, scheme from D. Nygren
- Sapphire windows are secured with clamps having soft interfaces, and are O-ring or Helicoflex sealed
- Sapphire windows are coated with TPB
- Wire mesh screens (grounded) shield photocathodes from buffer e-field
- PMT bases are potted with heat conducting epoxy to flexible copper braids thermally connected to enclosures
- Modules (60 total) mounted to a common carrier plate that attaches to an internal flange of the pressure vessel head.
- PMT cables are enclosed in individual pressure resistant, vacuum tight metal tubing conduits.
- Conduits all lead to a central vacuum manifold and sealing to internal flange of axial nozzle.

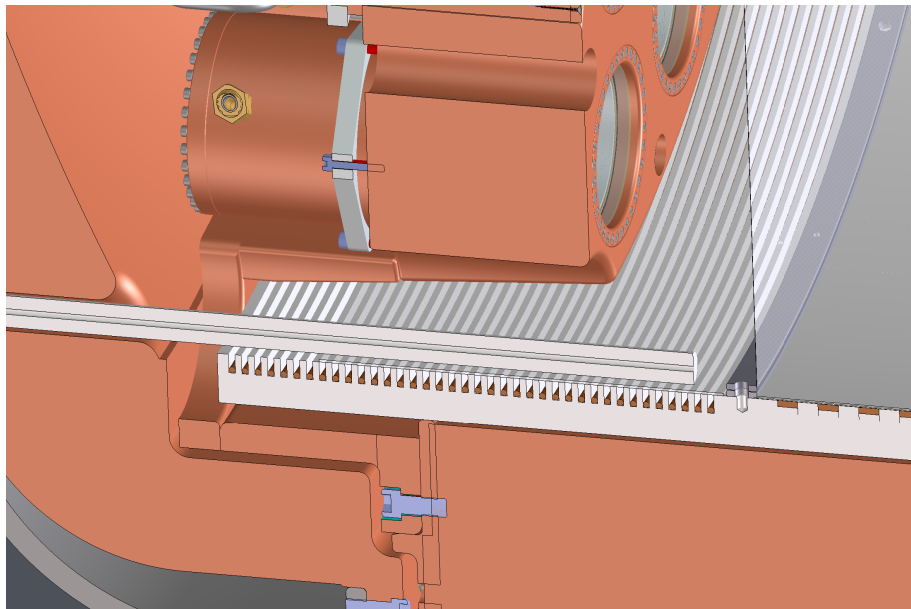
- PMT cables route through central manifold to (5) 41 pin CF feedthroughs on a CF octagon, outside the lead shielding.
- Vacuum($< 10^{-4}$ torr) is applied at octagon port; gives($low 10^{-3}$ torr) inside enclosures for insulation.
- Large vacuum tank limits pressure buildup in central manifold in case of sapphire window failure
- Xenon permeation through seals is recovered with a cold trap.
- Central manifold incorporates a calibration source tube and collimator.

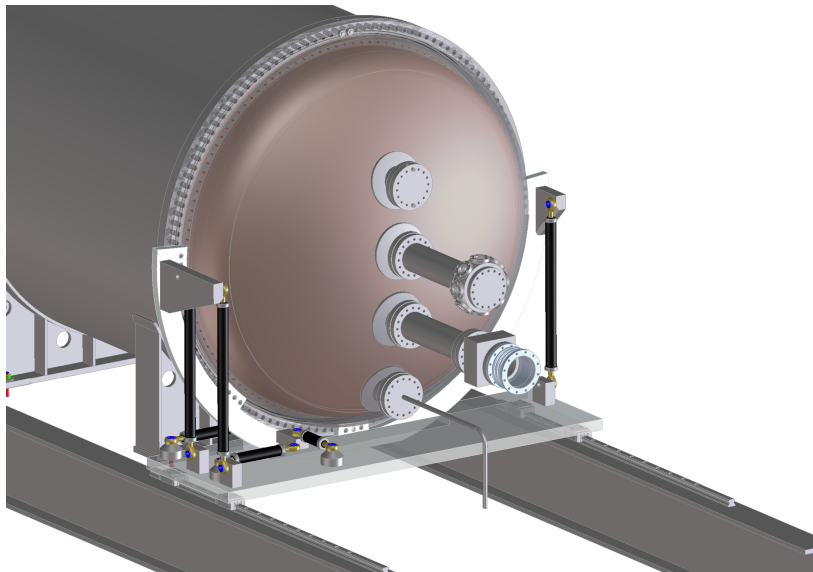
- Design by James White, Clement Sofka, TAMU
- 3cm polyethylene rotomolded and machined
- 130 cm drift length, 25 cm cathode buffer region grade-down
- "C-clamp" EL mesh connection avoids sparking or tracking
- EL meshes and frame based on proven designs up to 50 cm dia.
- EL mesh of fine wire ($30\mu\text{m}$) and pitch (0.5mm), 88% transparent
- Coarse, stiff wire mesh on cathode for simplicity (88% transparent)

Drift field strength	0.3 kV cm^{-1}
EL field strength (E/p)	$3.0 \text{ kV cm}^{-1} \text{ bar}^{-1}$
Optical gain	$2500 \text{ photons/e}^{-}$
Drift length	130 cm
EL gap	0.5 cm
Cathode voltage	$-61.5 \text{ kV @15 bar (a)}$
Gate grid voltage	$-22.5 \text{ kV @15 bar (a)}$
Anode grid voltage	0

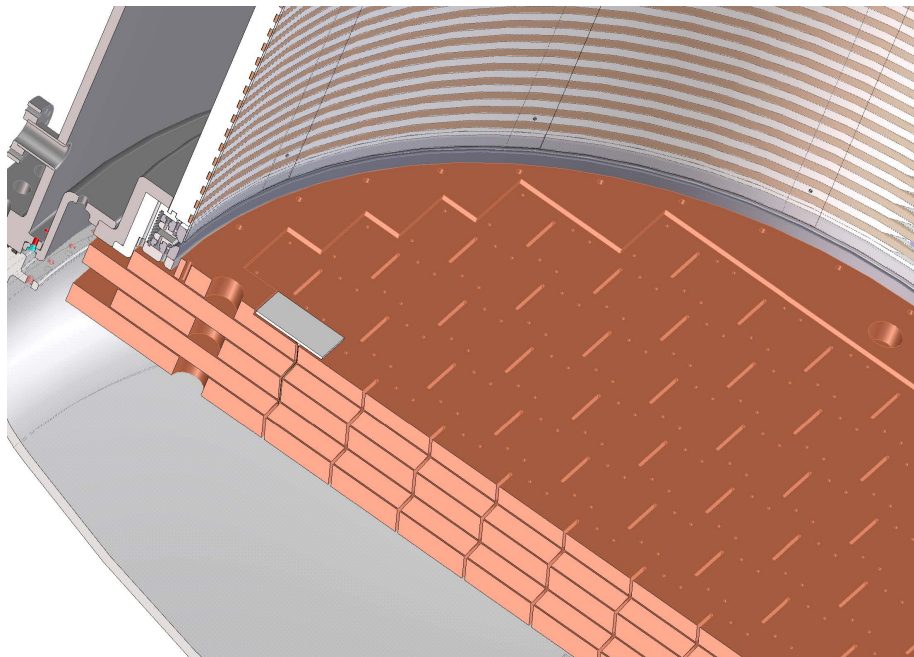


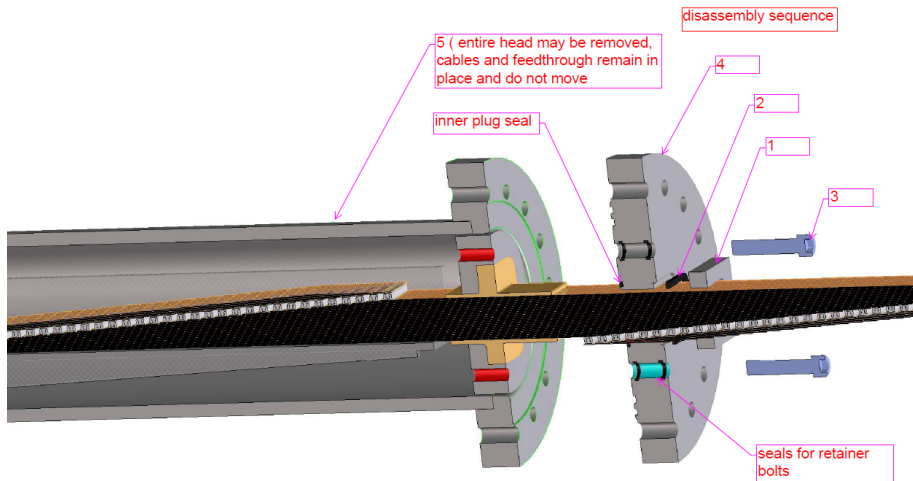


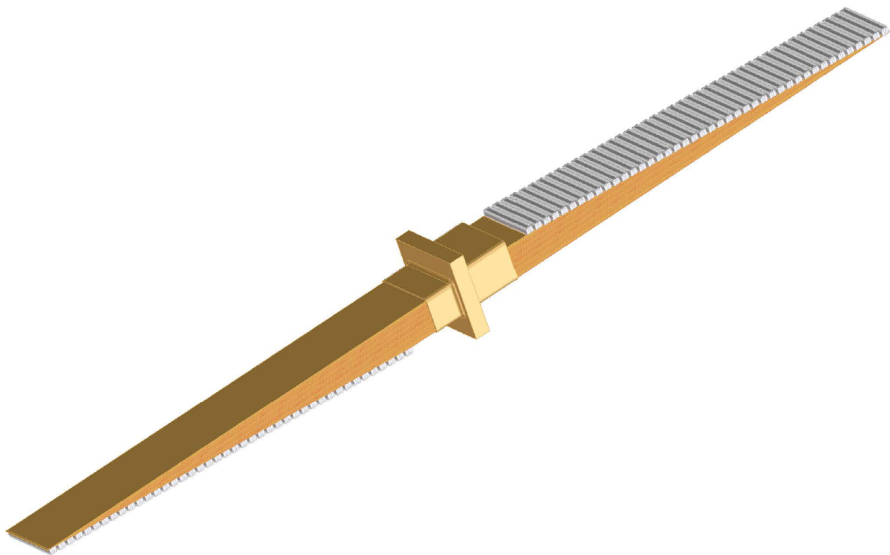




- 111 Dice Boards (DBs) 80mm square pitch, 64 SiPMs/DB
- DB is 4 layer Cuflon multilam PCB, 80 pinout
- Xe flows around edges of each DB and behind them (no flow allowed elsewhere)
- DB carrier plate doubles as ICS shield (allows connectors inside vessel)
- ZIF connector (0.5mm pitch) on FPC cable attaches to DB pigtail, behind Cu shield
- Cables (FPC) are stripline, 50Ω for reduced capacitance to ground
- Cables bundled into 3 sets, rest on shelves cantilevered from shield
- Feedthrough is all-polyimide (Cirlex) multilayer rigid-flex circuit (42 FPCs/FT)
- Feedthrough made with a machined flange for internal sealing
- Metal flange and PV head removable from outside without disturbing cables







LBNL Feedthrough Stripline FPC Design Proposal

feedthrough will consist of 42 of these FPCs laminated with polyimide bondply ('adhesiveless')

D. Shuman 9/18/2012
after consultation with Fralock engineer, Jim Webb
and with Maurice Garcia-Sciveres, LBNL.

