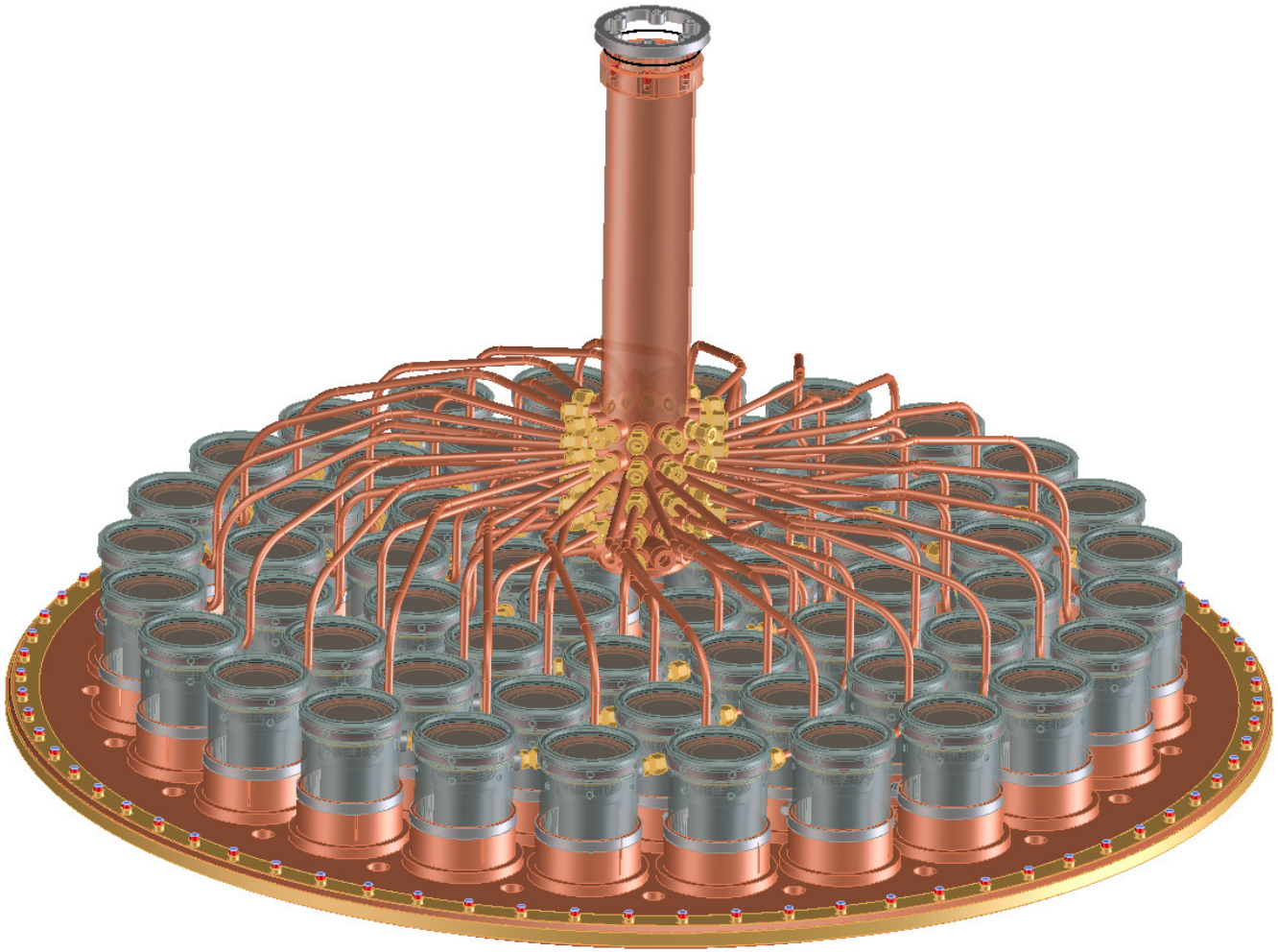
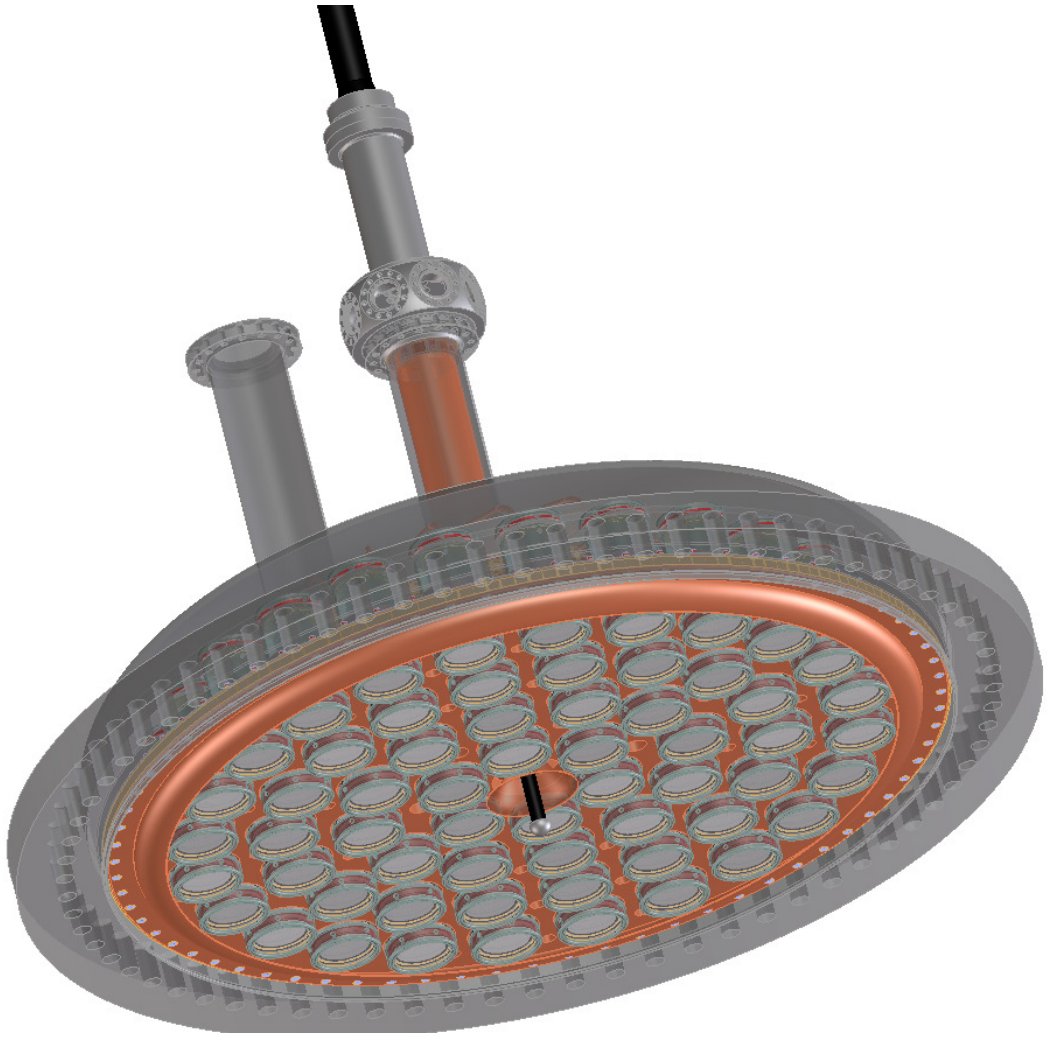
NEXT100-PMT
System Requirements

- pressure resistance 15.4 barg ext press.
- pressure isolation (window break)<2 barg
- radiopurity <50mBq total
- heat dissipation <10 deg C
- ease of maintenance
- minimum cost





Pressure Resistance

- Enclosure buckling- ASME methodology- 2 mm min thk
- Window thickness determination
  - Use Weibull distribution for acceptance (at a test pressure)
  - Use fracture mechanics to determine test pressure
- Copper tube (1/4” dia.) collapse
  - Buckling - .005” min
  - Ellipticity (0.8 max) at bends – 3 ksi max (bend + press.)

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

Weibull distribution eqs.

$$P_f = 1 - e^{-\left(\frac{\sigma}{\sigma_0}\right)^m}$$

$$P_f = 1 - e^{-\left(\frac{A}{A_0}\right)\left(\frac{\sigma}{\sigma_0}\right)^m}$$

$$P_f = 1 - e^{-k(m)\left(\frac{A}{A_0}\right)\left(\frac{\sigma}{\sigma_0}\right)^m}$$

Pressure Isolation

- to avoid collateral enclosure pressurization if a window breaks
- Central manifold open to vacuum (emergency recovery tank- 30 m^3)
- 63 gm/s Xe max flow through cable conduit – choked flow condition

Temperature drops PMT(530 mW ea.) to PV conduction, no gas cooling or radiation

Resistor potting	0.23 C	
Heat sink	0.12 C	
Can (Ti)	1.76 C	
Can clamp	0.08 C	
Carrier plate	1.3 C	
Kapton insulation	3.0 C	
PV flange	1.2 C	
TOTAL	7.7 C	

Remaining Design Tasks

- Heatsink - copper cable?, diaphragm?- how to pot?
- PMT base design- side connections?
- Spanner wrenches
- Improve can clamp?
- Improve carrier plate insulation- test

R&D Plan

- Obtain PMT's - characterize?
- Build can prototype
  - use stainless pipe
- Build window test cell
  - use same lip design, pressure ring, O-ring and kapton gasket for test
- Design/build pressure test chamber to test:
  - leakage under pressure (Ar then Xe, Ne?)
  - internal vacuum inside can
  - set up CC gauge on backplate
- Test temperature rise inside
  - add thermistor to resistor board