

Comments on TPC Mass

TK HEMMICK

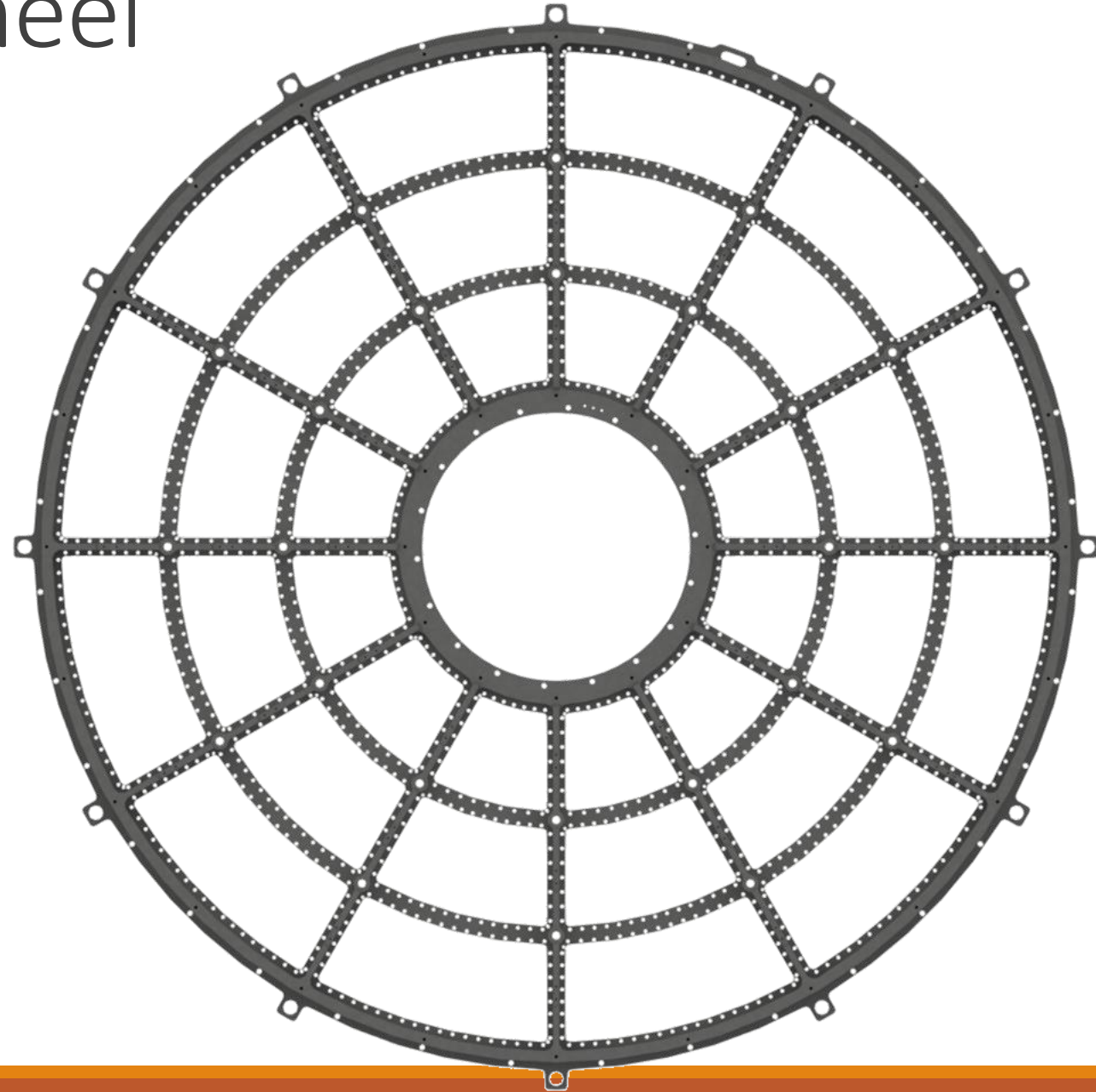
The Infamous Wagon Wheel

Some Considerations:

- Magnet Quench (must withstand Faraday)
- Electronics
 - Provide a little mass with chips & boards
 - Provides more mass with cabling.
 - Provides LOTS of mass via cooling:
 - FEE: 8 SAMPA, 1 FPGA, few LRD
 - $20 \frac{W}{FEE} \times 26 \frac{FEE}{Sect} \times 12 \frac{Sect}{End} \times 2(?)End$
 - 12.5 kWatt (not small)

Strategies

- Make as uniform as possible.
- “Bunch Up” the mass and limit live area
- GEM Module
 - Pad Plane
 - GEM Foils
 - FEE Cards



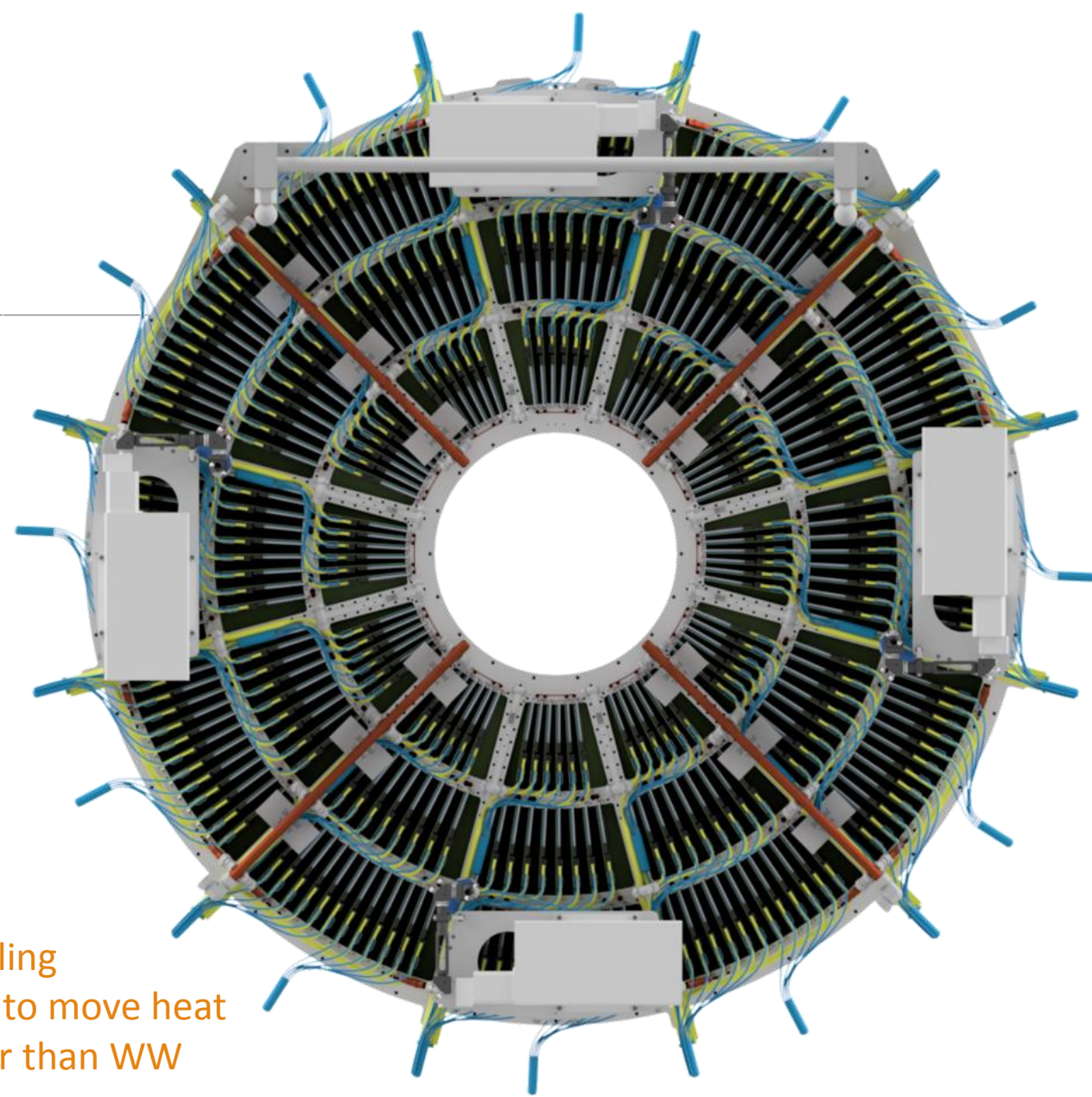
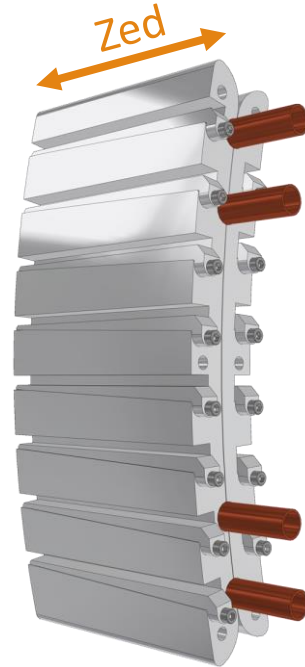
Manipulating the Mass

Parts stacked on unavoidable obstructions

- Cooling Lines
 - Entirely aligned with the gaps between module active areas.
- Cooling Manifolds
 - Entirely aligned with gaps between module active areas.
- Low Voltage Power Cables
 - Dropped from 12 gauge to 18 gauge in active area
 - Follow gaps between active areas except for last ~2 cm
- Fiber Optical Cables
 - Follow gaps except last ~1 cm

Parts creating new obstructions

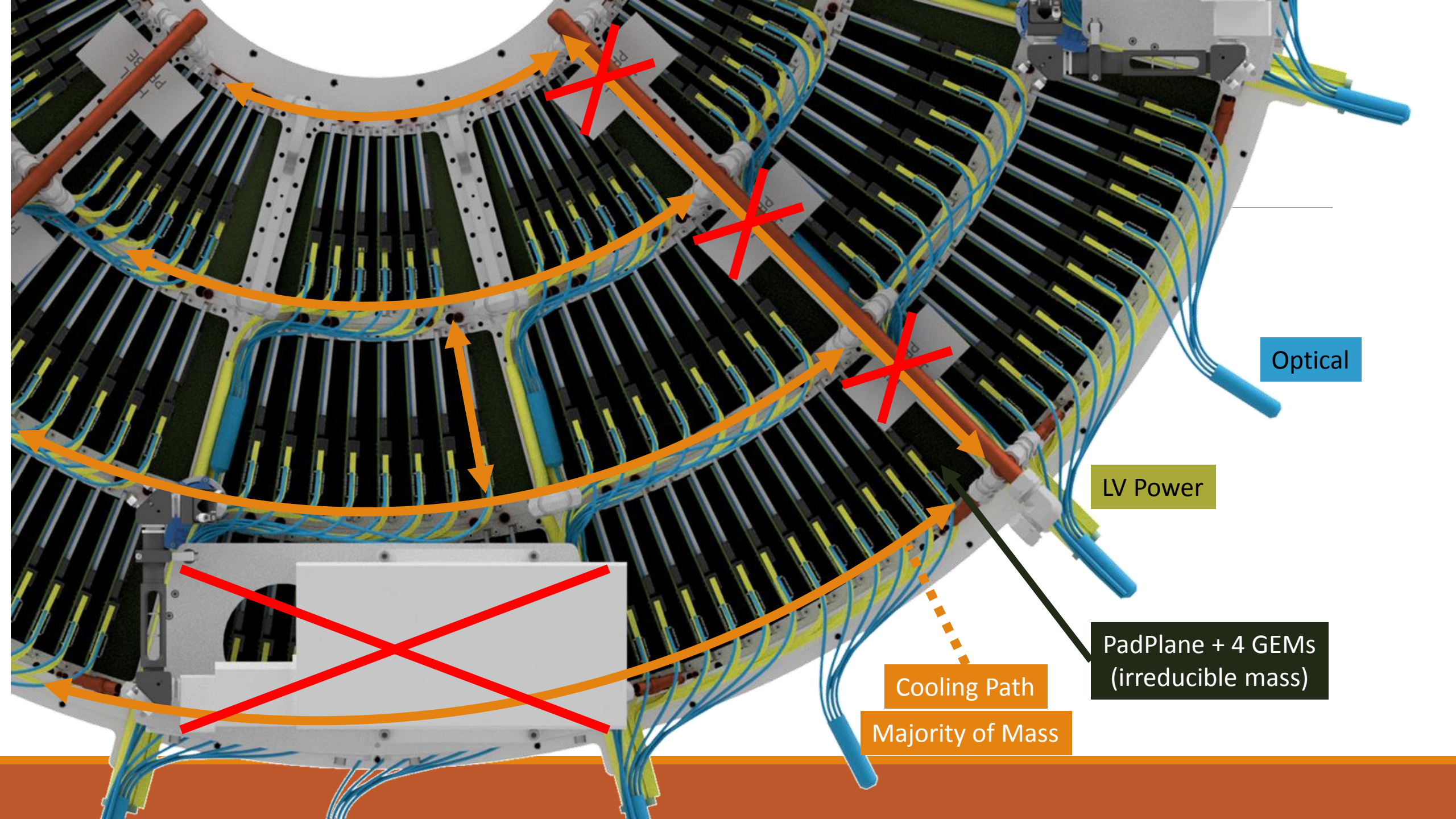
- Hall Probes
 - Laser Benches
 - Support Arms
- } Remove for EIC
- (Reconfigure for EIC?)



Card Guild/Cooling

- Just enough to move heat
- Much thicker than WW

All Services shown except 3 SHV/sector



Optical

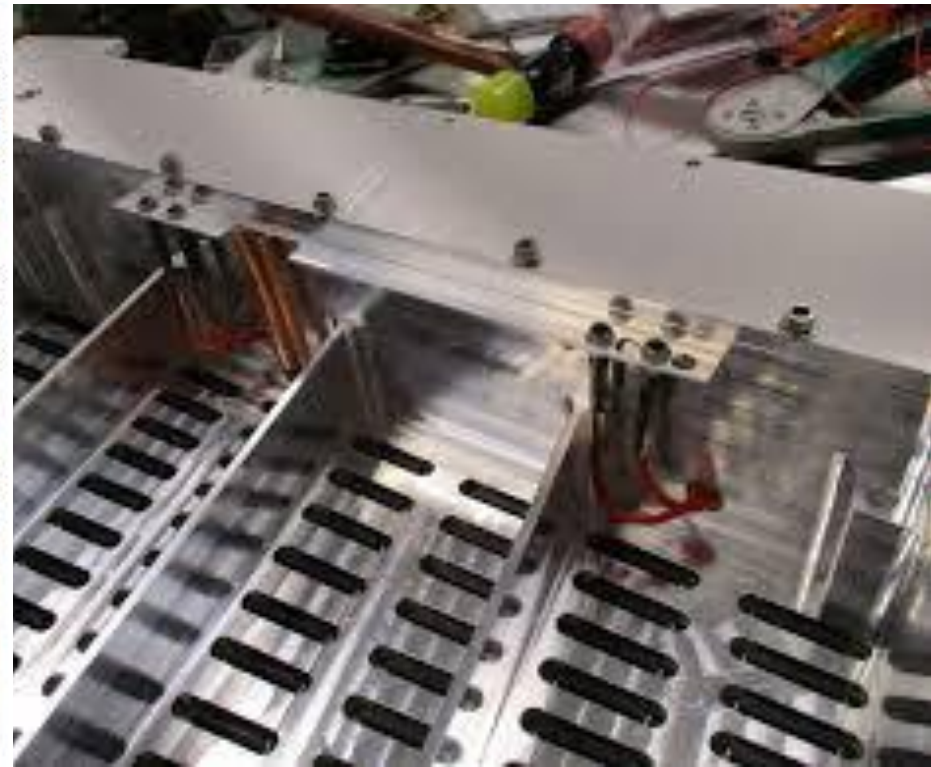
LV Power

PadPlane + 4 GEMs
(irreducible mass)

Cooling Path

Majority of Mass

ALICE “ALUBODY”



Smaller Padplane holds its own shape.

Summary

The fully instrumented gets its mass dominantly from the cooling and other support services.

- SAMPA is the bulk of the power consumption...(likely irreducible?)
- sPHENIX strategically chose to “gather the mass”
 - Considered as an “acceptance limitation”.
 - Can be debated whether this is the best strategy or not.
 - Mass gathering exercise is hard to do significantly better than the present design.

In my opinion the strategy of instrumenting only one end is the most realistic.

- Replace the electron-arm end cap with a single HV plane.
- Care required:
 - sPHENIX CM runs at ~45 kV (driven by ion velocity considerations to minimize space charge.
 - 90 kV end cap requires a careful design.
 - sPHENIX central “membrane” is actually 5 mm thickness honeycomb sandwich (sectorized & stiff to survive magnet quench)
 - 2 X (10 mils FR4 + 1/2-oz Cu) → 0.3% + 0.25% → 0.55% Radiation Length.

BACKUPS

