

Buoyancy calculation update

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June 14, 2024

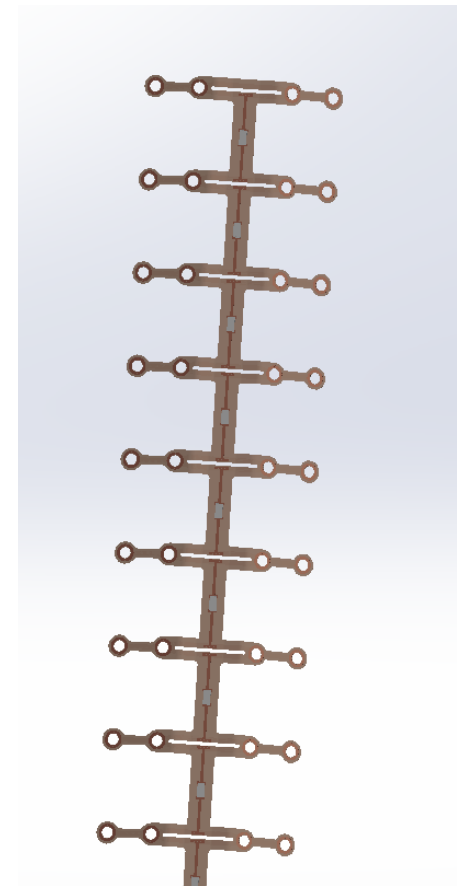
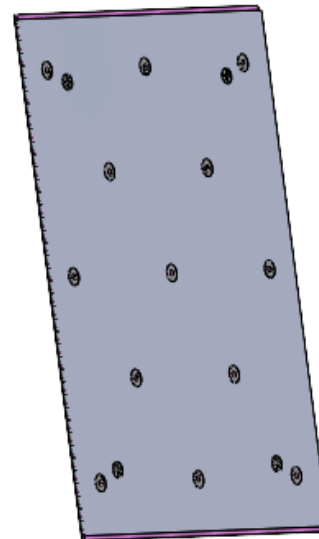
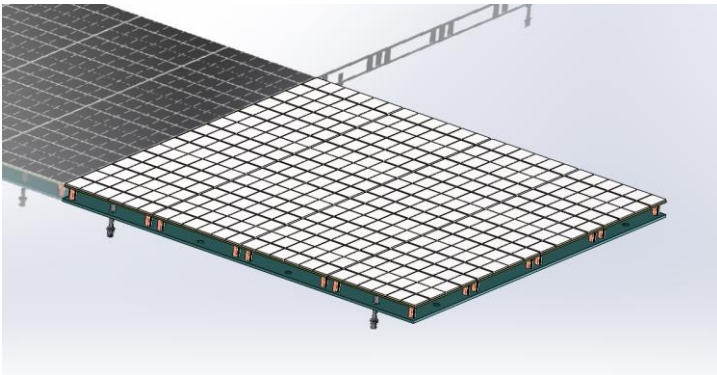
Mass budget

| DS-20K TPC Mass Budget | | | | | |
|------------------------|---|-----------------|----------------------|-----------------|--------------------------------------|
| Subsystem | Solidworks Assembly Identifier | Total Mass (kg) | Displaced Argon (kg) | Net weight (kN) | Notes |
| Top Optical Plane | DS20k_ID_MULT__TOPFull.SLDASM | 3066.4 | 2505.0 | -5.51 | |
| Anode | DS20k_ID_ANOD__Anode.SLDASM | 969.8 | 1108.0 | 1.35 | |
| Wire Grid | DS20k_ID_GRID__Grid.SLDASM | 138.9 | 24.3 | -1.12 | |
| Barrel | DS20k_ID_MULT__Barrel+FC.SLDASM | 8111.4 | 9106.8 | 9.76 | |
| Cathode | DS20k_ID_CATH__Cathode.SLDASM | 1259.3 | 1438.7 | 1.76 | |
| Bottom Optical Plane | DS20k_ID_MULT__BOPFull.SLDASM | 3066.4 | 2505.0 | -5.51 | Defined as TOP mass pending redesign |
| Support Rod | DS20k_ID_SUPP__SupportRod1.SLDASM | 162.7 | 31.5 | -1.29 | |
| Gas pocket | | | | 1.17 | |
| TPC Total: | | 16775.0 | 16719.3 | 0.6 | |

- April 12-25 update (with change to 25 mm diameter support rods)
- TPC floats slightly (0.6 kN)

Common components

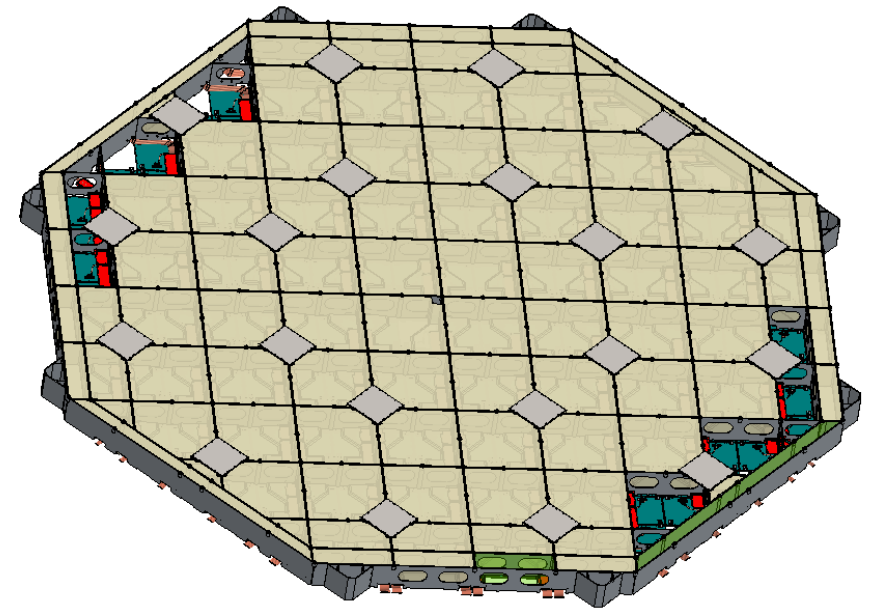
- Included in larger assemblies
- PDUs, vPDUs, Reflectors, resistors
- Broadly unchanged since Nov. budget except SS pins



TOP (and BOP)

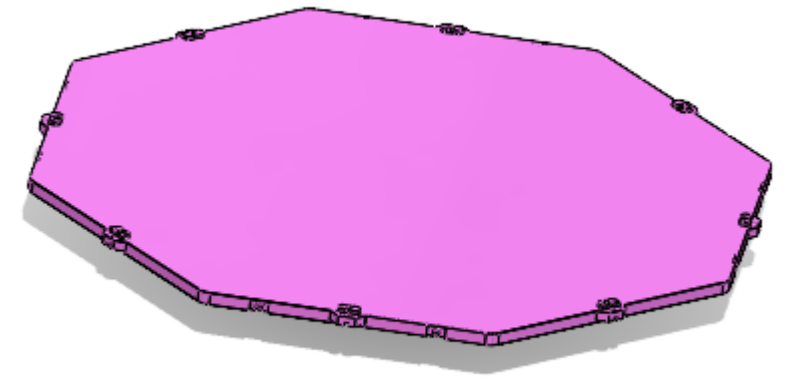
- TOP model from mid-April
- BOP provisionally estimated as identical to TOP

| Total mass (each) | Displaced argon | Net weight |
|-------------------|-----------------|------------|
| 3066.4 kg | 2505 kg | -5.51 kN |



Anode

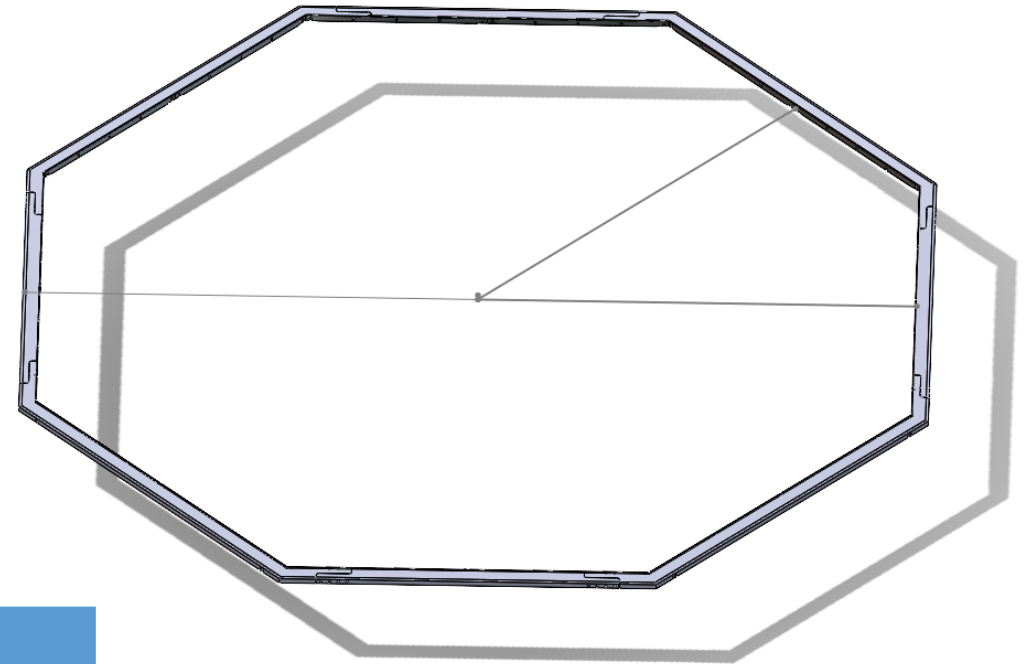
- Budget uses “_R1” version of anode window
- Includes support rod connection but not new lip height



| Total mass | Displaced argon | Net weight |
|------------|-----------------|------------|
| 969.8 kg | 1108 kg | 1.35 kN |

Wire grid frame

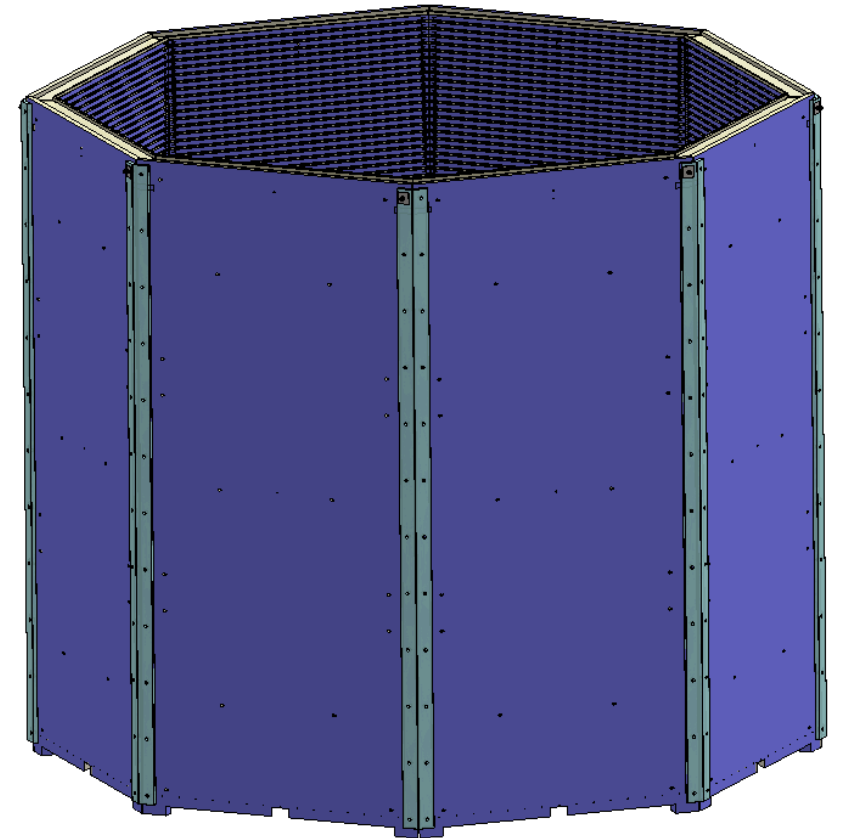
- Updated mid-April before Tristan's model uploaded
- Does not include wires (negligible?)



| Total mass | Displaced argon | Net weight |
|------------|-----------------|------------|
| 138.9 kg | 24.3 kg | -1.12 kN |

Barrel

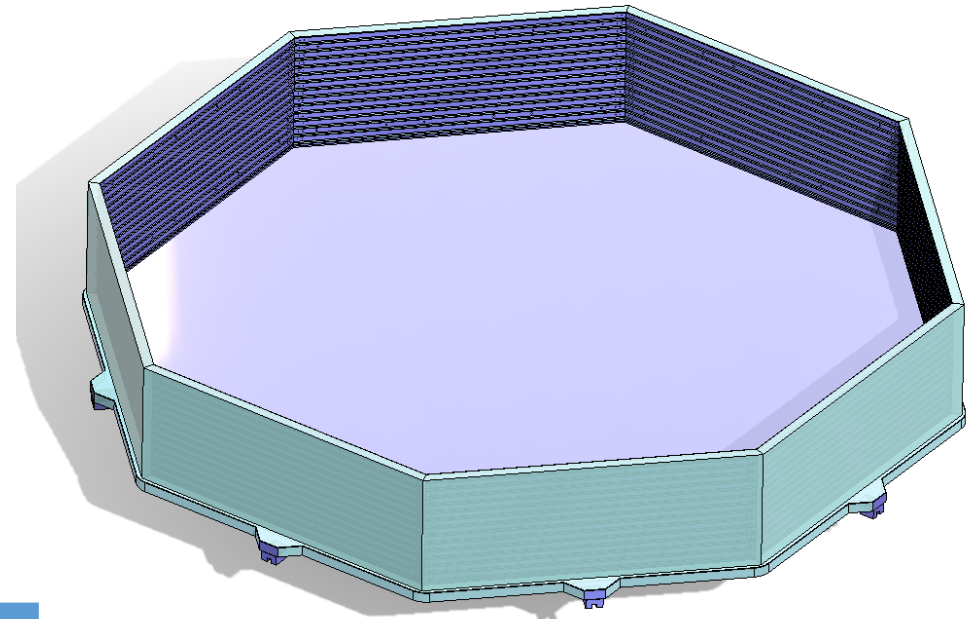
- Includes provisional, conservative external reflector & PDU mounts (panel-sized sheets of ¼" PMMA)



| Total mass | Displaced argon | Net weight |
|------------|-----------------|------------|
| 8111.4 kg | 9106.8 kg | 9.76 |

Cathode

- No changes since September update



| Total mass | Displaced argon | Net weight |
|------------|-----------------|------------|
| 1259 kg | 1438.7 kg | 1.76 kN |

Support rods

- Provisionally expanded to 25 mm diameter
- Otherwise unchanged since September update

| Total mass | Displaced argon | Net weight |
|------------|-----------------|------------|
| 162.7 kg | 31.5 kg | -1.29 kN |



Backup

Calculation method

Mass:

$$m = \rho_{RT} V_{RT}$$

Displaced LAr:

$$V_{cryo} = \left(\frac{\Delta L}{L} \right)^3 V_{RT}$$

- ρ_{RT} is room temperature density as agreed upon in material properties document: <https://darkside-docdb.fnal.gov/cgi-bin/private/ShowDocument?docid=5495>
- V_{RT} is room temperature volume estimated by SW
- $\frac{\Delta L}{L}$ is agreed upon change in linear dimension
- There are some exceptions