A next-generation optical sensor for IceCube-Gen2

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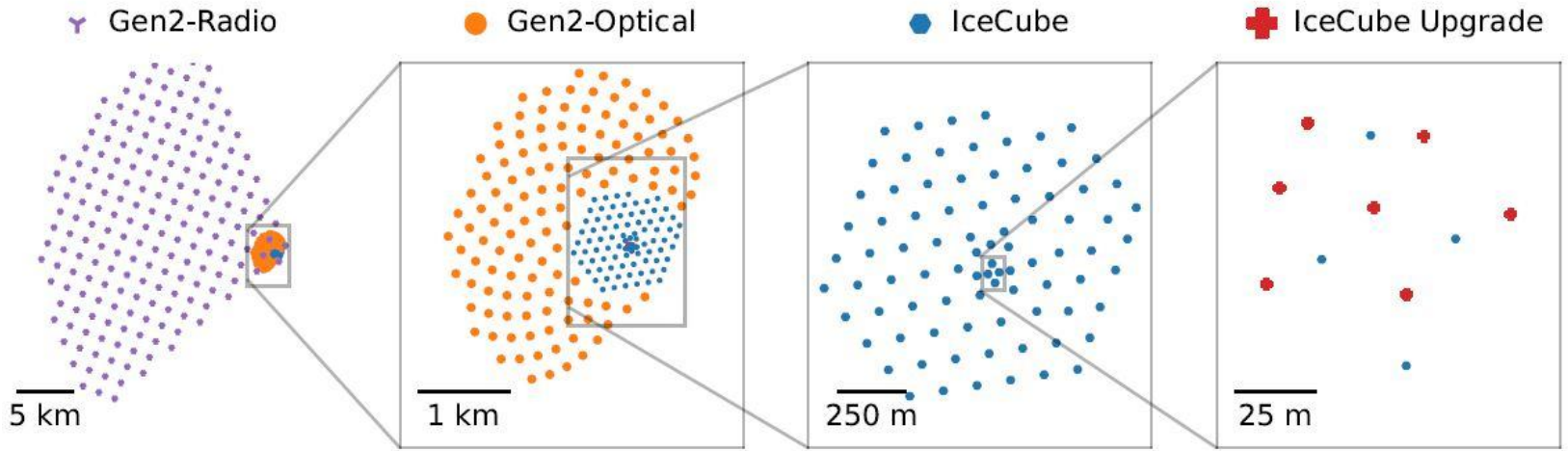
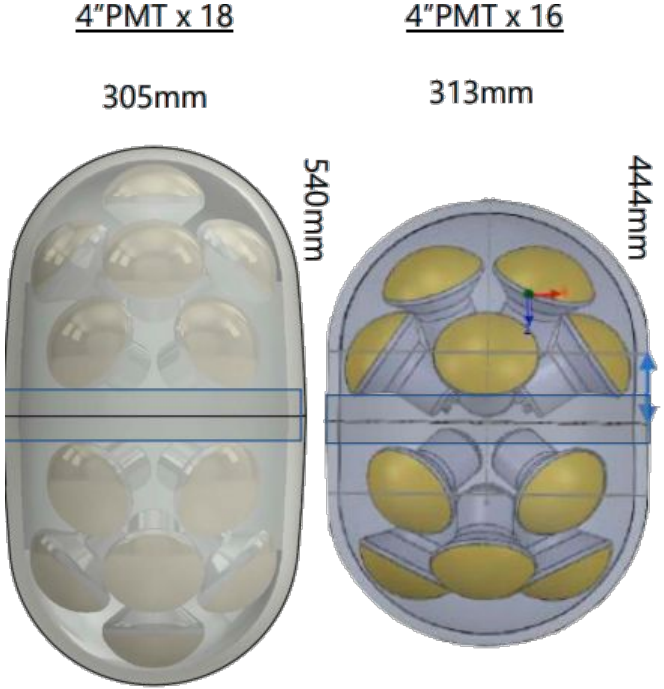
Multi-PMT Optical Module for IceCube-Gen2

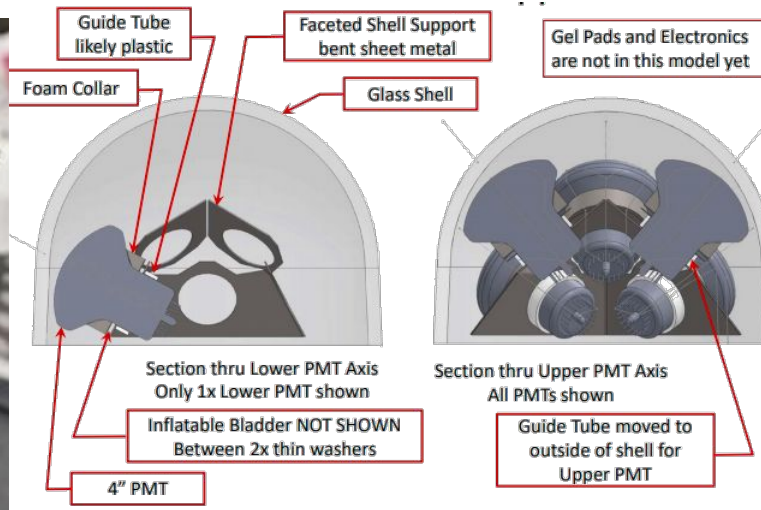
- **Long Optical Module** (LOM): evolution of modules used in IceCube Upgrade (deployment planned for 2023-24)
- **Goals** of design optimization:
  - Reduced sensor diameter to save time and cost on hole-drilling
  - Increased sensor effective area using larger PMTs to reduce channel count
  - Improved electronics for reduced power and easier assembly, manufacture, and testing
- **Near term plan:**
  - Build 20 Modules, deploy 12 for the Upgrade
  - Develop preliminary design for Gen2, which will have over 10k modules across 120 strings



LOM Mechanical Design

- Support structure orients the PMTs while absorbing stresses
- Pre-cured optical gel ‘pads’ used to interface PMTs to glass pressure vessel
- Support structure designed to aid bubble-free PMT-vessel interface

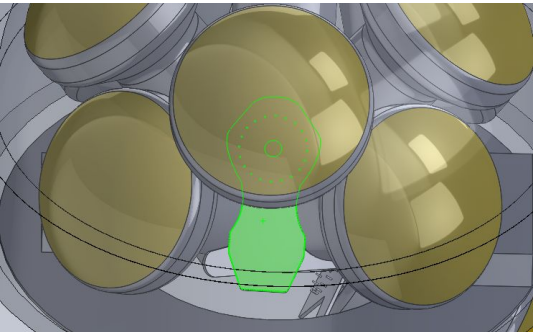


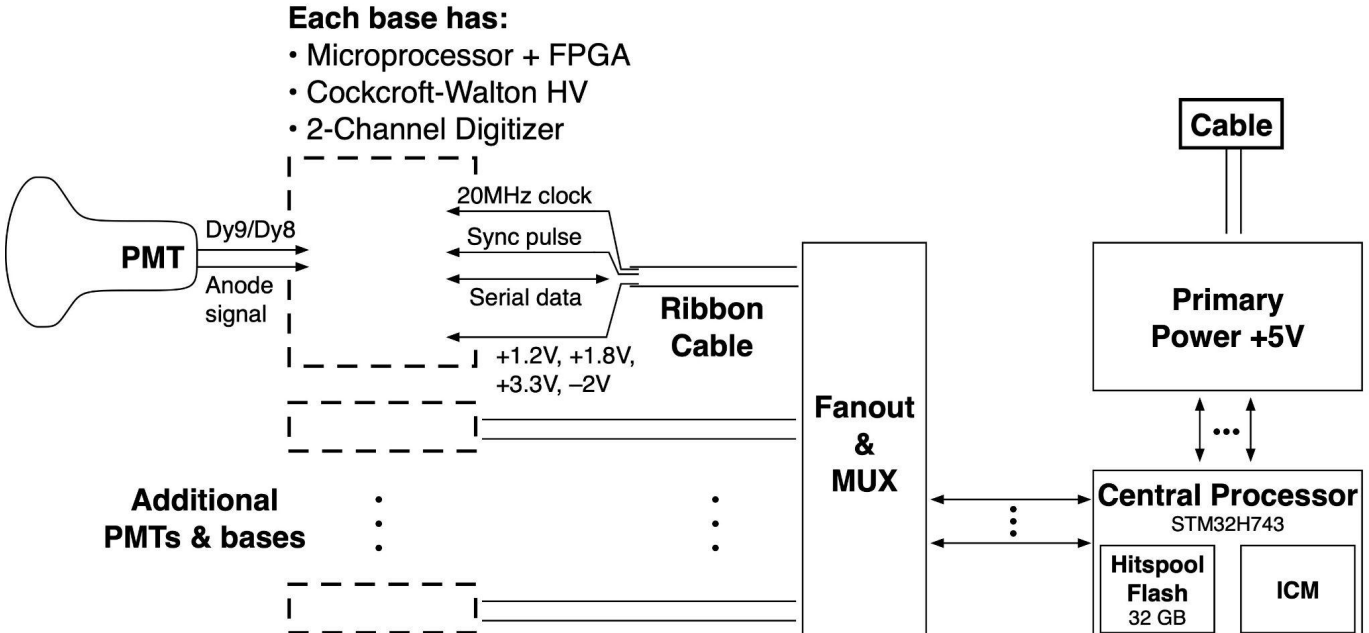


LOM Electronics Design

- Waveform processing and bias circuits moved to PMT base
- A fanout carries communication, synchronization clocks, and power to PMT bases from the Central Board, which is also responsible for transmission to the surface.
- Dynamic Range extended by digitizing both anode and dynode 8
- Flash memory chip retains all hit data for a week.

PMT bases shaped to fit in spaces between PMTs





Outlook

- Various design constraints to be considered and optimized in the LOM are illustrated here, and possible solutions are discussed

- Guiding principle is to arrive at a solution that is economical, fault-tolerant and easily scalable for mass production.

- Design and testing of various subsystems underway, and the first prototypes are expected to be completed soon.