



Pacific Ocean Neutrino Experiment

Status and outlook

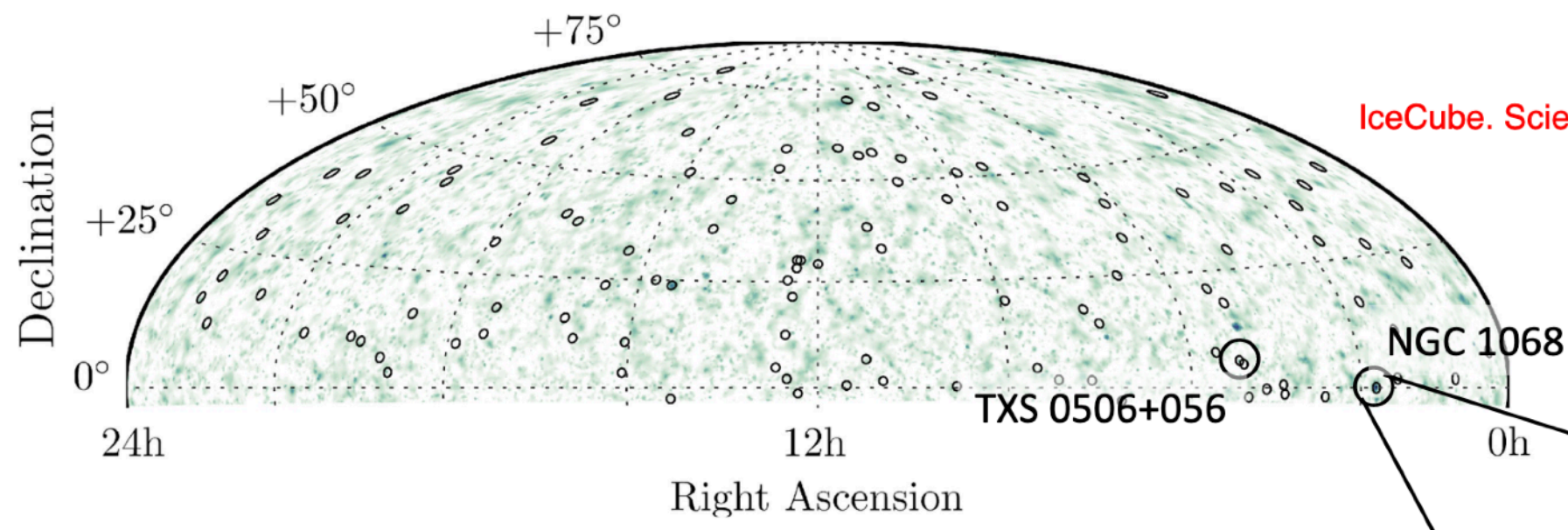
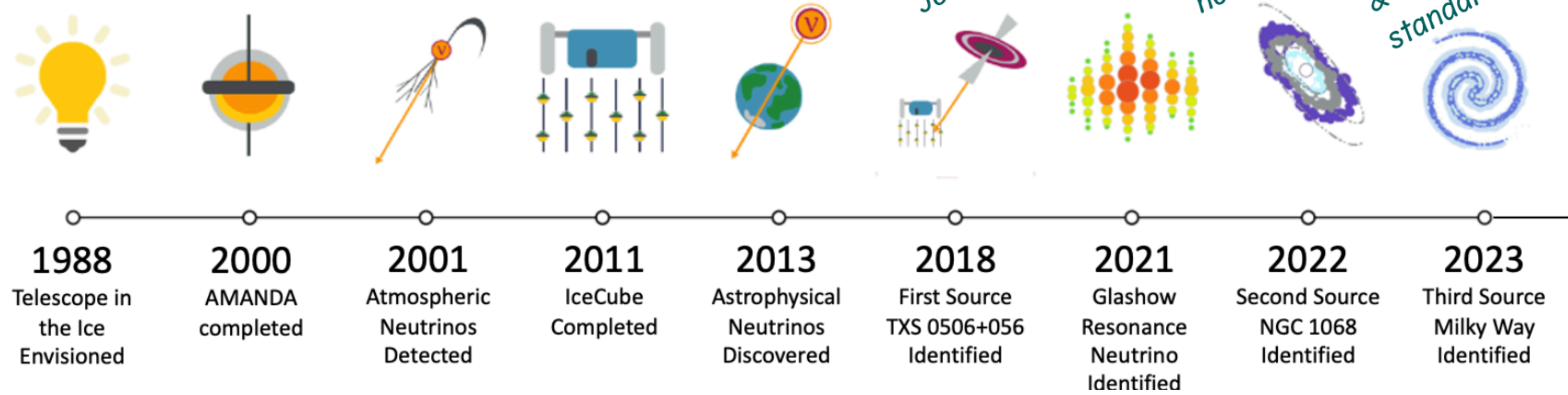


SIMON FRASER
UNIVERSITY



Science of large-scale neutrino observatories

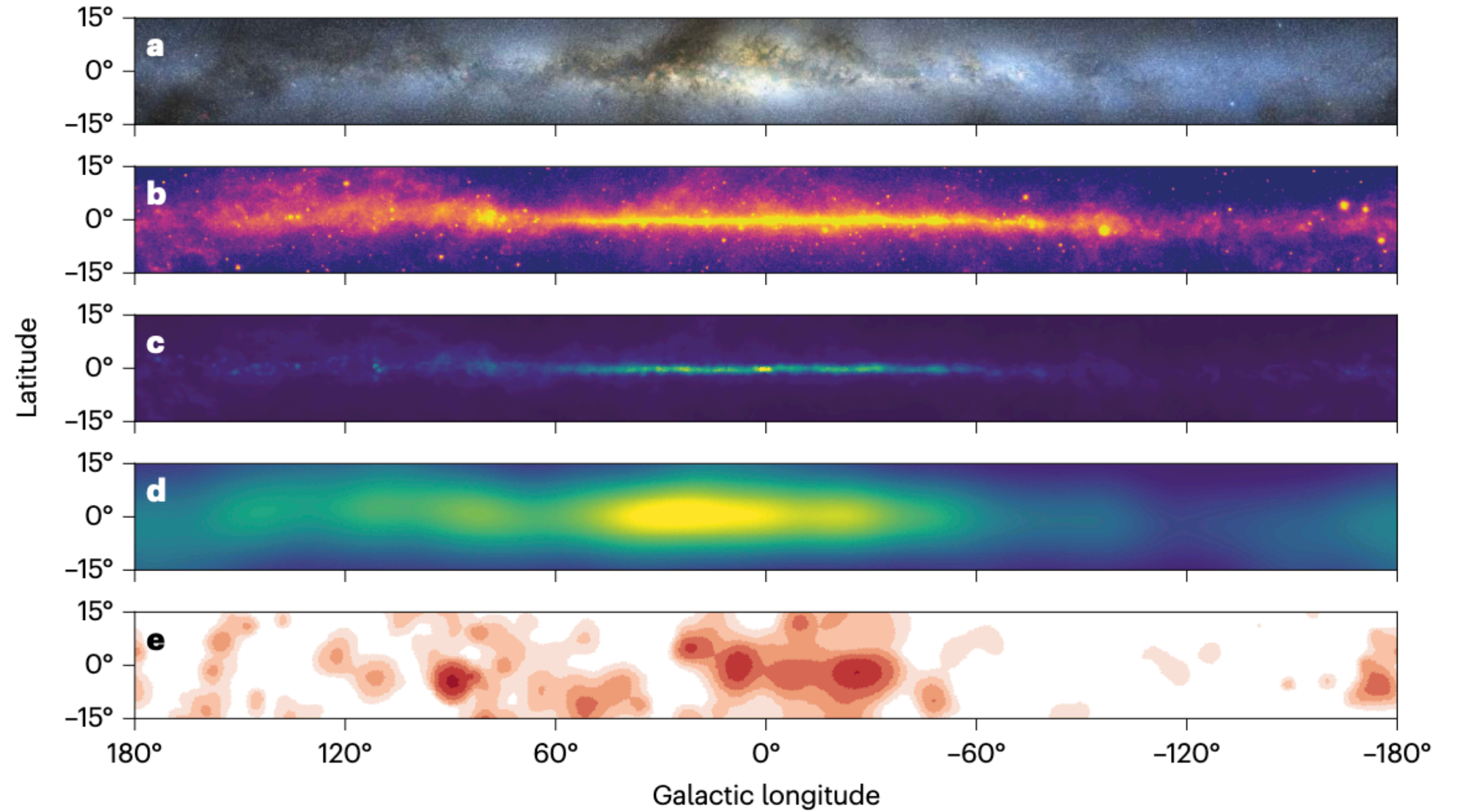
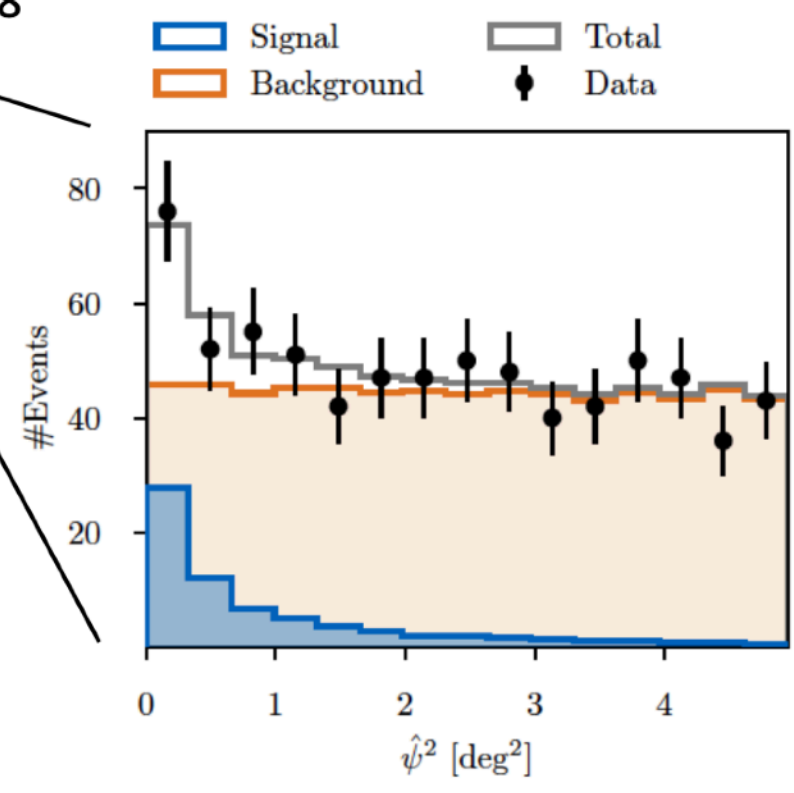
Astrophysical high-energy neutrino flux



IceCube. Science (2022)

Improved data processing
 At the location of NGC 1068:
 79^{+22}_{-20} neutrinos
 Spectral index: -3.2 ± 0.2

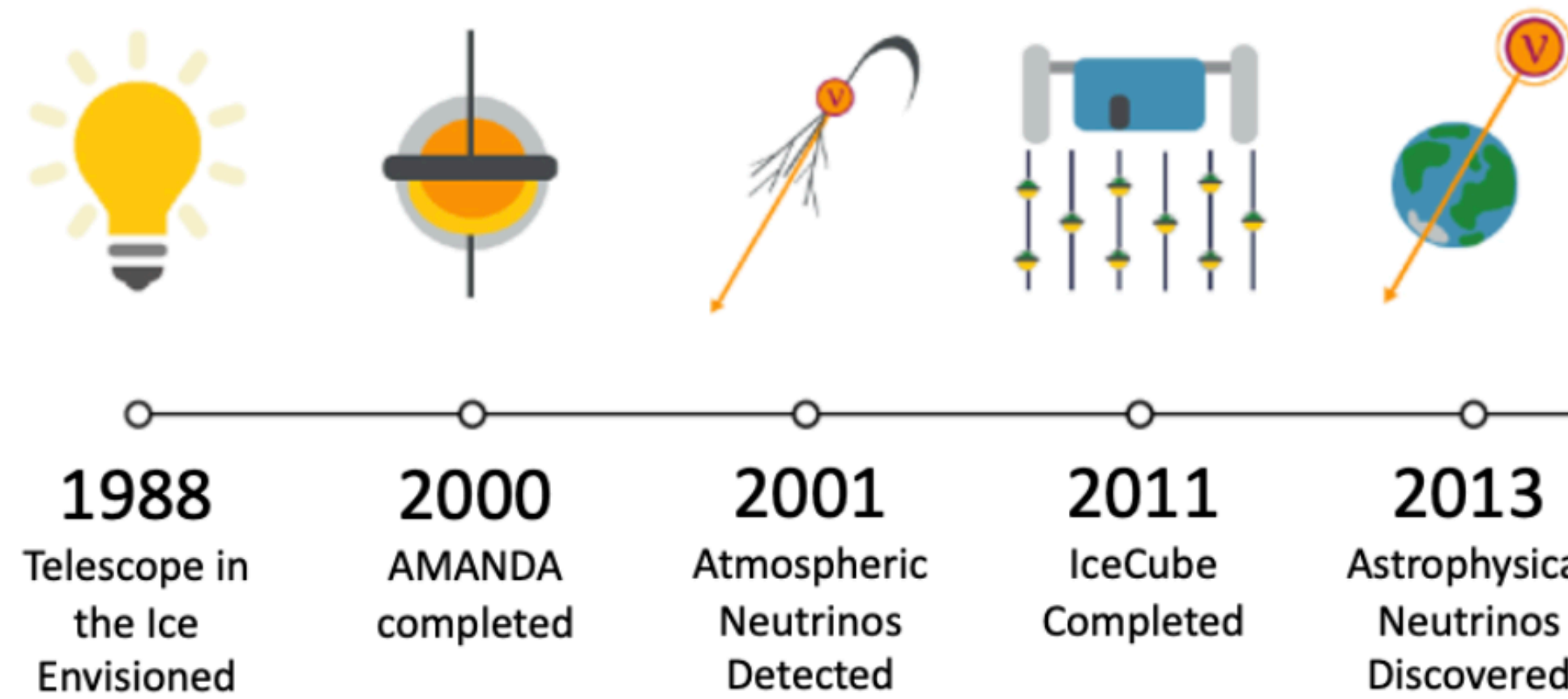
Post-trial significance 4.2σ



Atmospheric neutrino program ... see Neutrino/Dark Matter Symposium day

Science of large-scale neutrino observatories

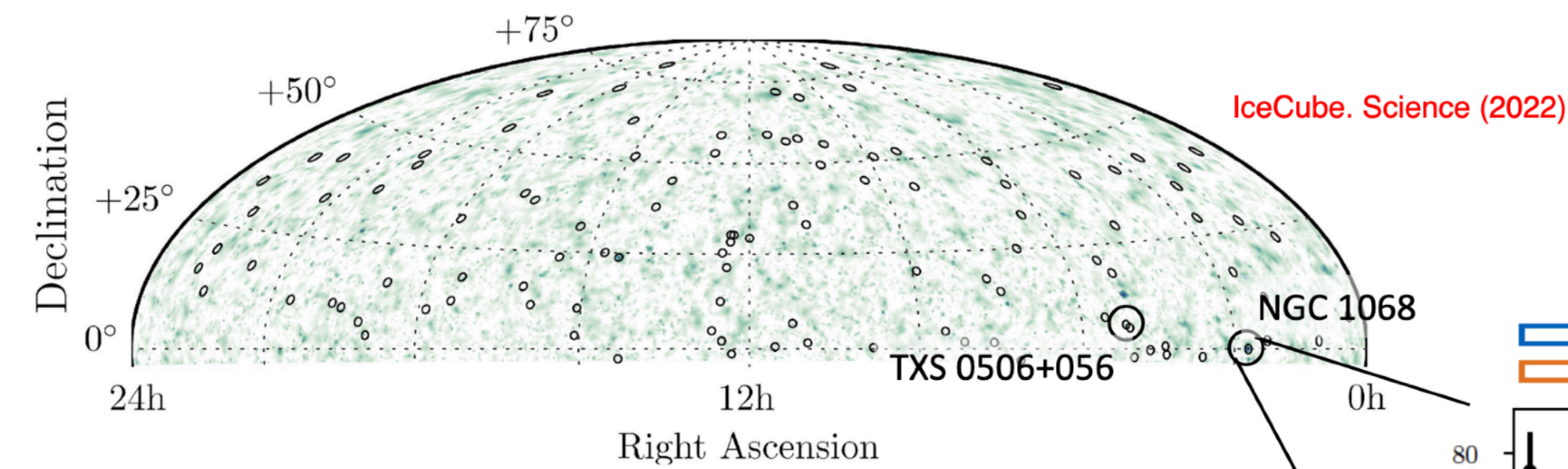
Astrophysical high-energy neutrino flux



Recipe:

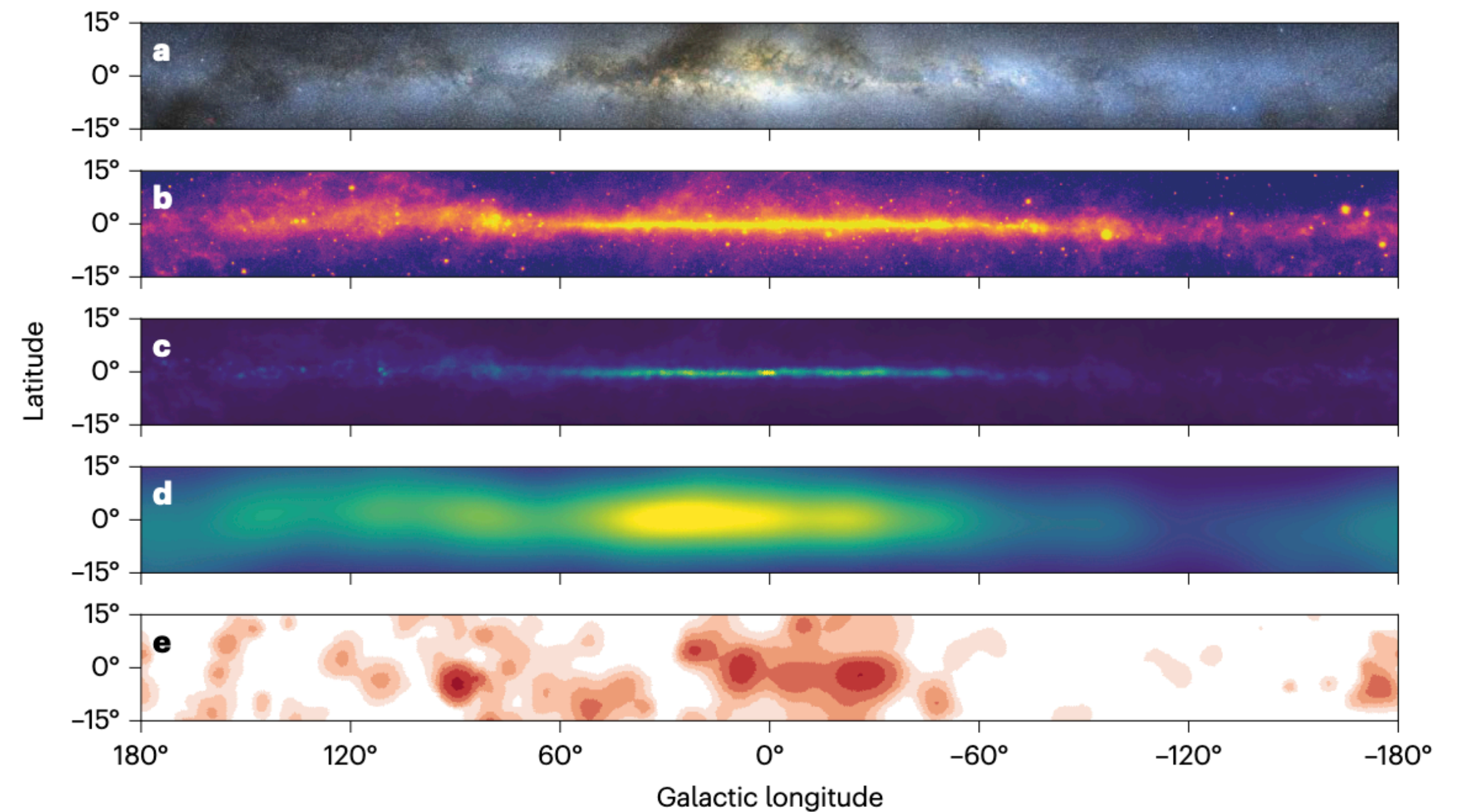
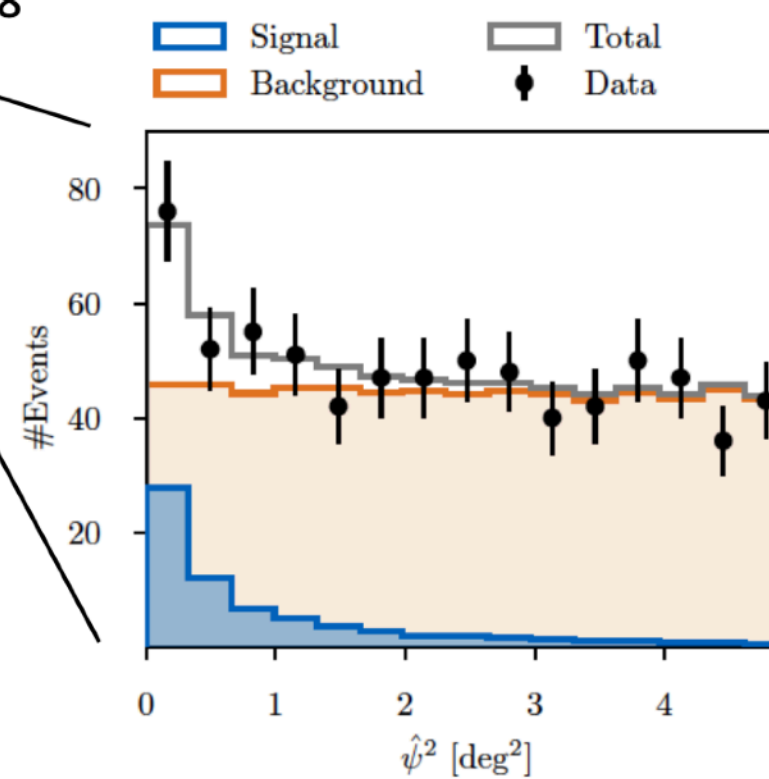
- Deep optically clear, stable natural Cherenkov medium
- High-energy flux requires $O(\text{cubic-km})$ instrumented volume

First Source Identified	Glashow Resonance Neutrino Identified	Second Source Identified	Third Source Identified
TXS 0506+056	Resonance Neutrino	NGC 1068	Milky Way



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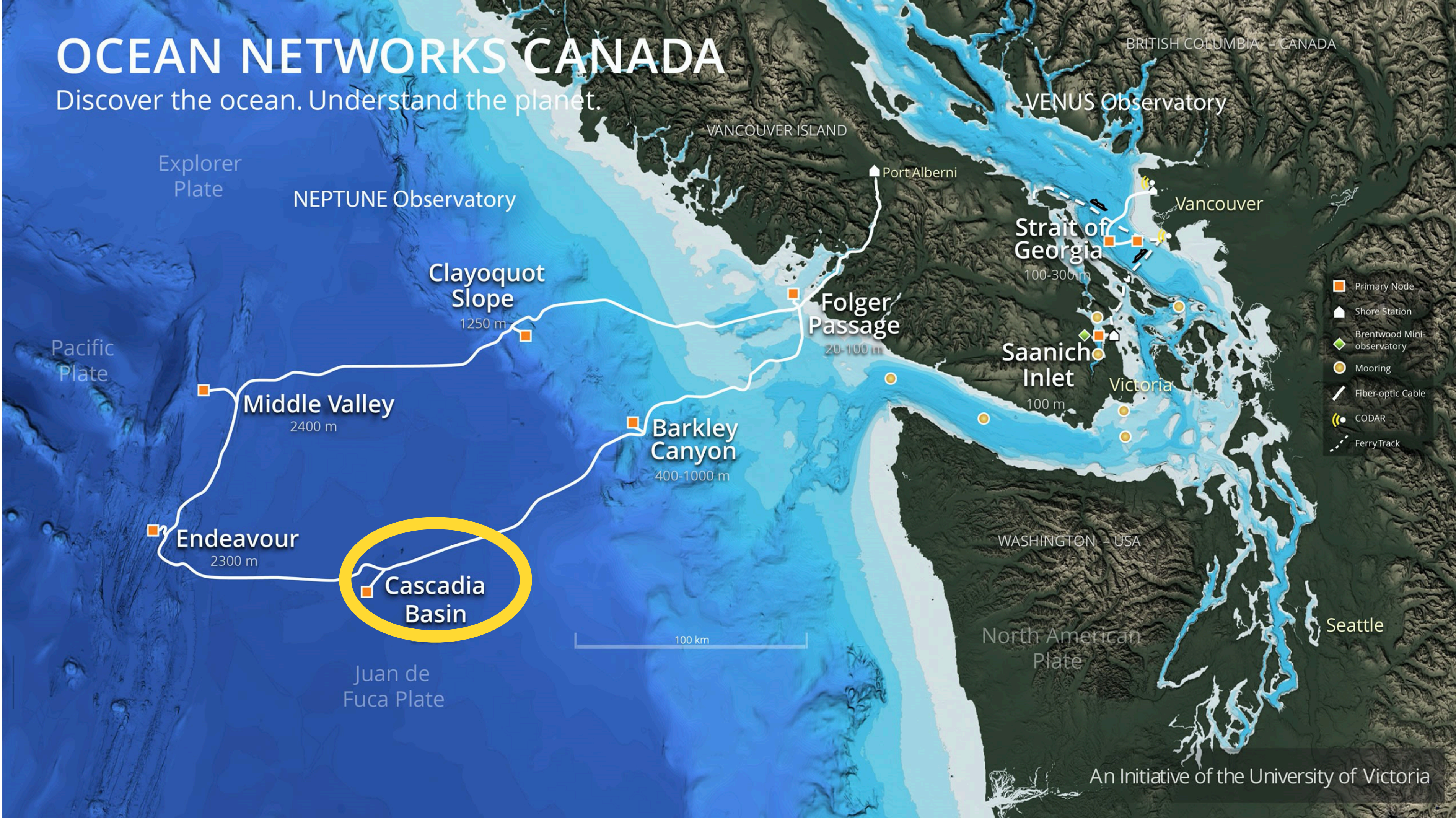
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Leveraging Canada's investments in deep ocean science for particle astrophysics

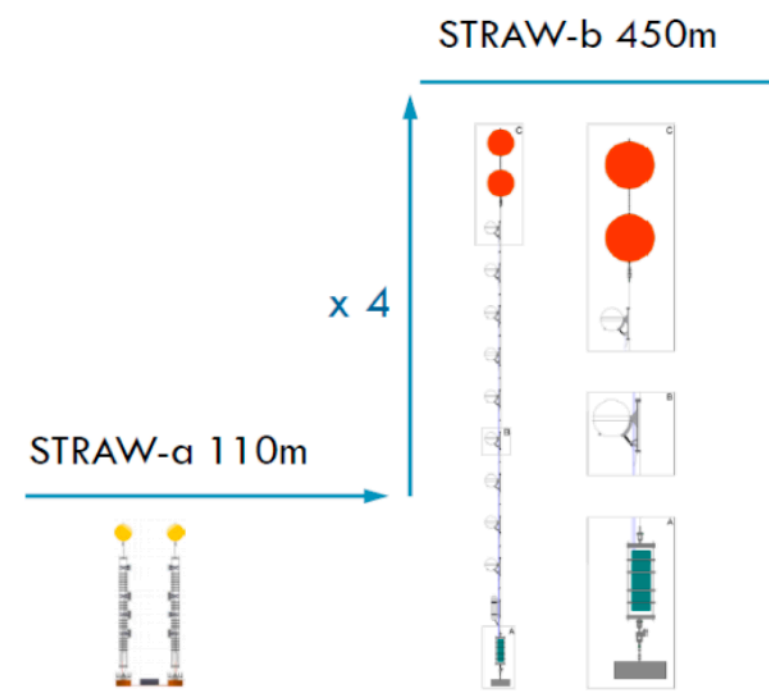


Leveraging Canada's investments in deep ocean science for particle astrophysics

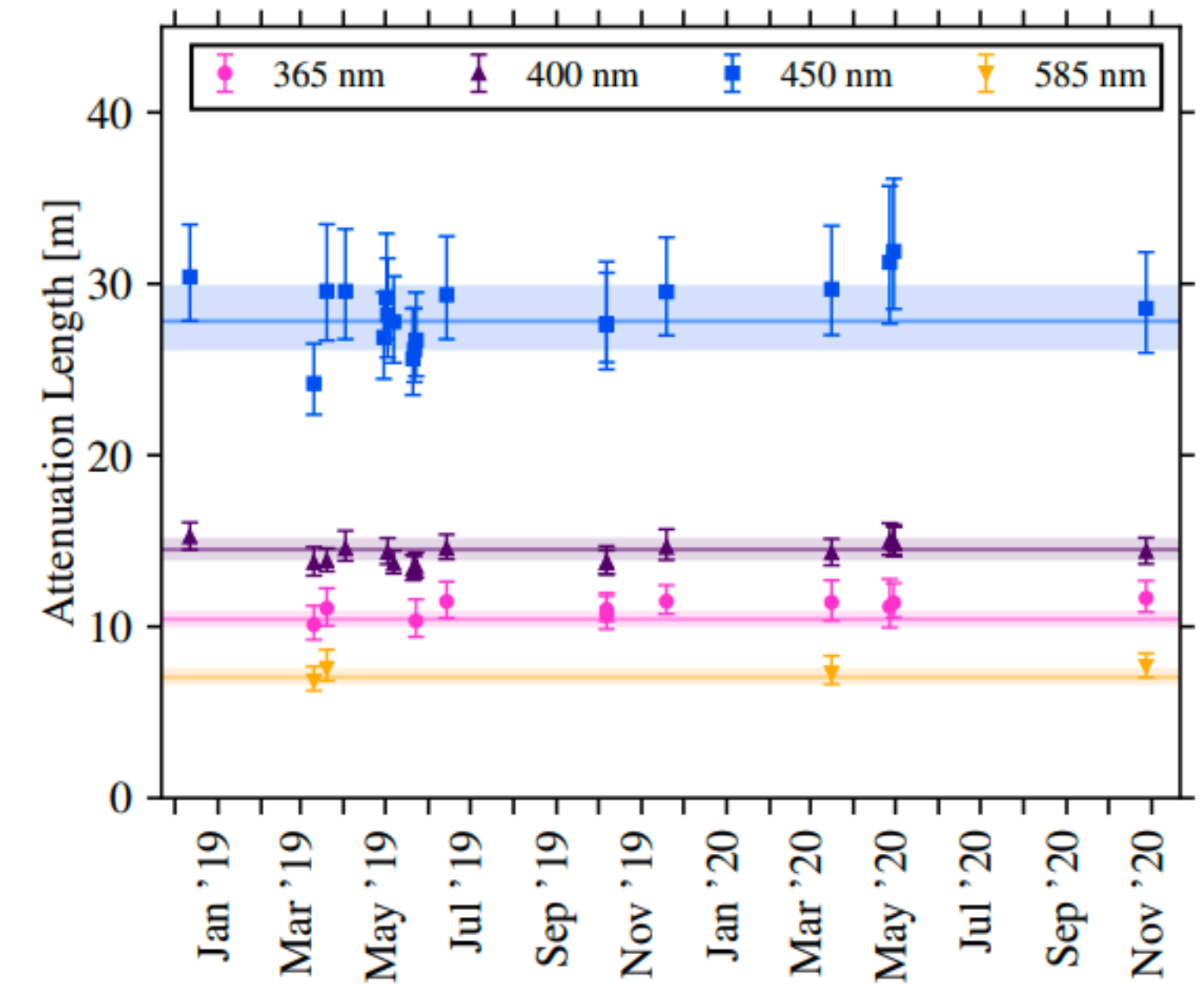
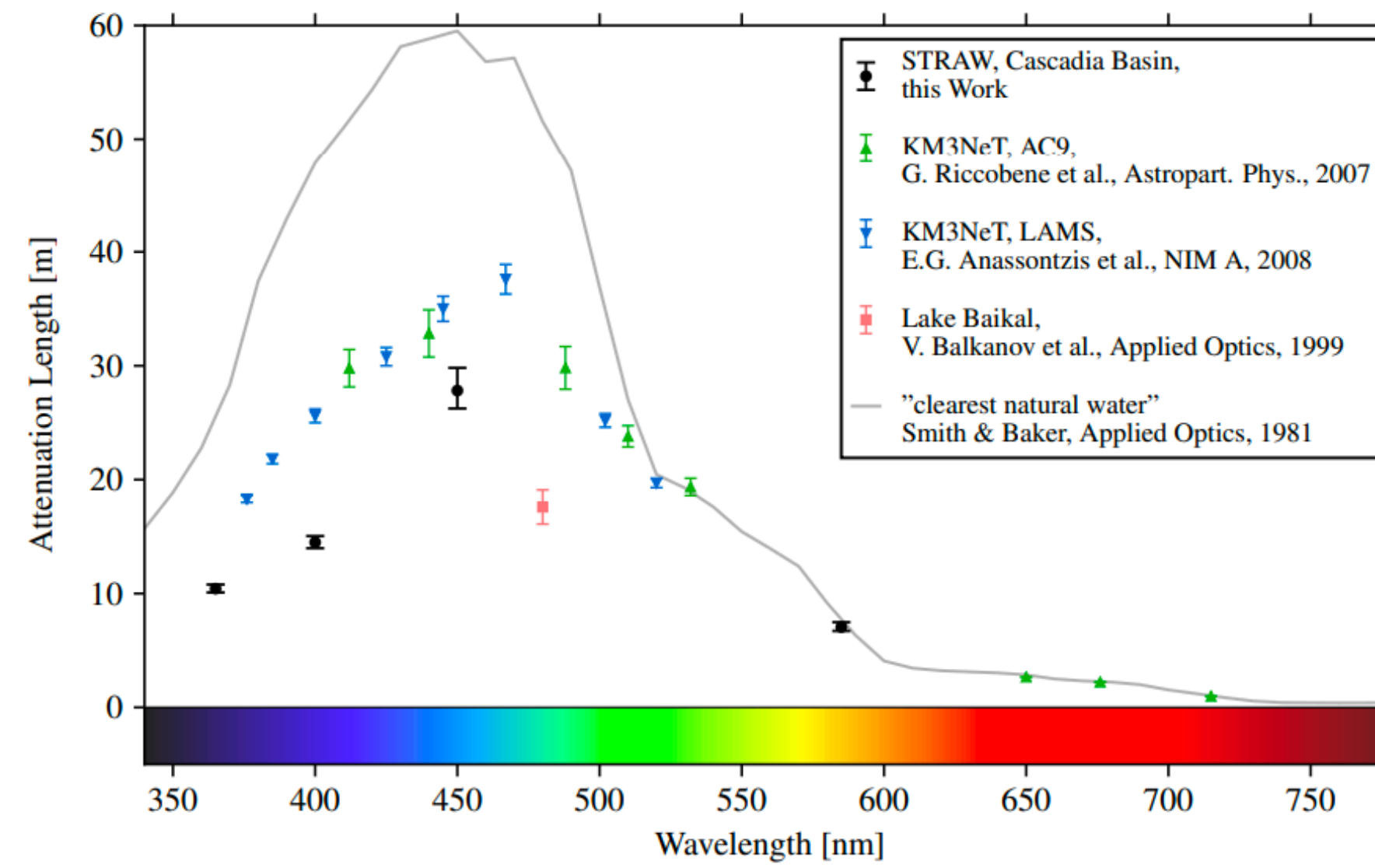
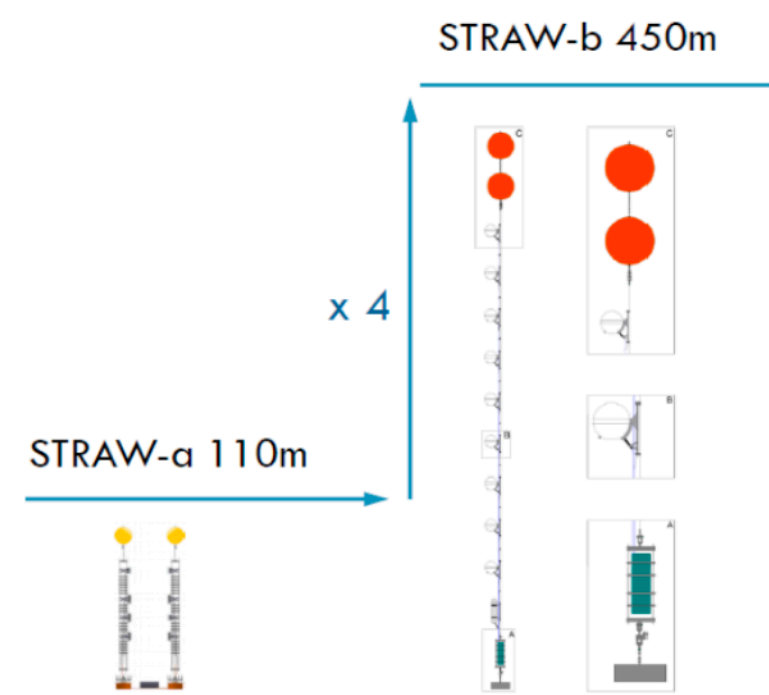


- Neptune observatory instruments the Cascadia basin (2600m depth abyssal plane) with power and communications. Near constant temperature 2C year-round; currents ~0.1m/s

Pacific Ocean Neutrino Experiment (P-ONE) - Pathfinder



Pathfinder
Phase 1 (2018 – 2023)



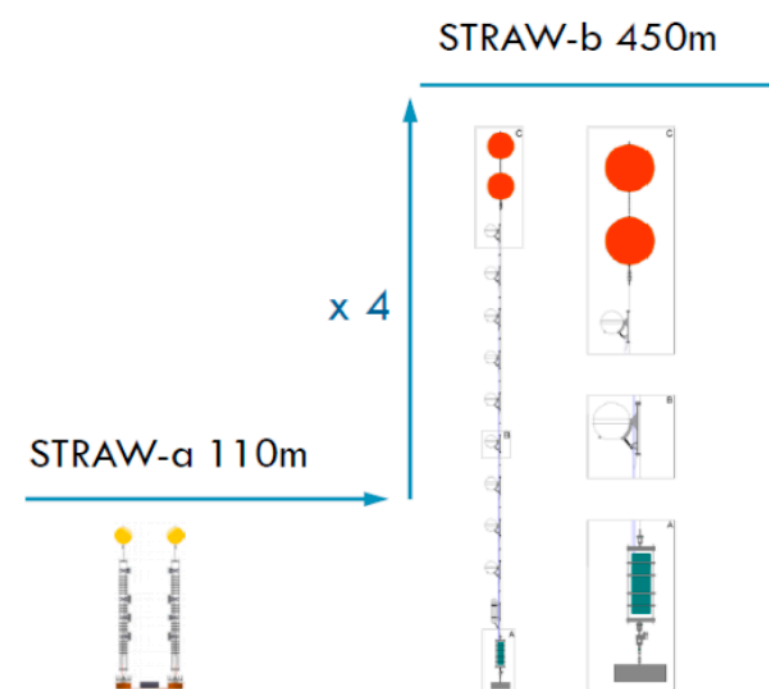
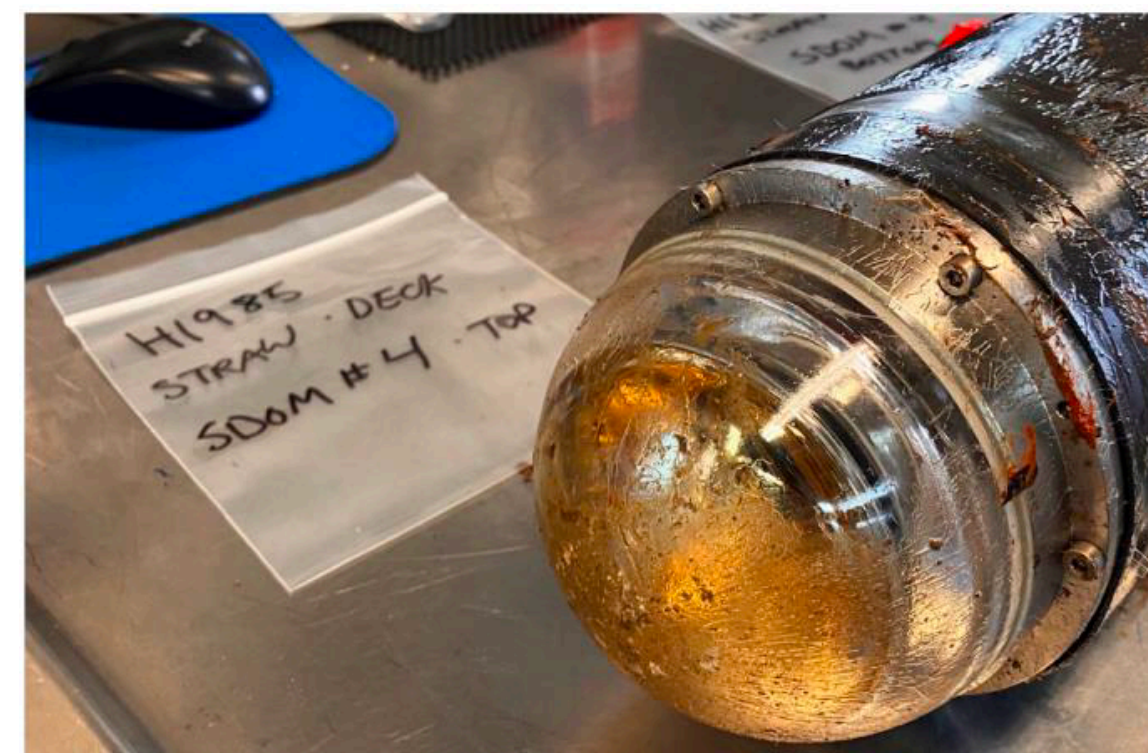
Pathfinder

Phase 1 (2018 – 2025)

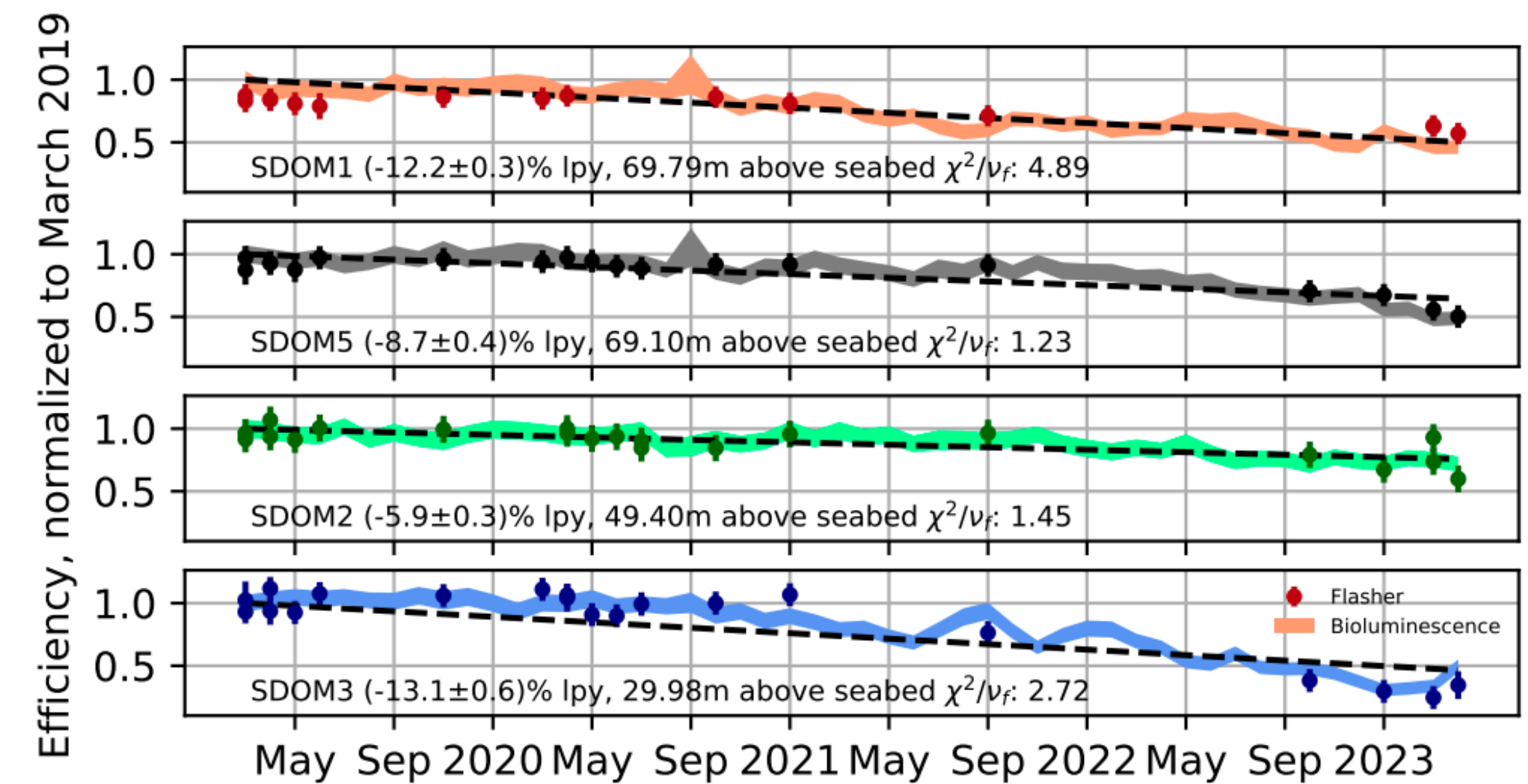
- Measured attenuation after 2 years of monitoring = 27.7–1.3/+1.9m at 450nm
- Stable over the period of data collection
- Compatible with measurements at Mediterranean sites

Pacific Ocean Neutrino Experiment (P-ONE) - Pathfinder

- Summer 2023 recovery of both strings
 - Dive inspection revealed some level of sedimentation and biological growth
 - Analysis of data reveals decreasing transparency for the modules as function of time
 - Mitigation studies underway

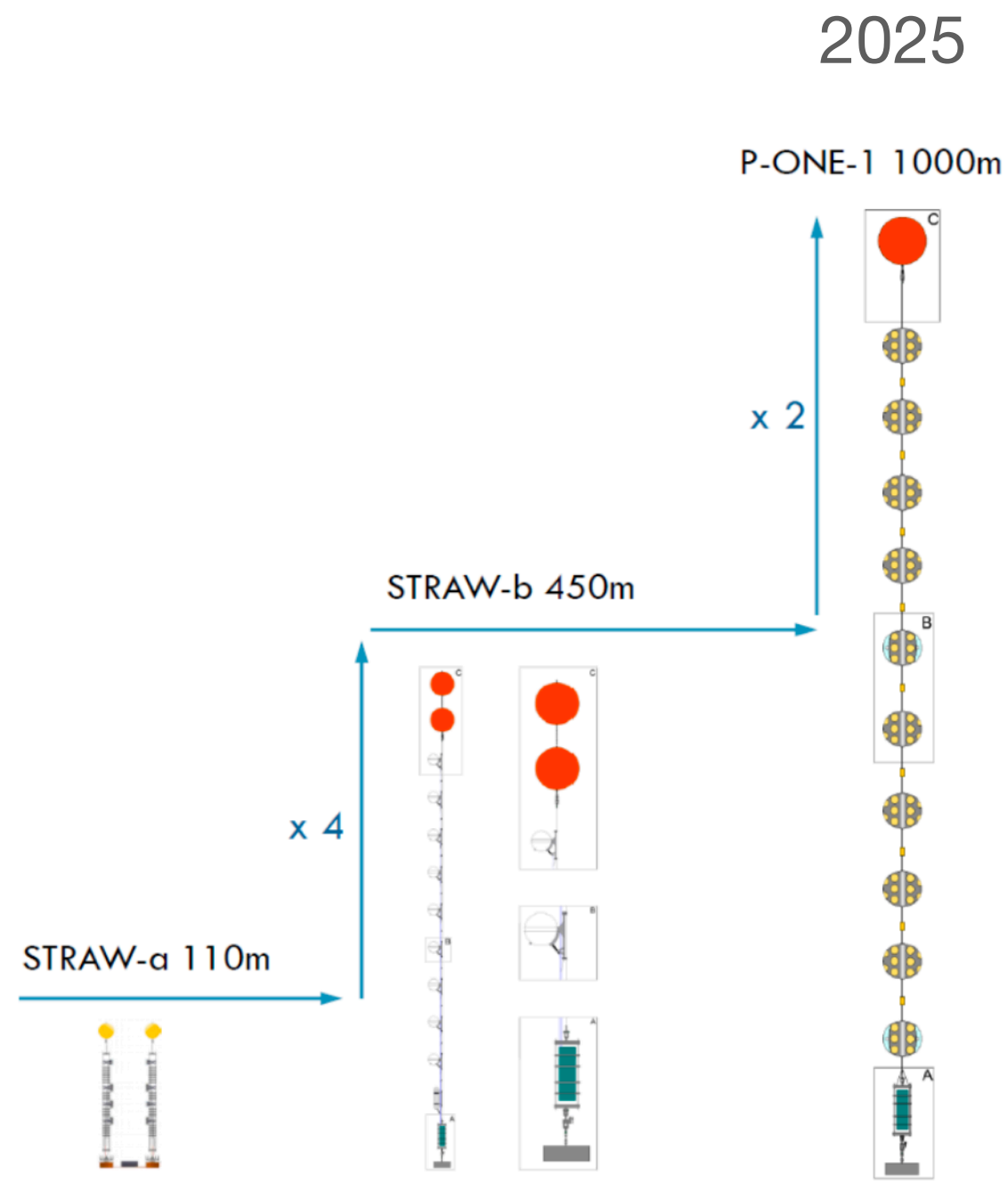
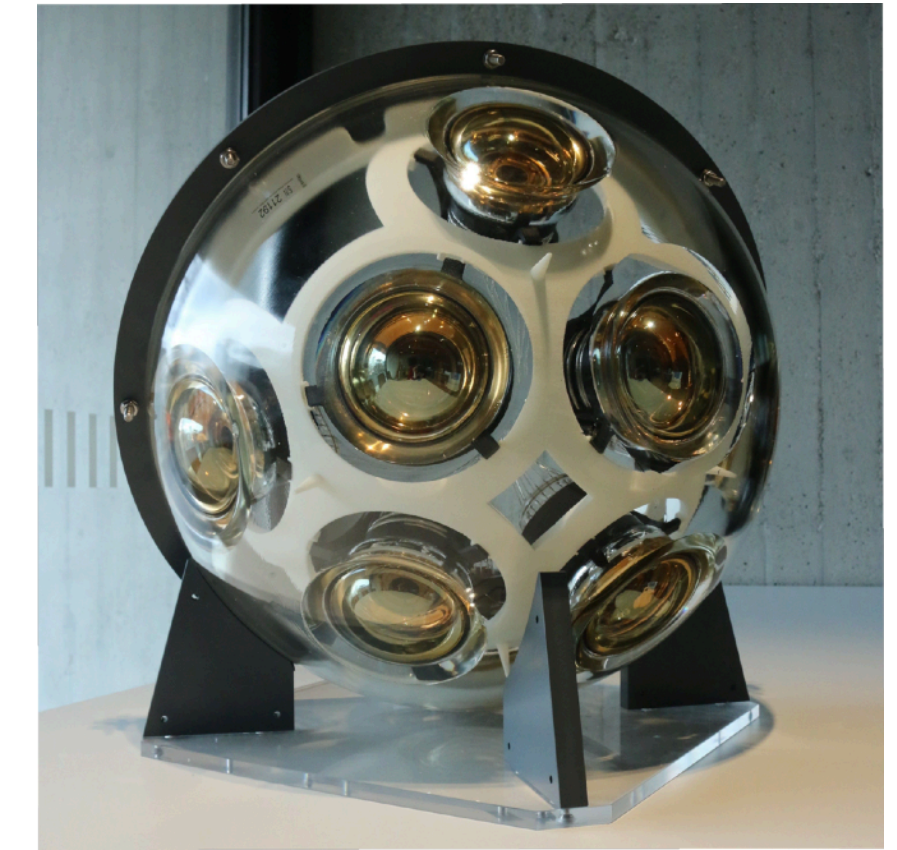
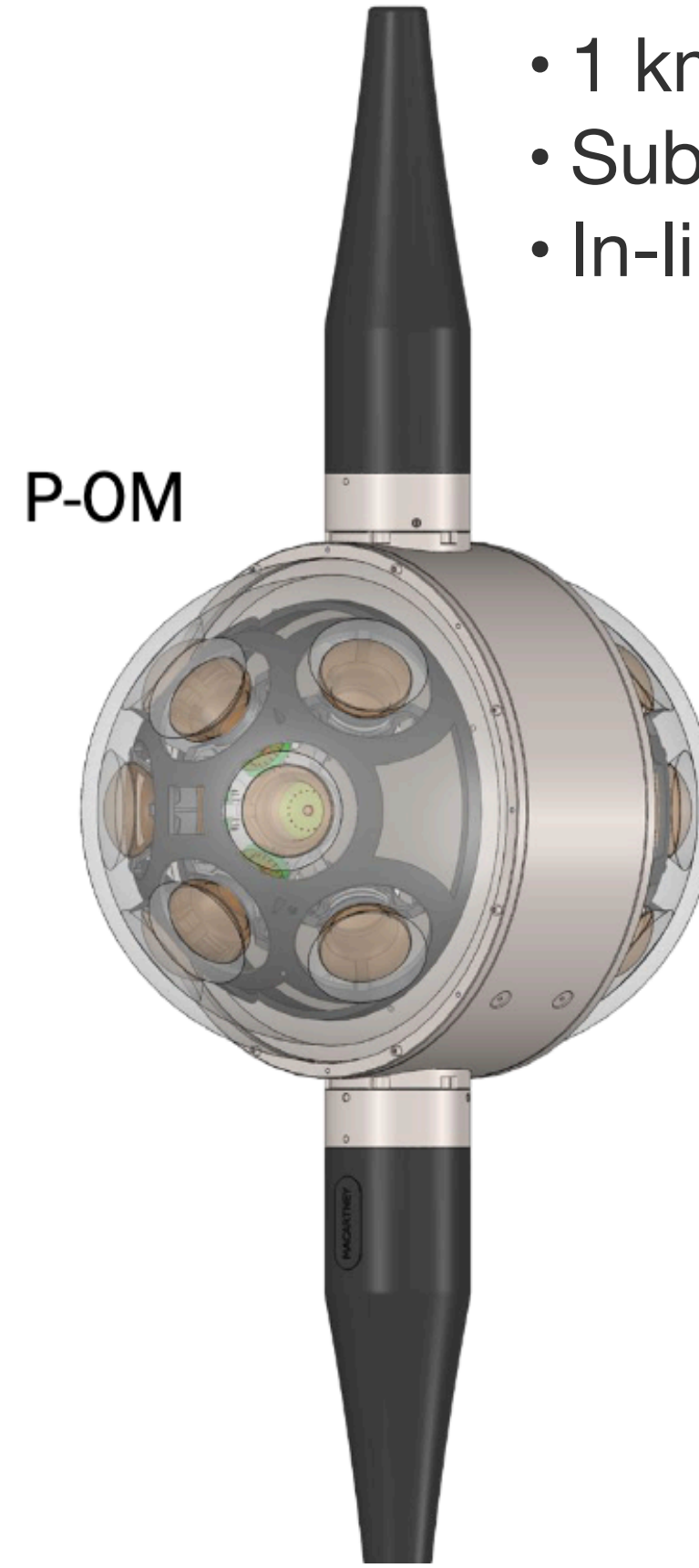


PoS (ICRC 2023) 1166



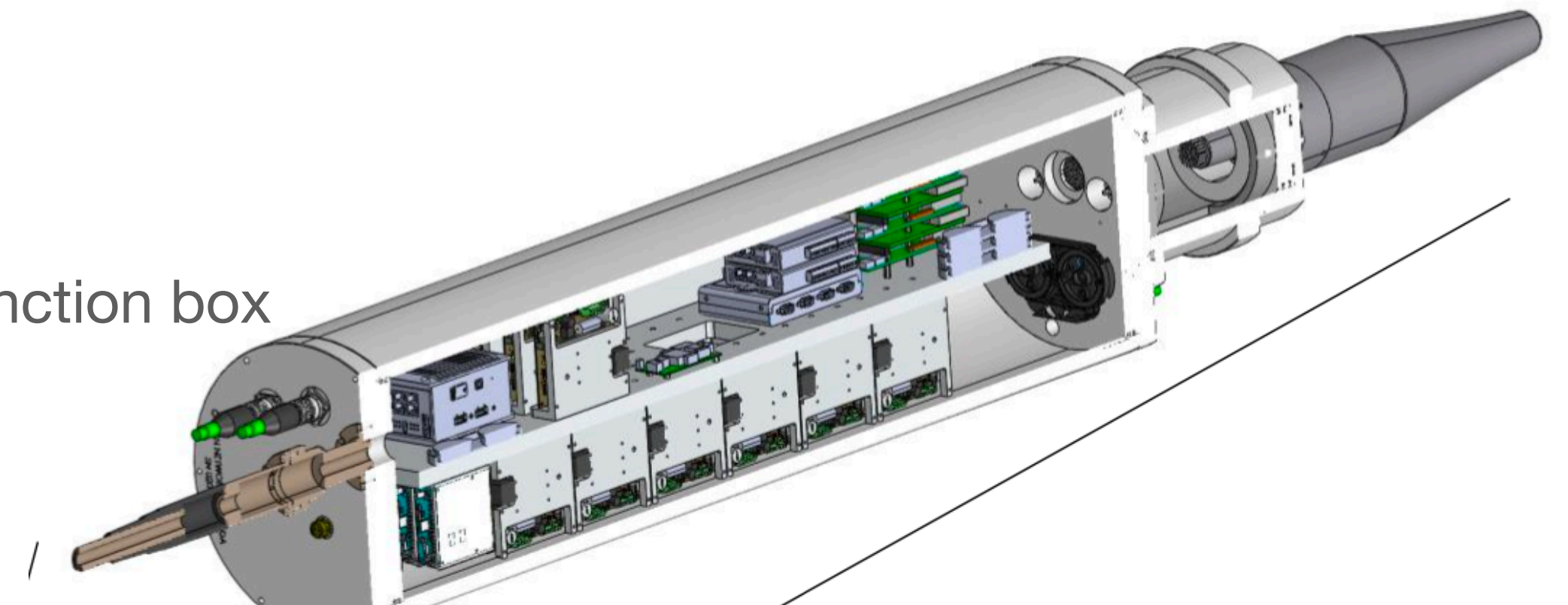
Pathfinder
Phase 1 (2018 – 2025)

- 1 km mooring line with 20 modules employing a connector-less design
- Sub-ns synchronization
- In-line network infrastructure



Pathfinder
Phase 1 (2018 – 2023)

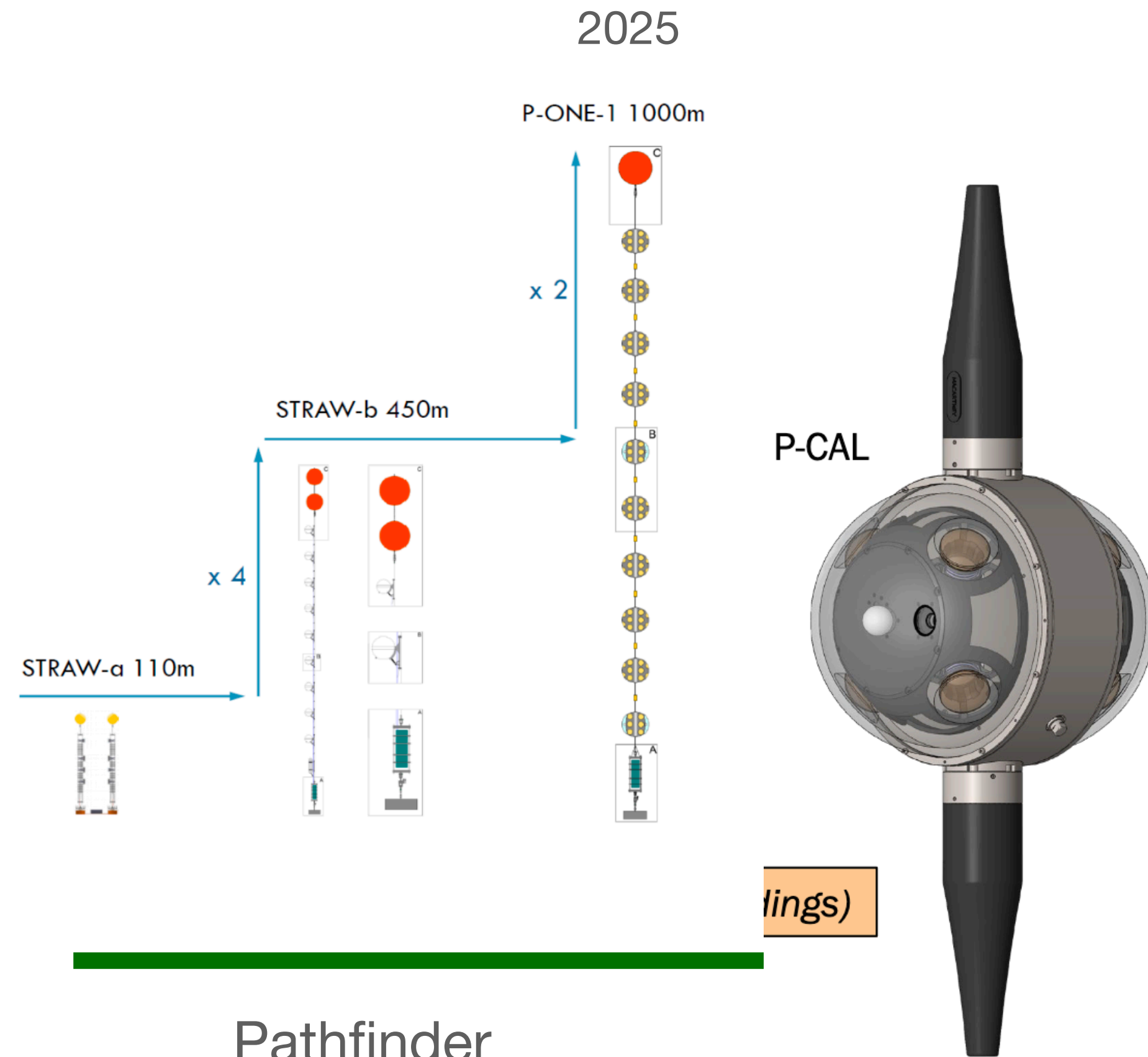
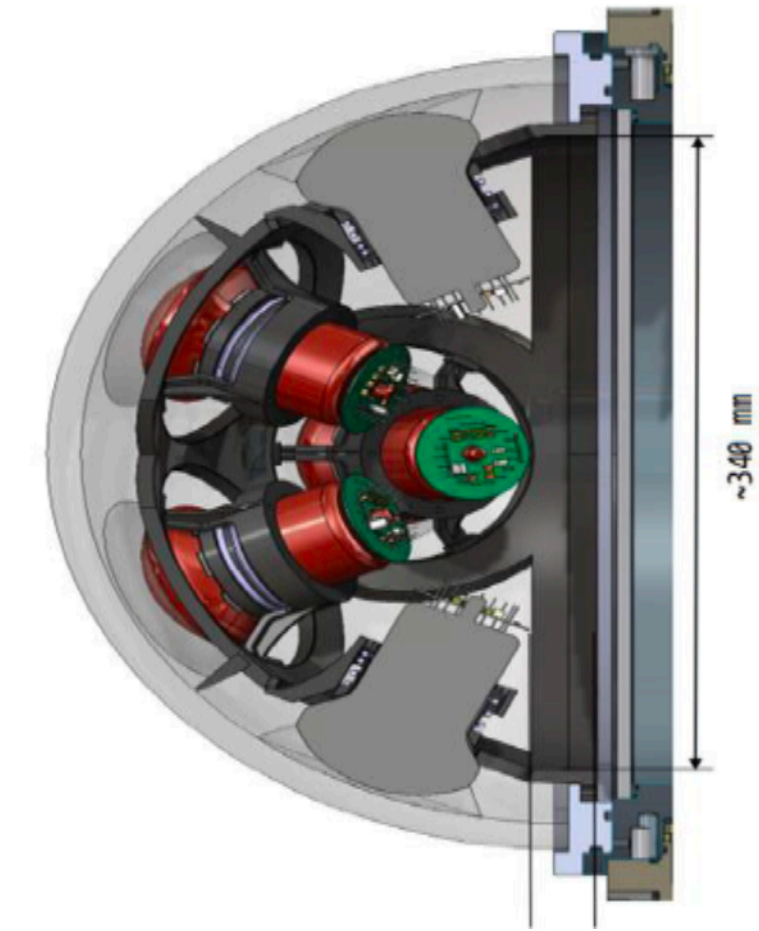
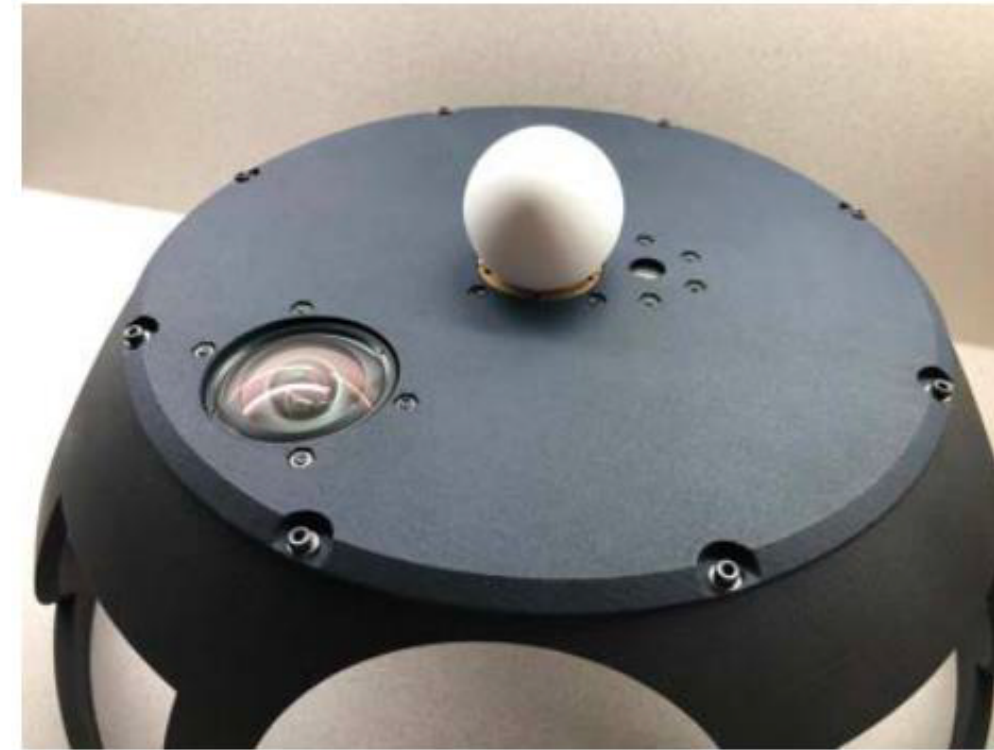
String junction box



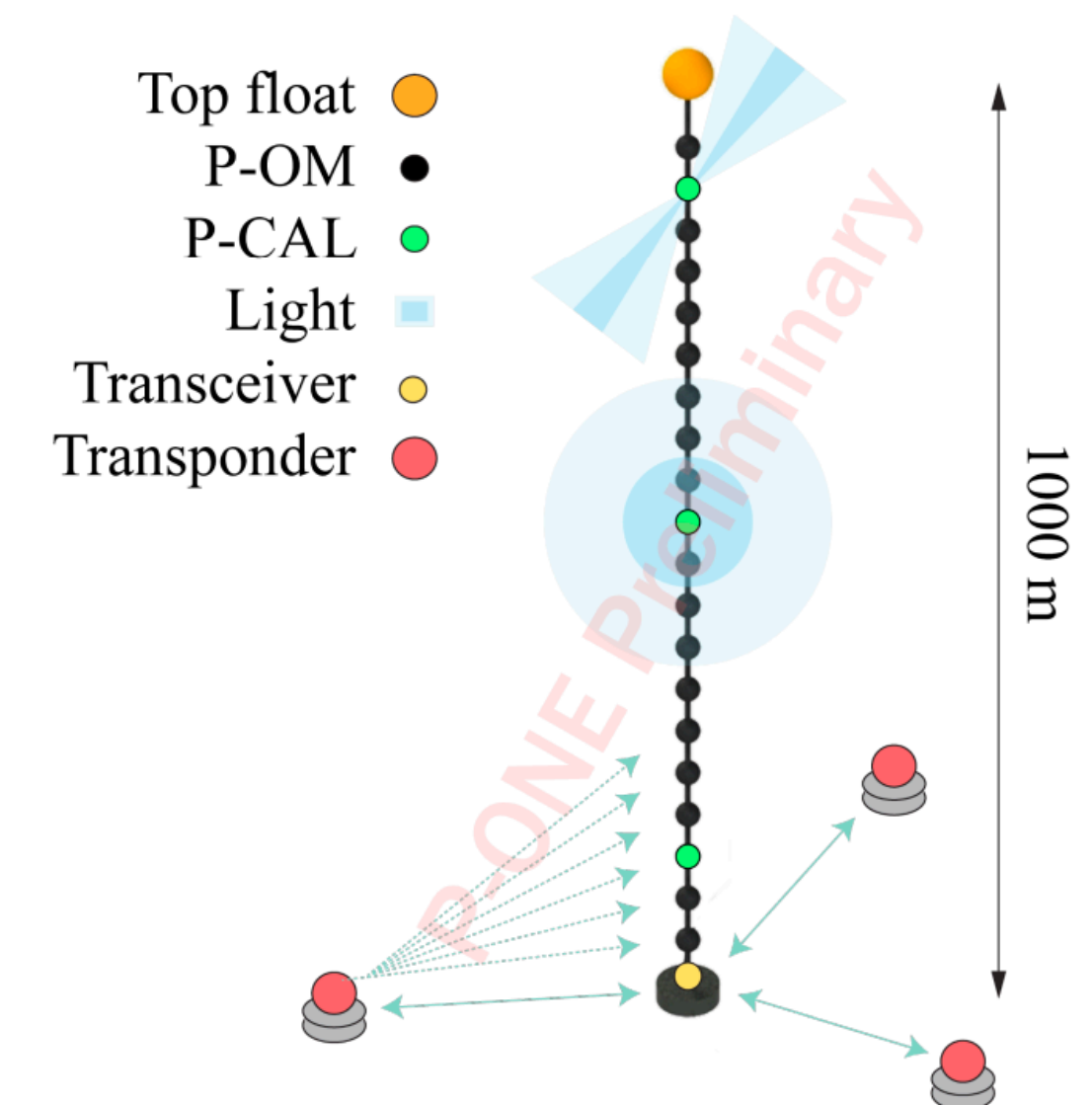
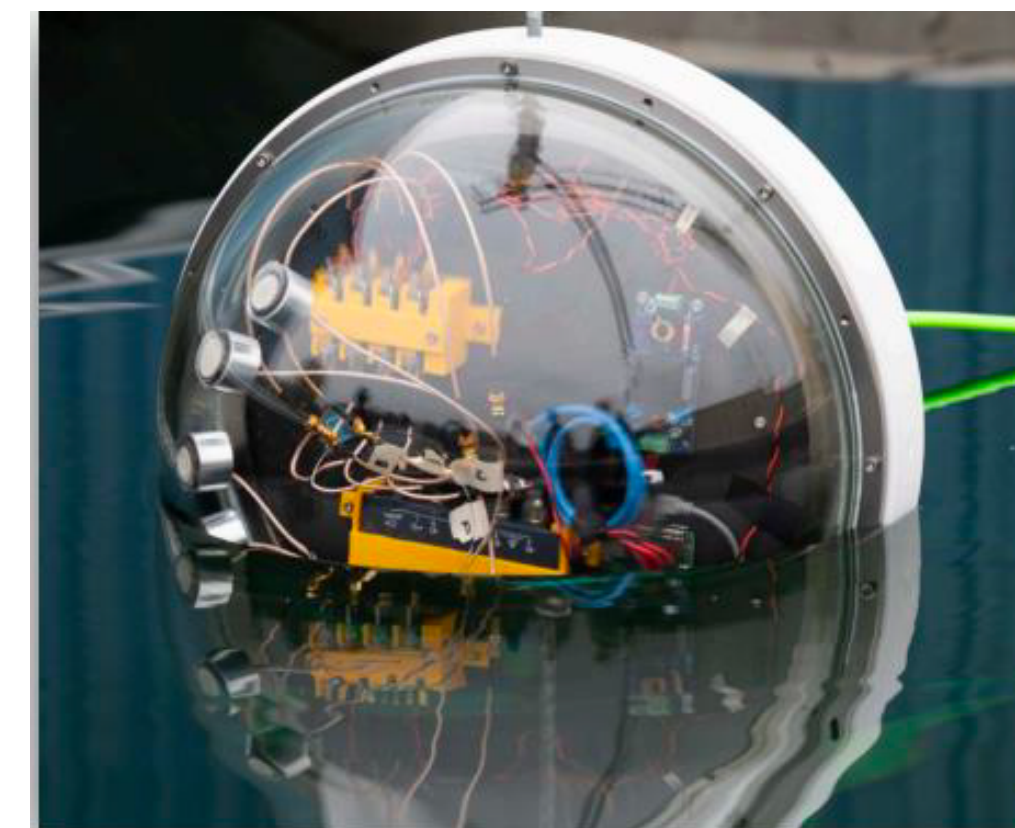
Calibration program

Muon scintillation tracker

P-CAL optical diffusing sphere*



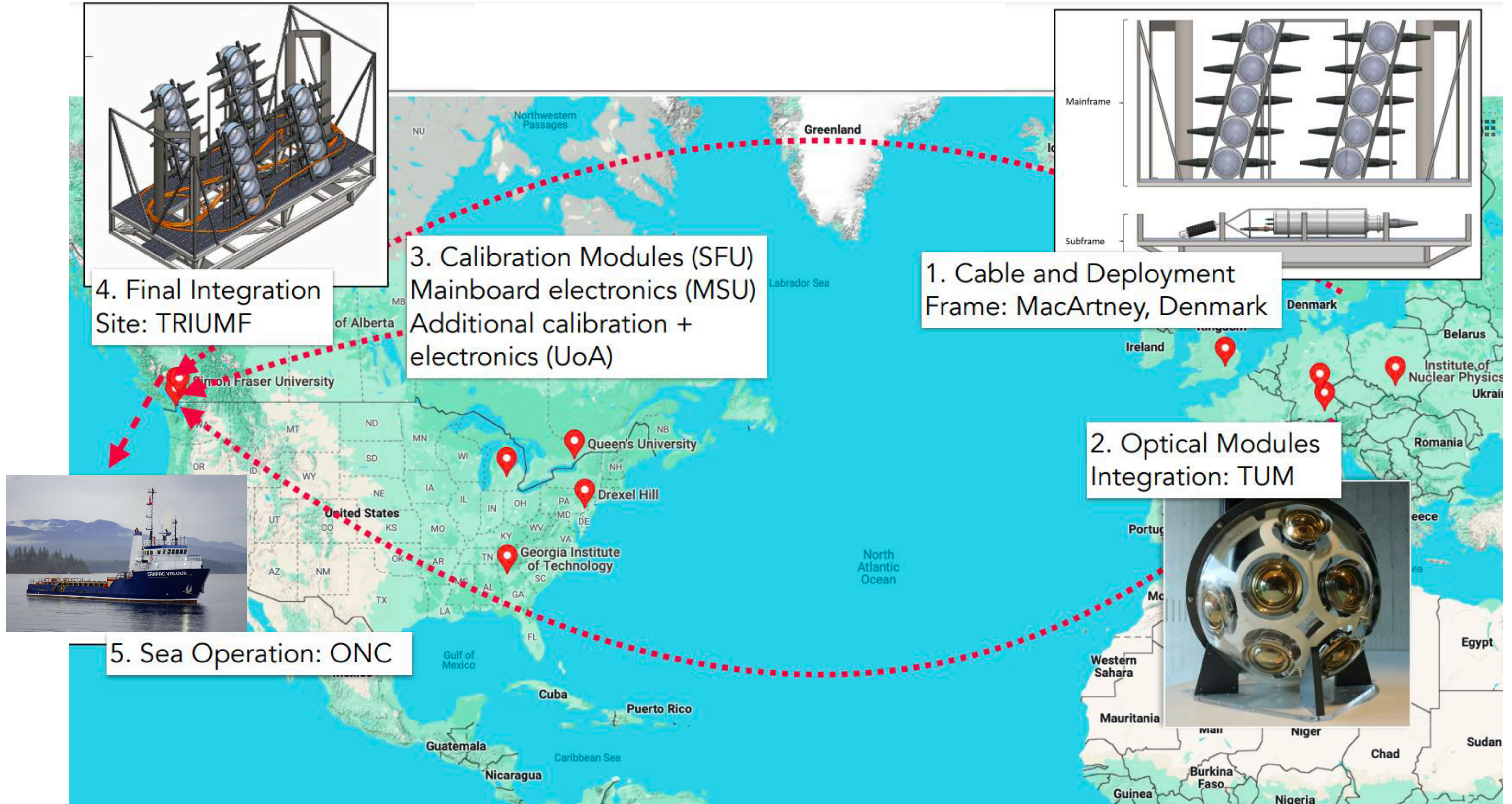
Acoustic position system

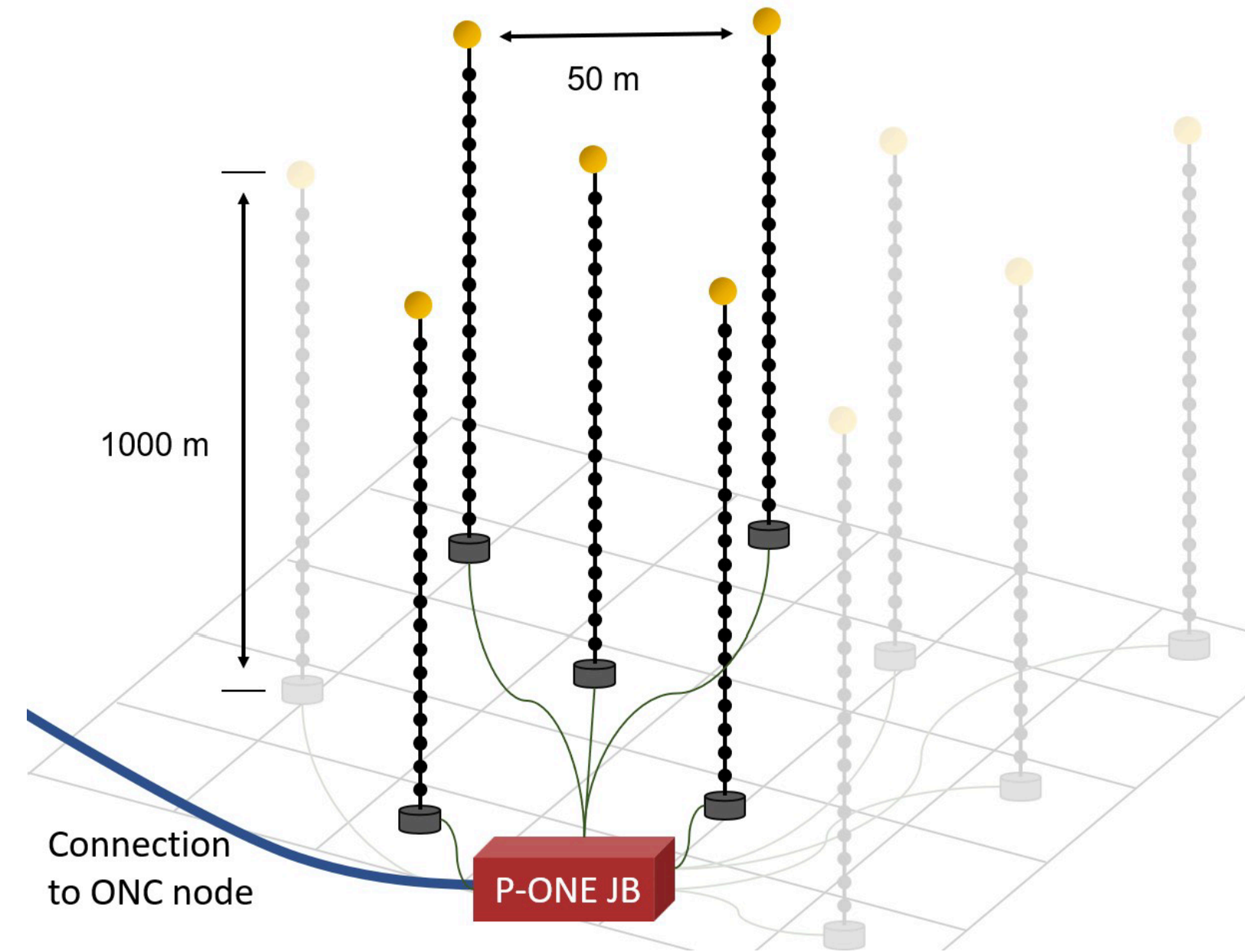
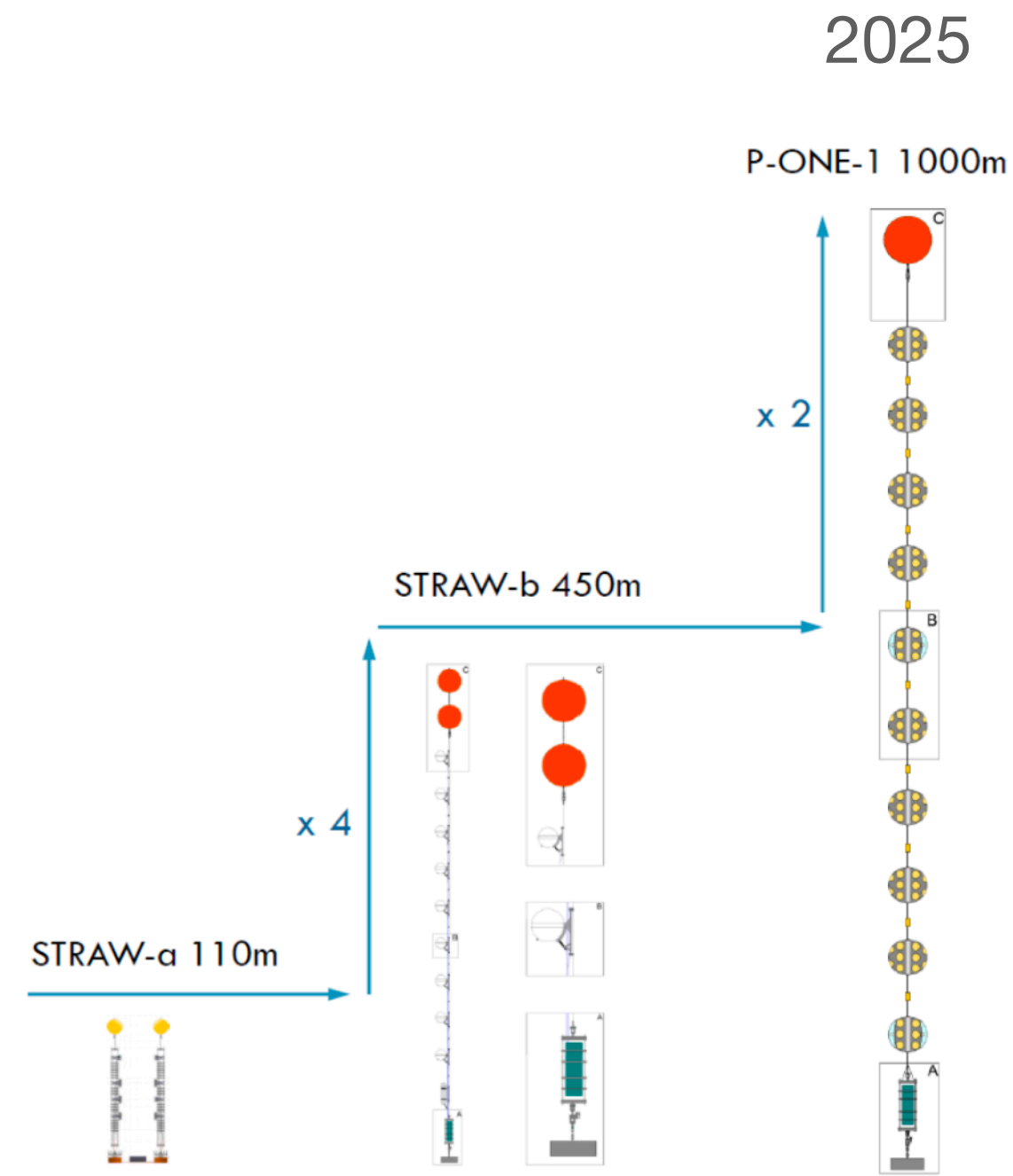


* P-CAL characterization at the U.Winnipeg HyperK test facility; component overlap with nEXO



P-ONE Logistics Chain





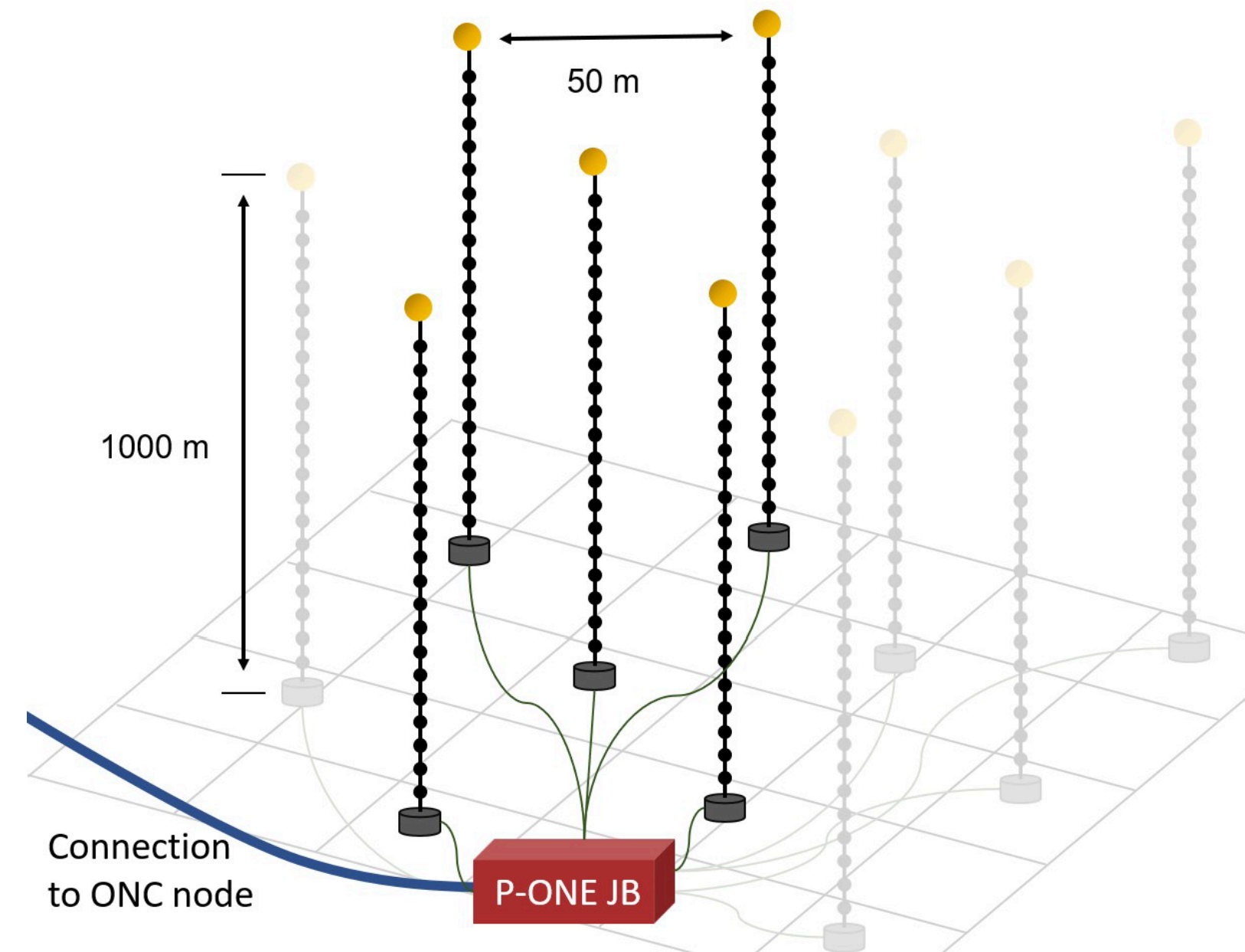
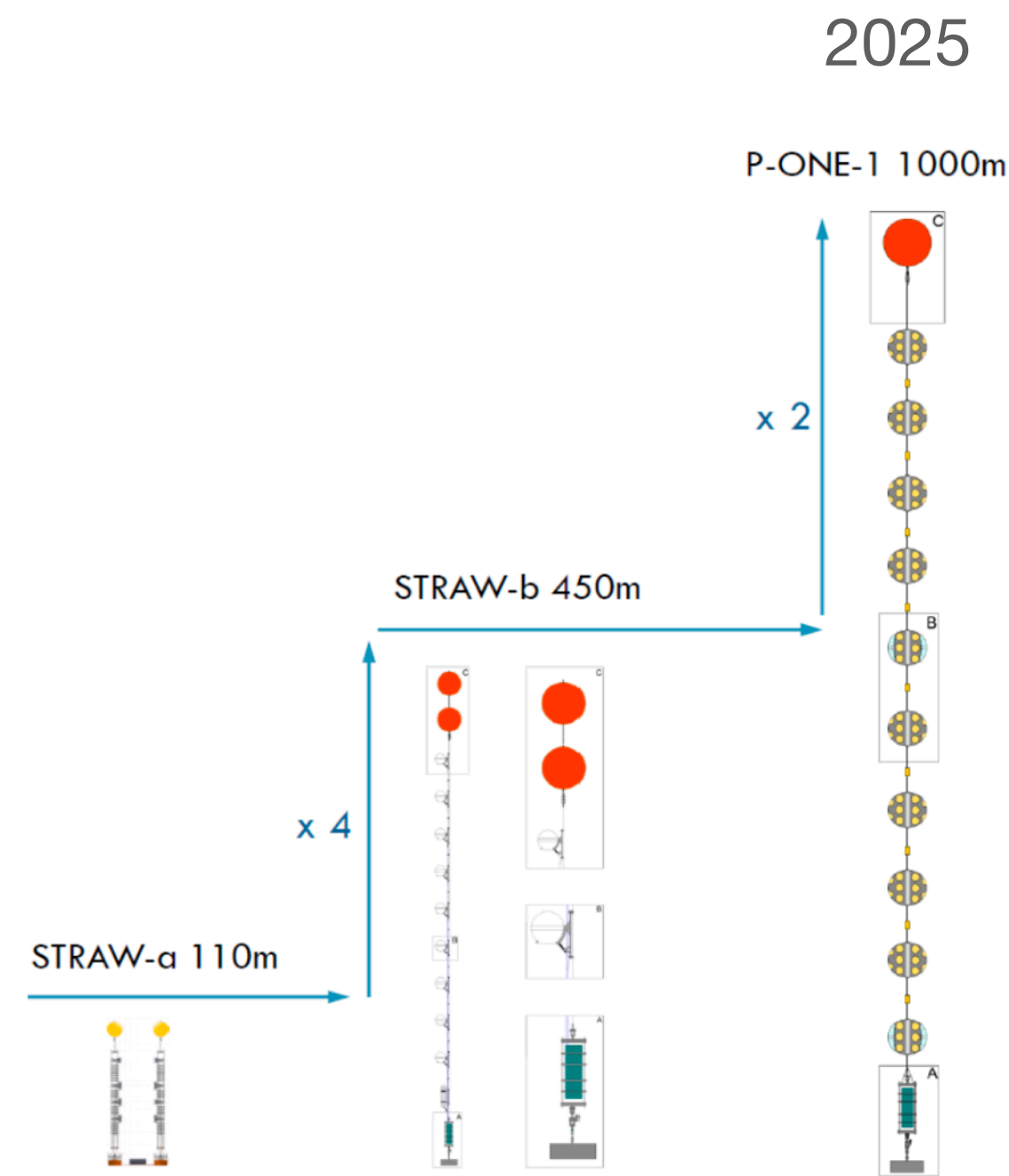
Pathfinder

Phase 1 (2018 – 2025)

Demonstrator (first cluster)

Phase 1 (2025 – 2028)

~13M project **funding currently secured** (2023 CFI-IF/ERC);
requests under review (NSF)



Core CFI deliverables:

- Precision calibration devices
 - Optical
 - Acoustic
 - Scintillation tracking
- Trigger/DAQ
- String integration/testing (TRIUMF)
- Deployment (ONC)
- Deep sea communications/power

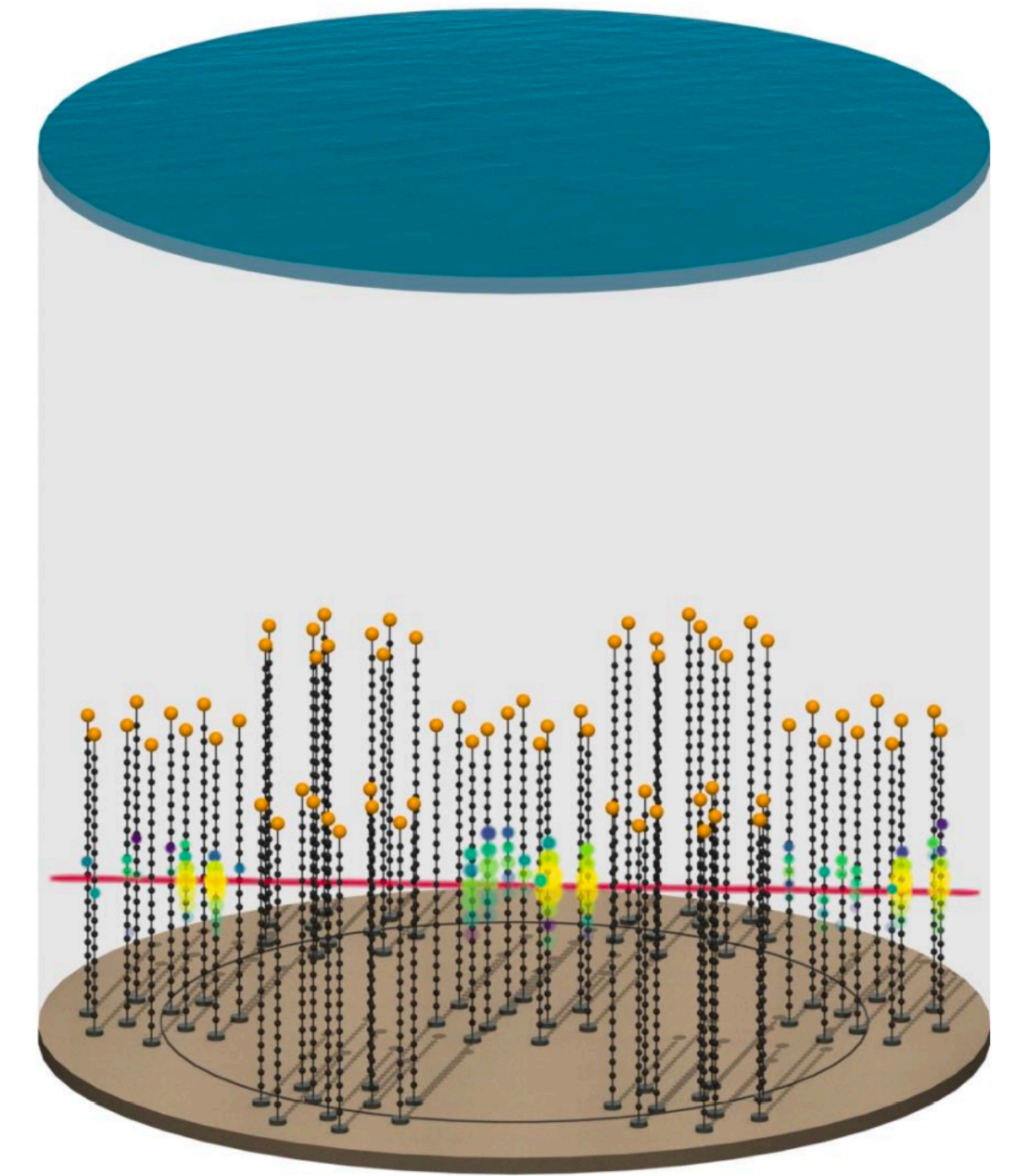
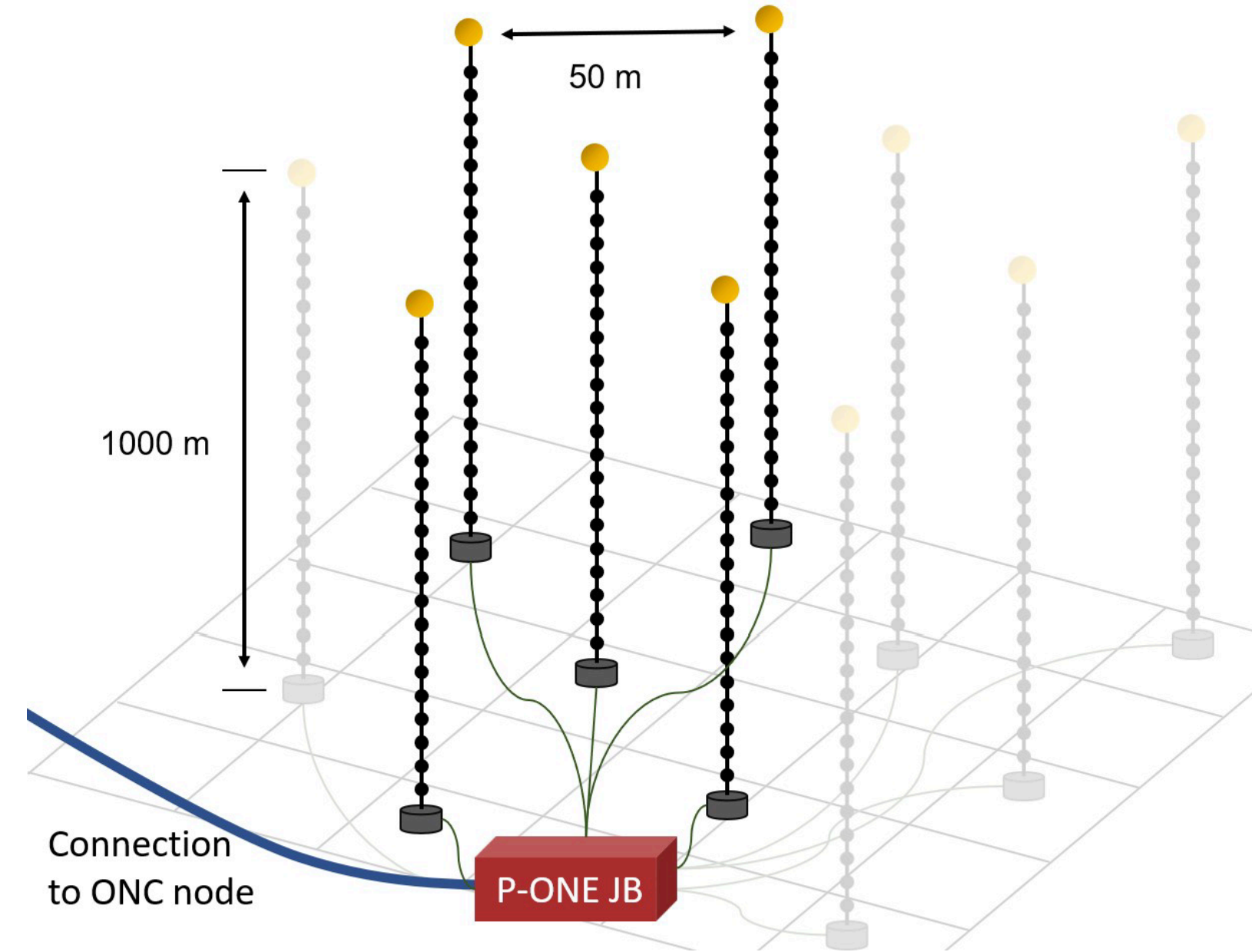
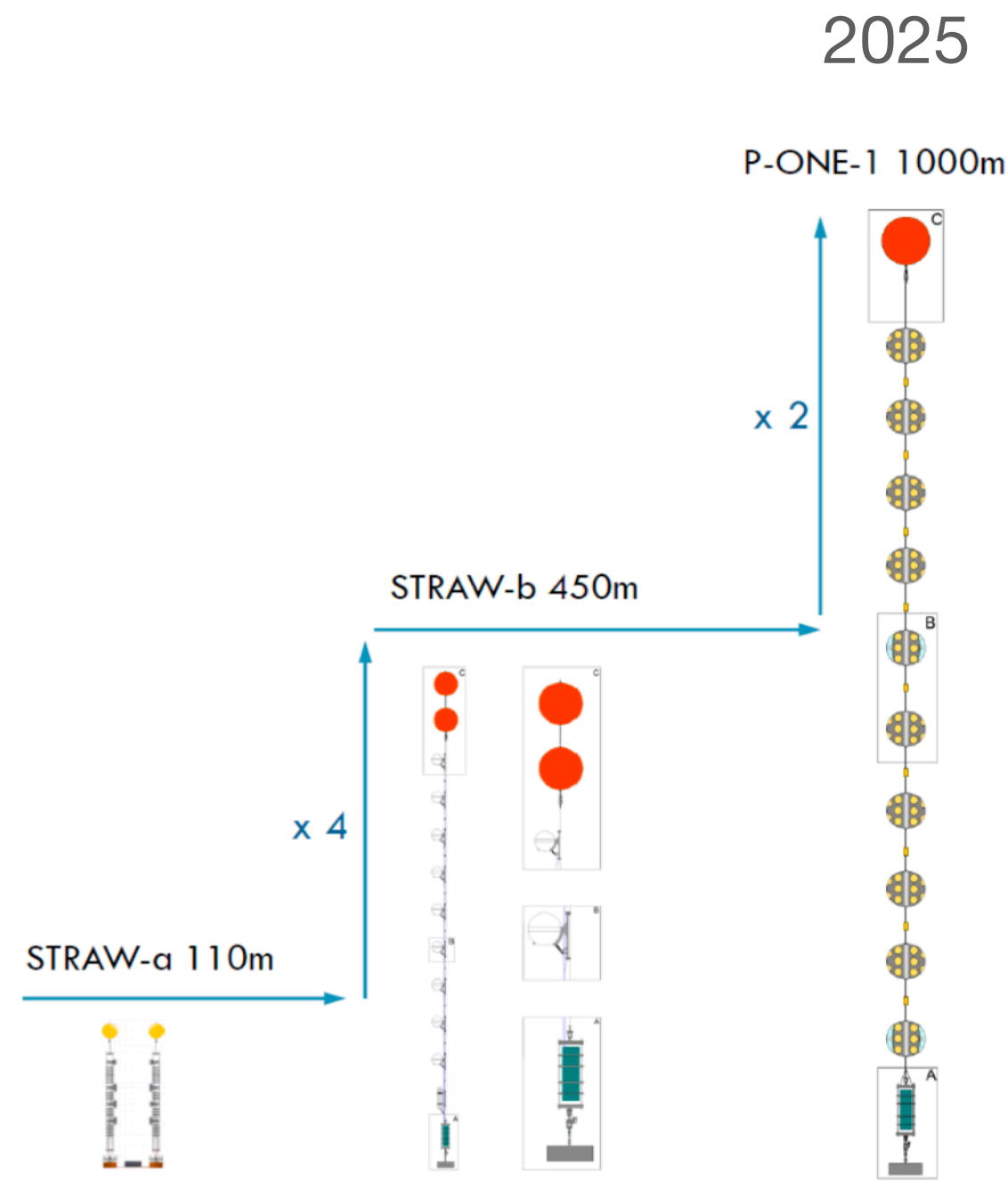
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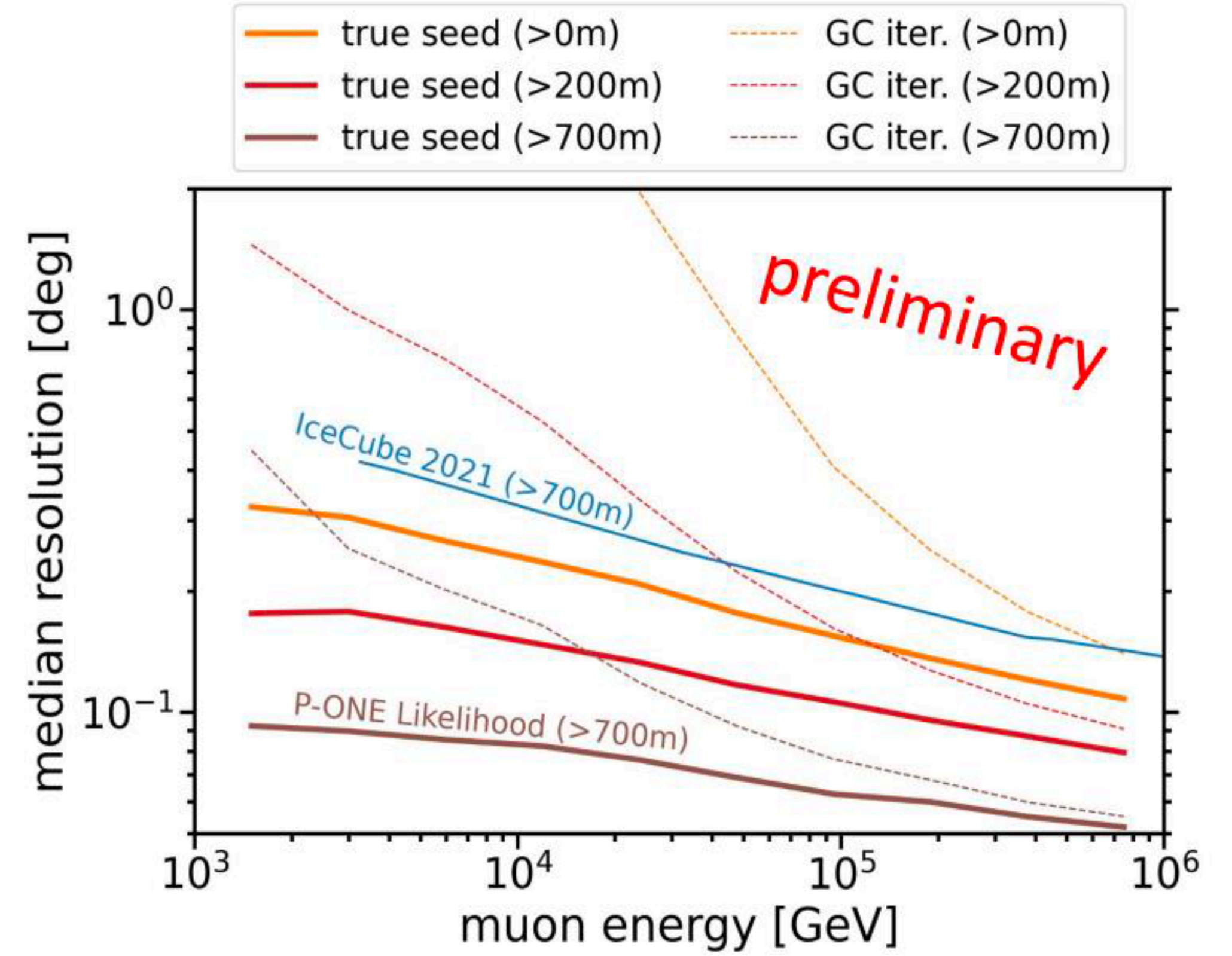
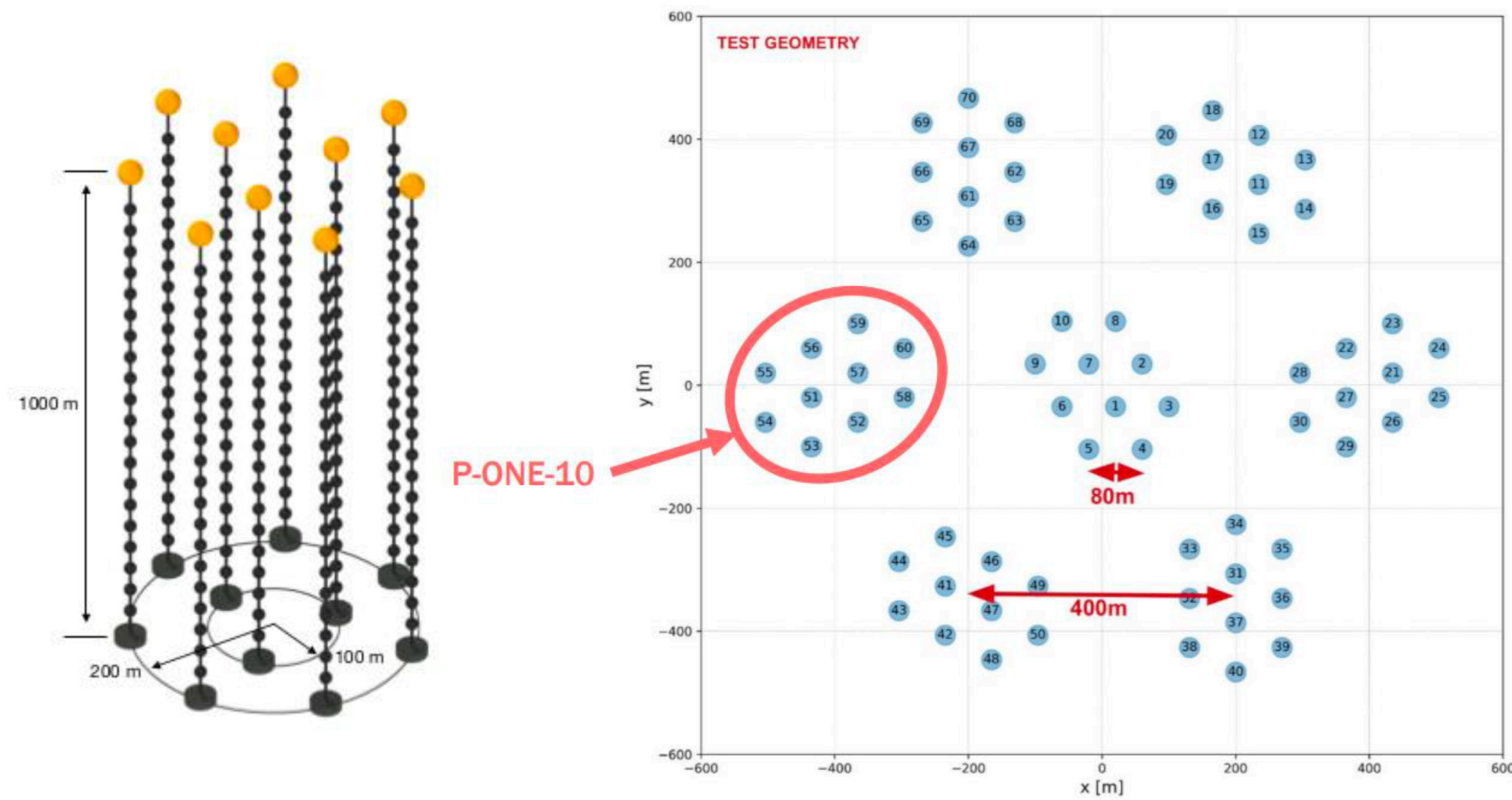


Pathfinder
Phase 1 (2018 – 2025)

Demonstrator (first cluster)
Phase 1 (2025 – 2028)
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P-ONE
Phase 1 (2028+)
O(100M)-scale
CFI-IF in preparation for next
generation deep ocean junction box

PoS (ICRC 2023) 1175



- Vibrant particle physics program leveraging high-energy neutrinos continues to rapidly evolve/grow
- The P-ONE program is in its early stages next phase of now underway.
 - First fully integrated detector line is tracking to first data in 2025
 - Will deliver 1st neutrinos in the Pacific Ocean
 - “Demonstrator” first cluster (estimated completion 2028) will provide significant Canadian detector construction activities over the next few years
- The detector and calibration source technologies, and trigger/DAQ developments are leveraging early synergies broadly in the Canadian experimental PP program landscape (most recently HyperK, nEXO);

Expressions of collaboration are very welcome!

