

Studying the universe from underwater

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Agenda

Neutrino Astronomy

P-ONE

Adapting for the ocean

Future



visible & infrared



messier 10

ultraviolet



messier 10

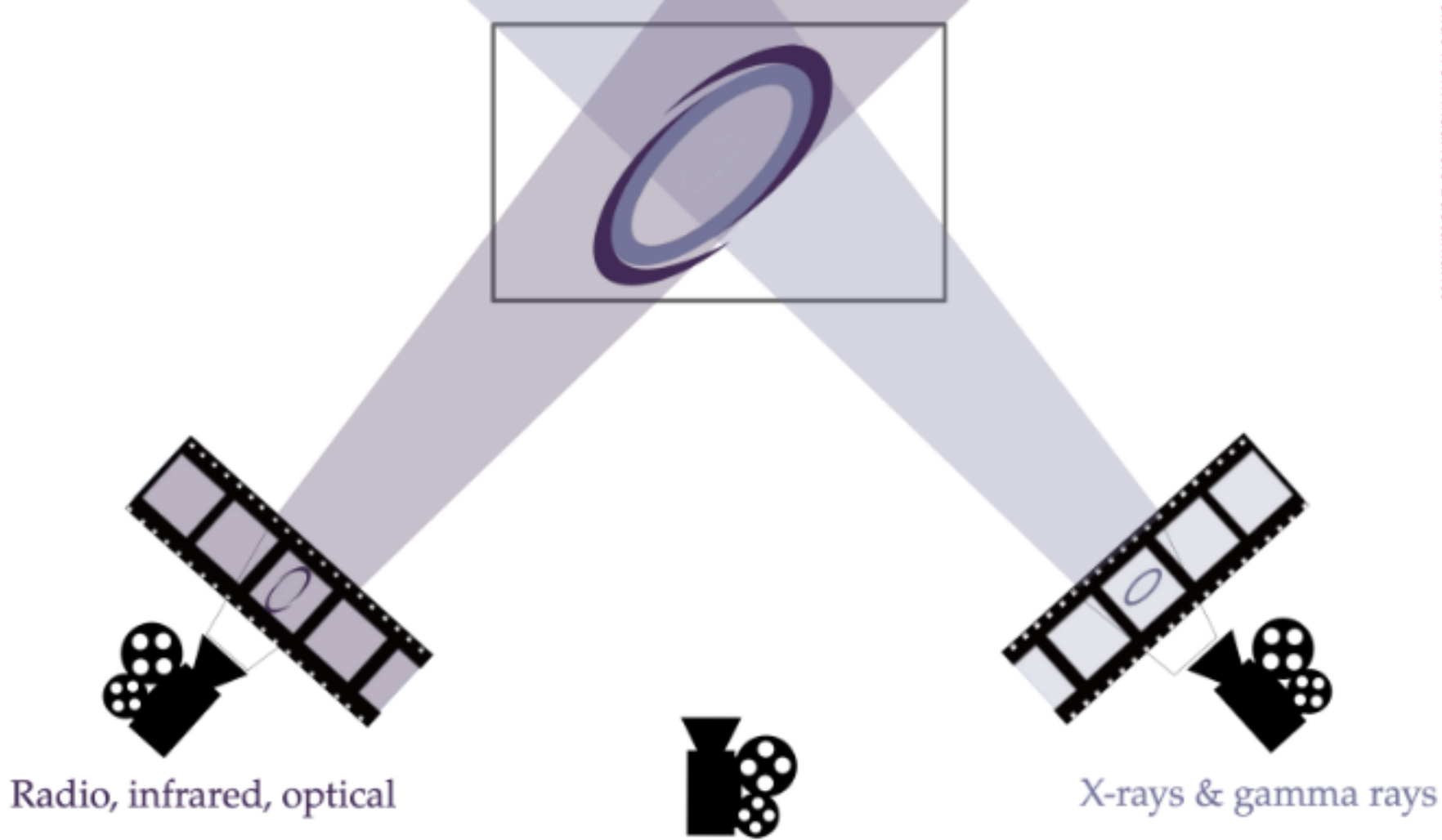






Radio, infrared,
optical







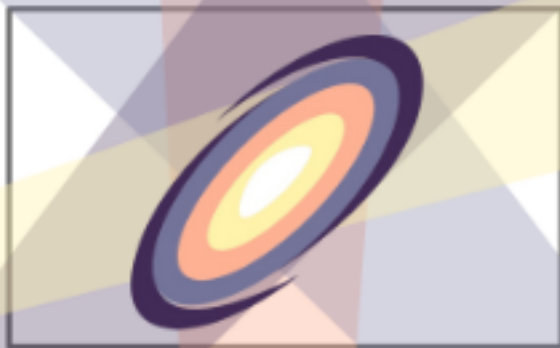
The diagram shows a central rectangular target area containing a blue and orange ring. Three cameras, represented by black silhouettes with film reels, are positioned around the target. Each camera is connected to a film strip. The left camera's film strip is purple and shows a purple ring. The bottom camera's film strip is orange and shows an orange ring. The right camera's film strip is blue and shows a blue ring. Three beams of light, colored purple, orange, and blue, originate from the target area and pass through the film strips.

Radio, infrared, optical

Neutrinos

X-rays & gamma rays

Gravitational waves



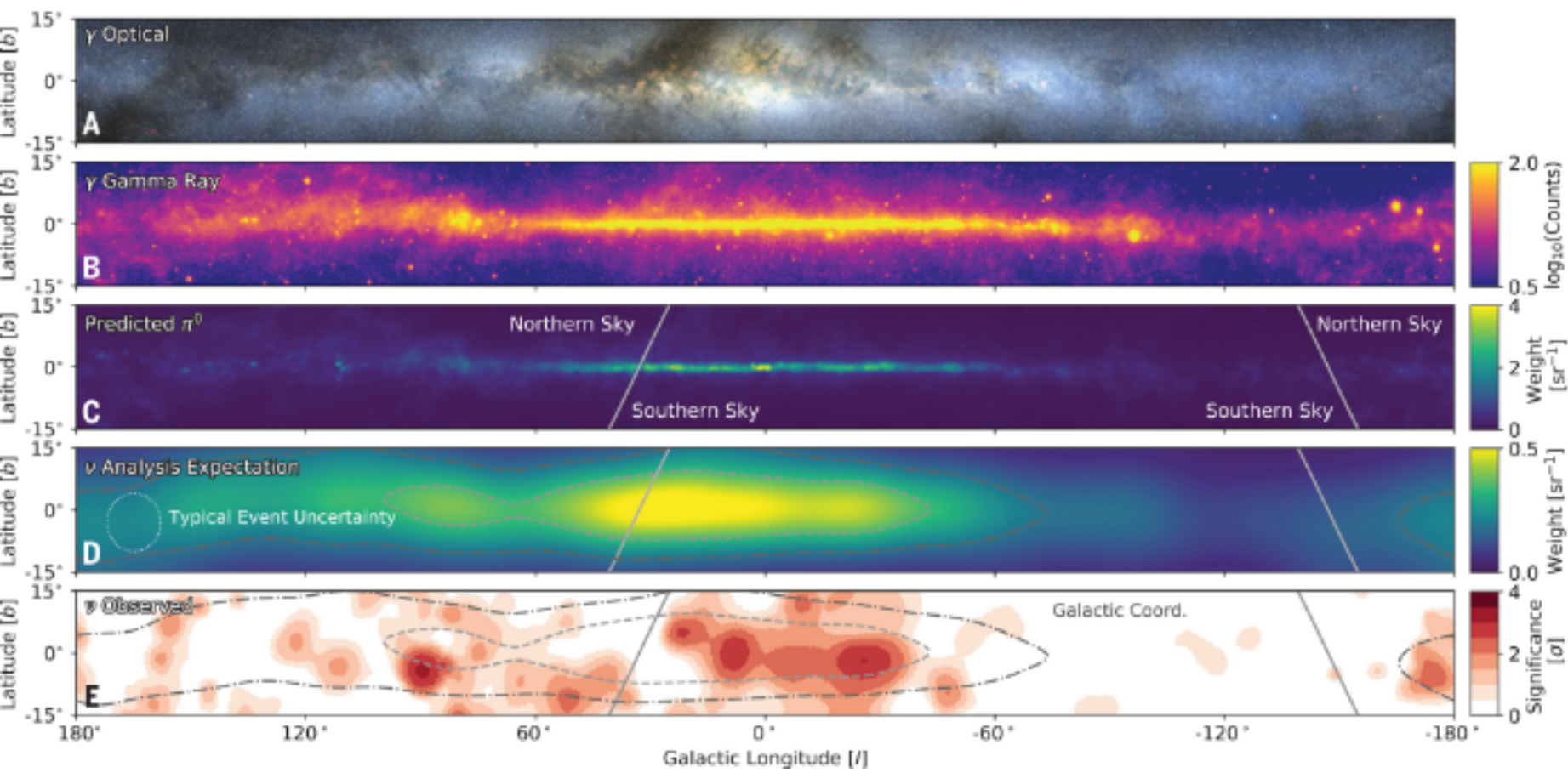
Radio, infrared, optical



Neutrinos



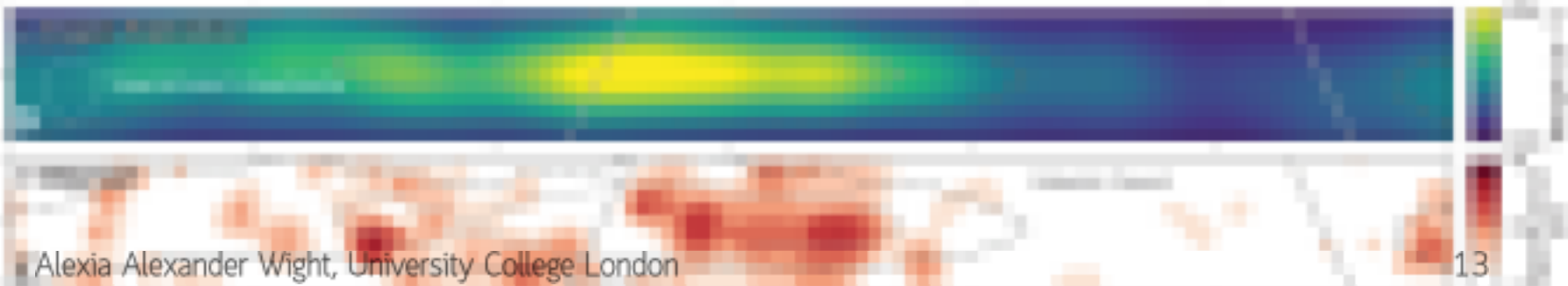
X-rays & gamma rays



Neutrino Astronomy

Have had several important discoveries in the last decade

- First observation of very-high-energy astrophysical neutrinos
- Discovery of first neutrino point source, TXS 0506+056 blazar



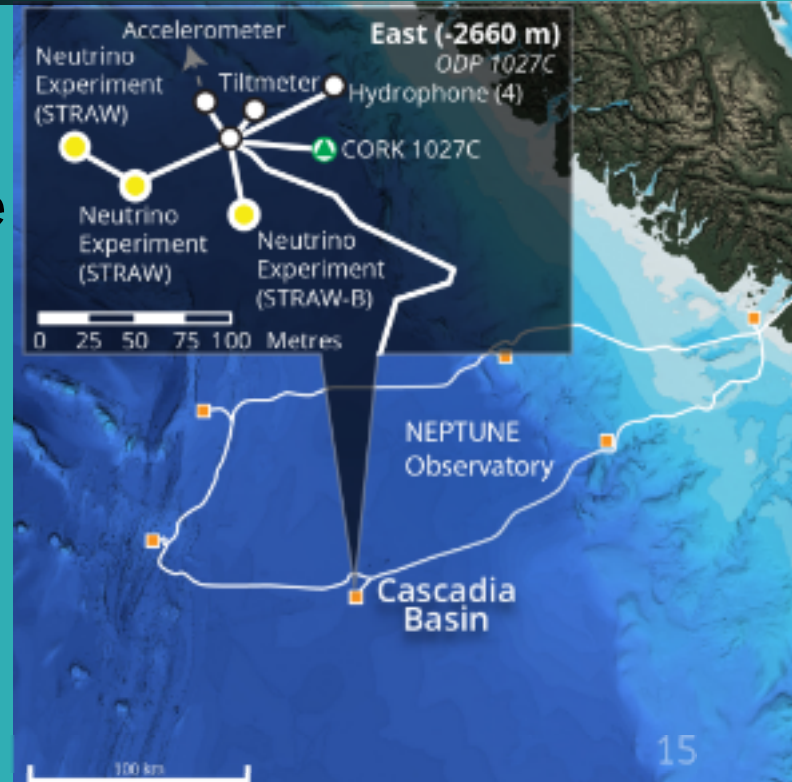
Neutrino Interferometry



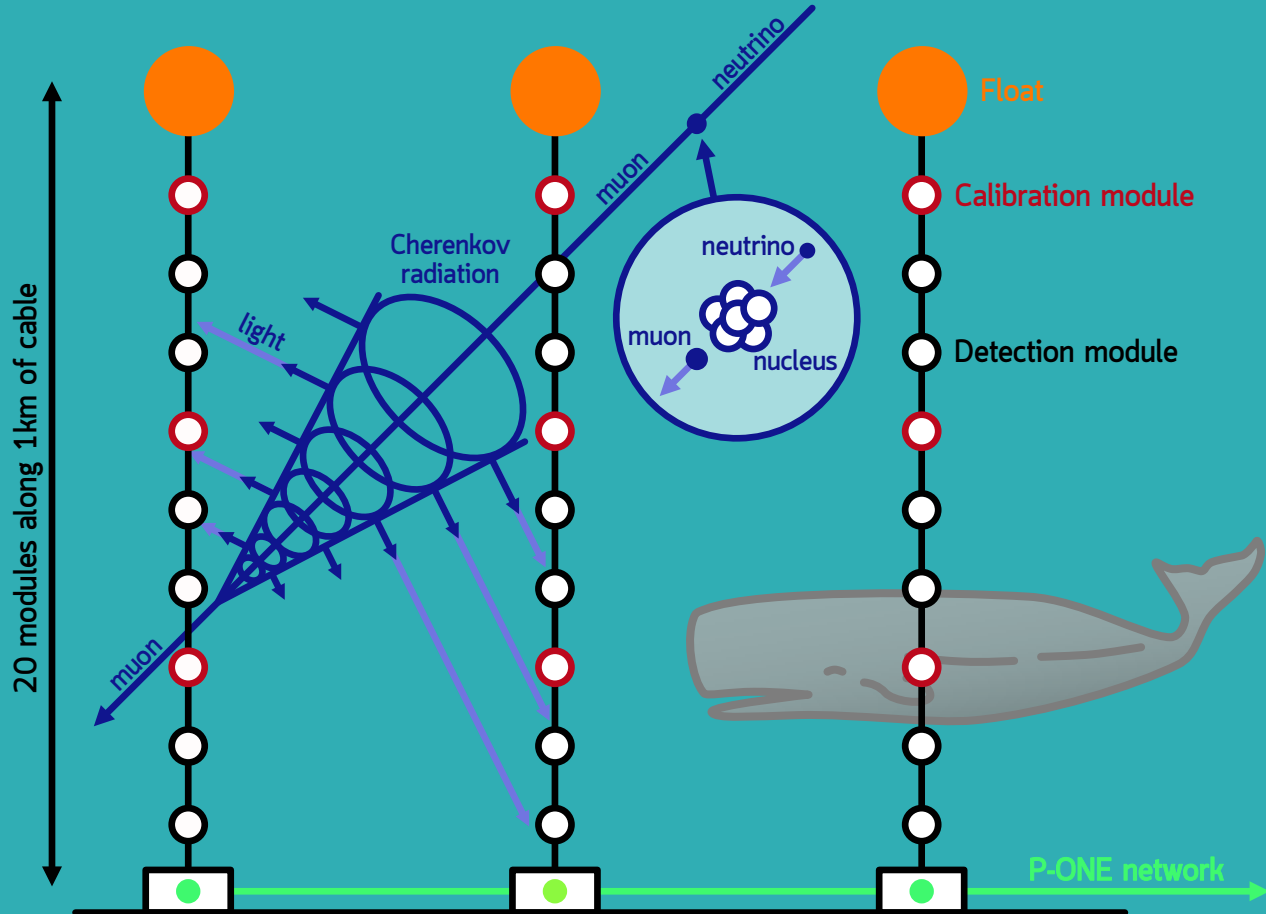
P-ONE

The Pacific Ocean Neutrino Experiment (P-ONE) is a neutrino telescope that will be based off the coast of Canada, in the Pacific.

- Good view of galactic centre where we expect to see many neutrino sources.
- Higher angular resolution than in ice.



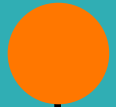
P-ONE

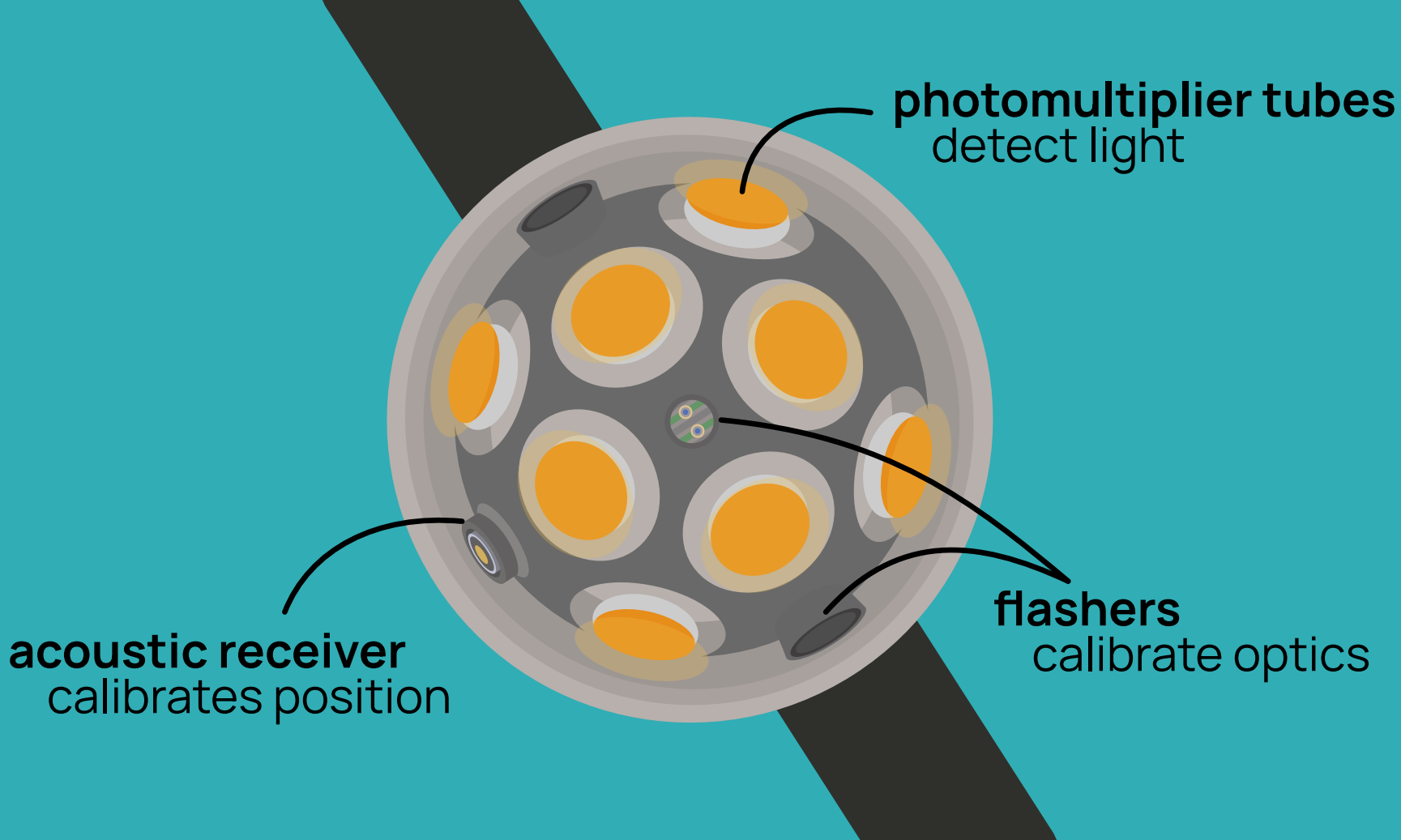


The line & modules

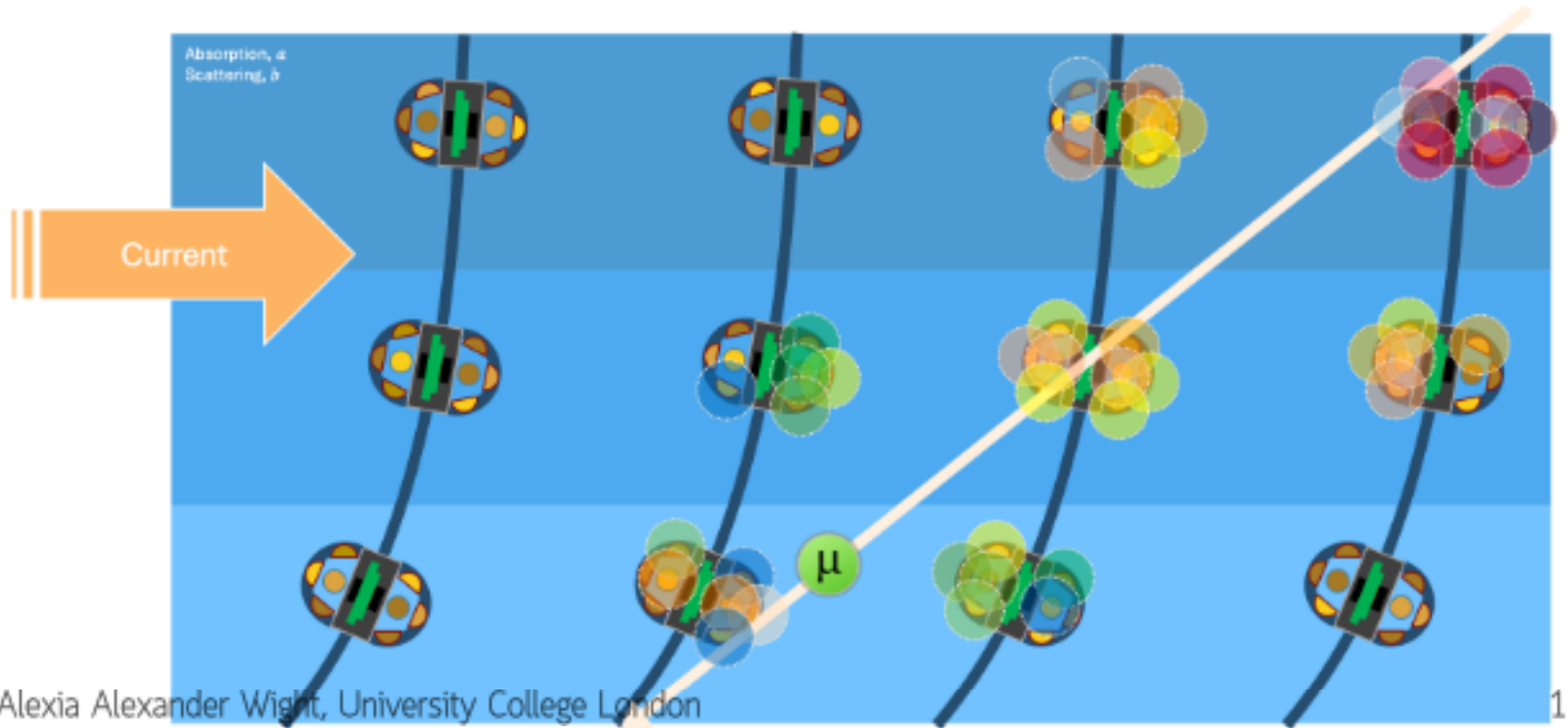
Core detector module is known as the P-OM (P-ONE optical module).

Will deploy the first line in 2026, containing 18 P-OMs and 2 P-CALs (calibration modules).





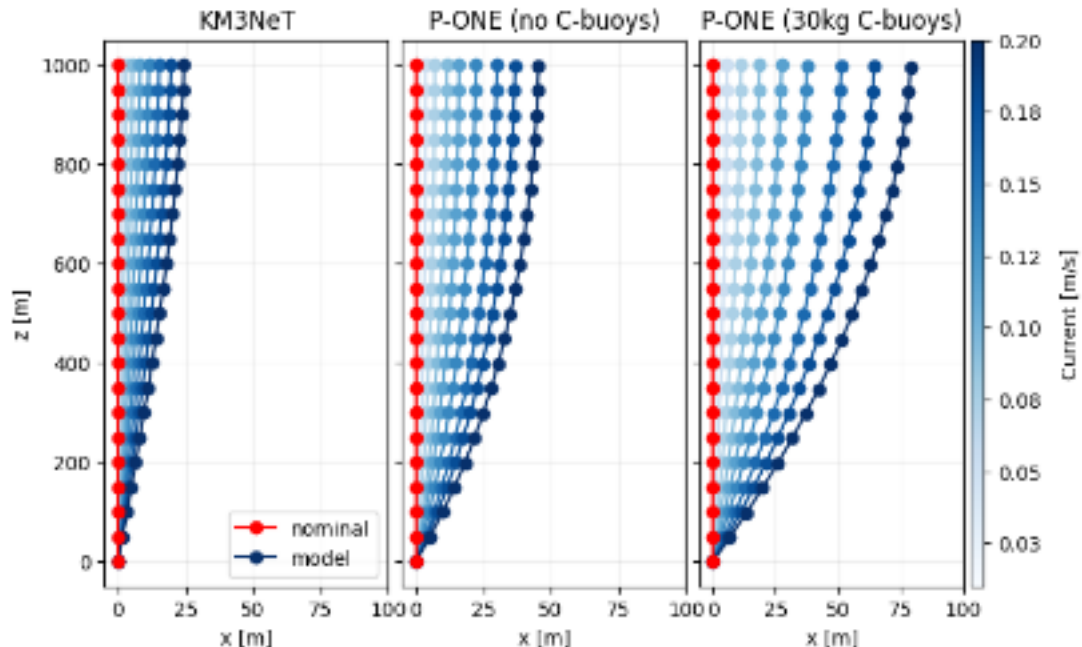
Adapting to the ocean



Positioning

We need to contend with ocean currents, so need a way to locate exactly where the optical modules are.

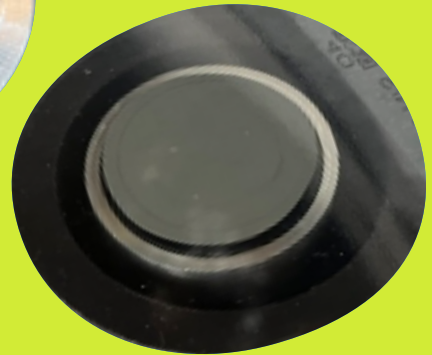
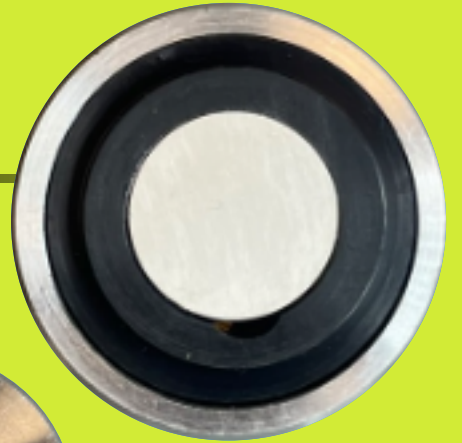
We expect 3 – 10 cm/s of current speeds at Cascadia Basin, causing drag of the line.



Acoustic receivers

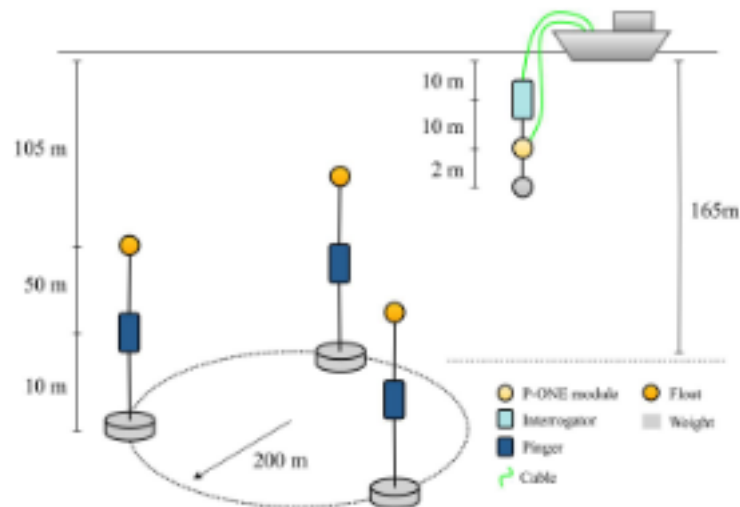
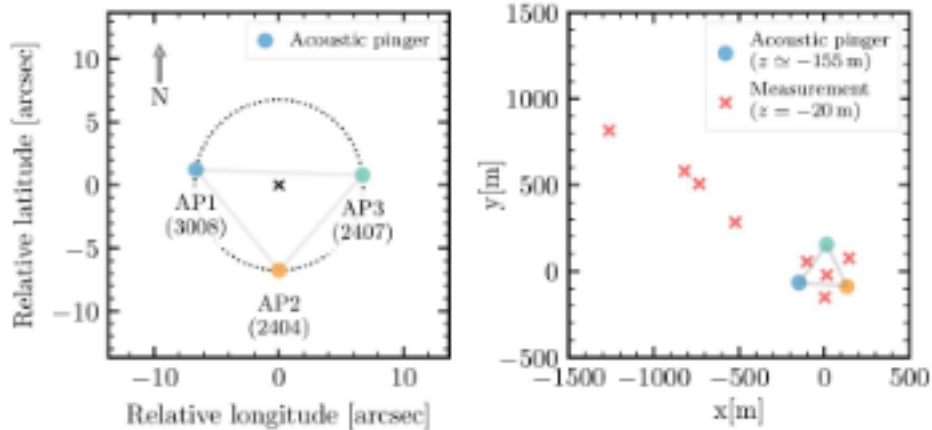
Purpose: Locating the position of the optical modules and the string.

Mechanics: Acoustic transmitter on the ocean floor send pings to piezoelectric acoustic receivers in the hemisphere.



Acoustic calibration

We have acoustic emitters on the ocean floor, sending out pings detected by the acoustic receivers.



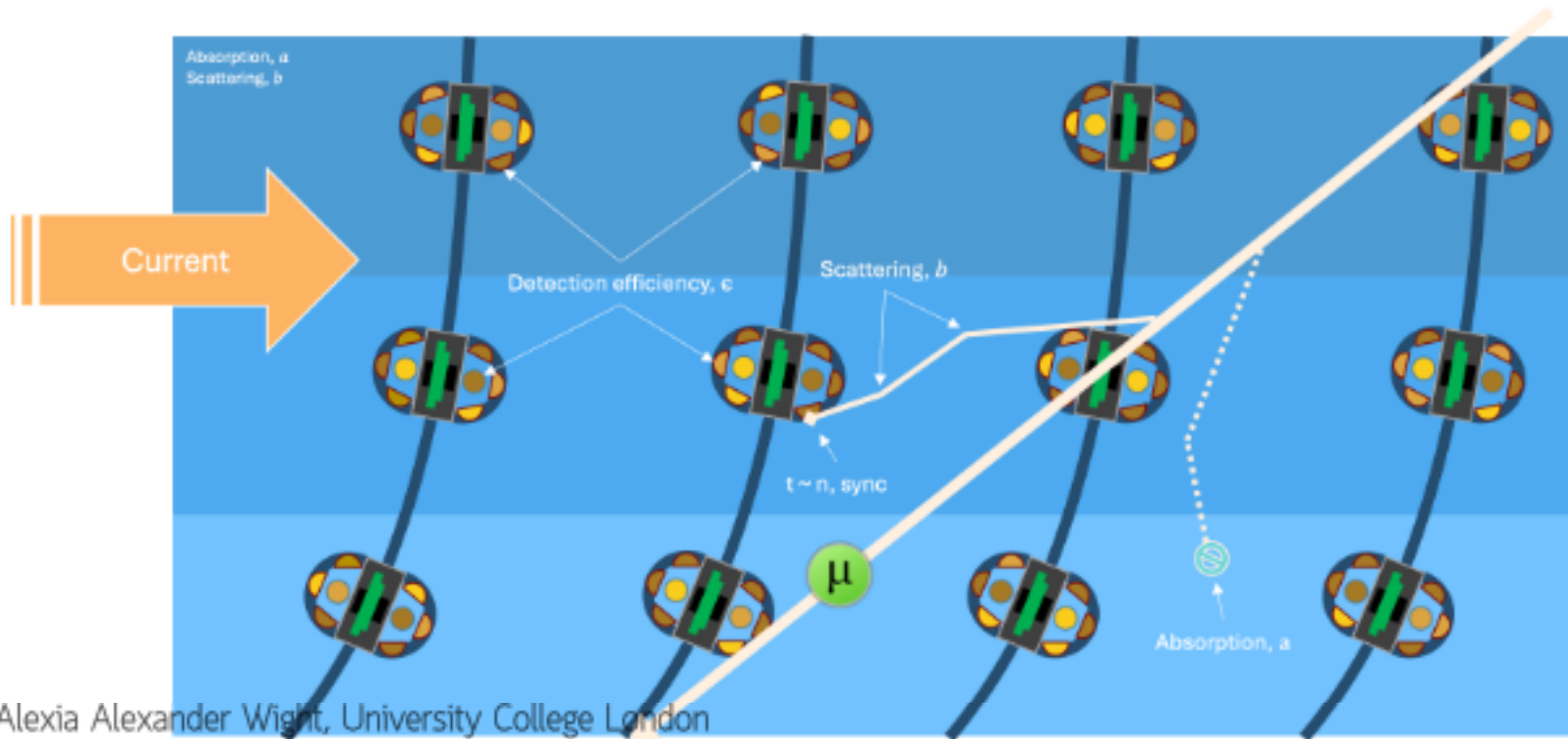
The P-CALs

Purpose: Calibration of the geometry of the detector and optical modules, and ability to capture images at depth.



Mechanics: 2 isotropic horizontal light sources per P-CAL, and a camera. Also contains 8 PMTs per module.

Optical calibration



Flashers



Purpose: Measure the optical properties of water at different depths in order to properly construct tracks.

Mechanics: Eight flashes per hemisphere in three inserts, pointing up, down, & sideways.



Optical calibration

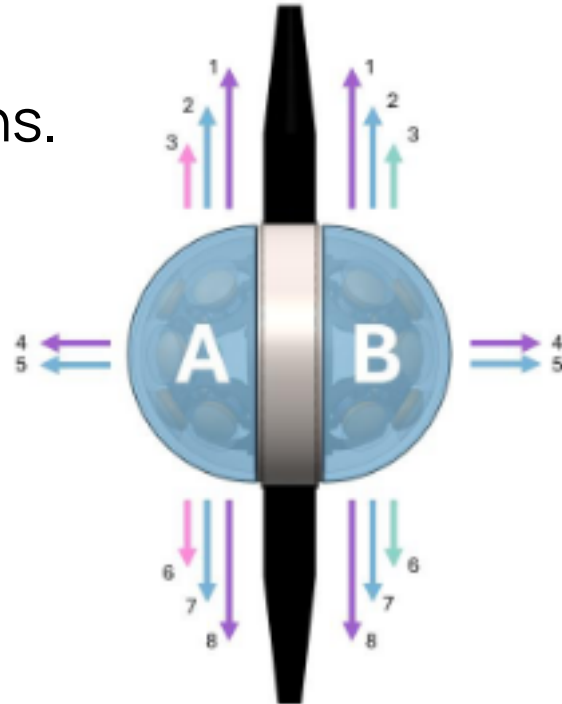
Flashers are a mixture of LED and lasers, with a range of wavelengths.

365 nm

405 nm

450 nm

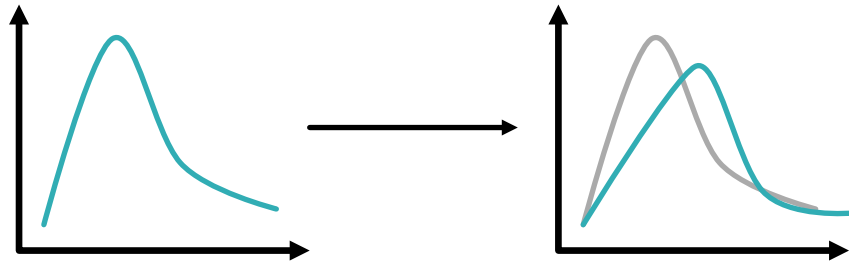
520 nm



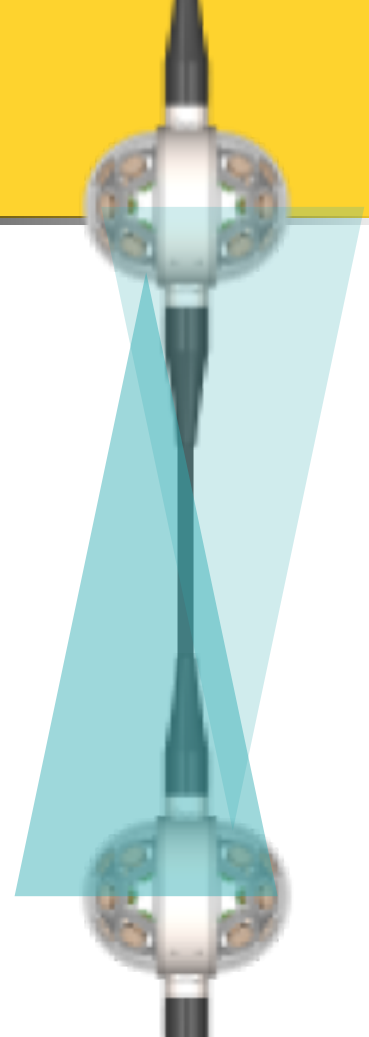
The flashers

We require depth dependent calibration.

Use known light pulses to calibrate water column properties.



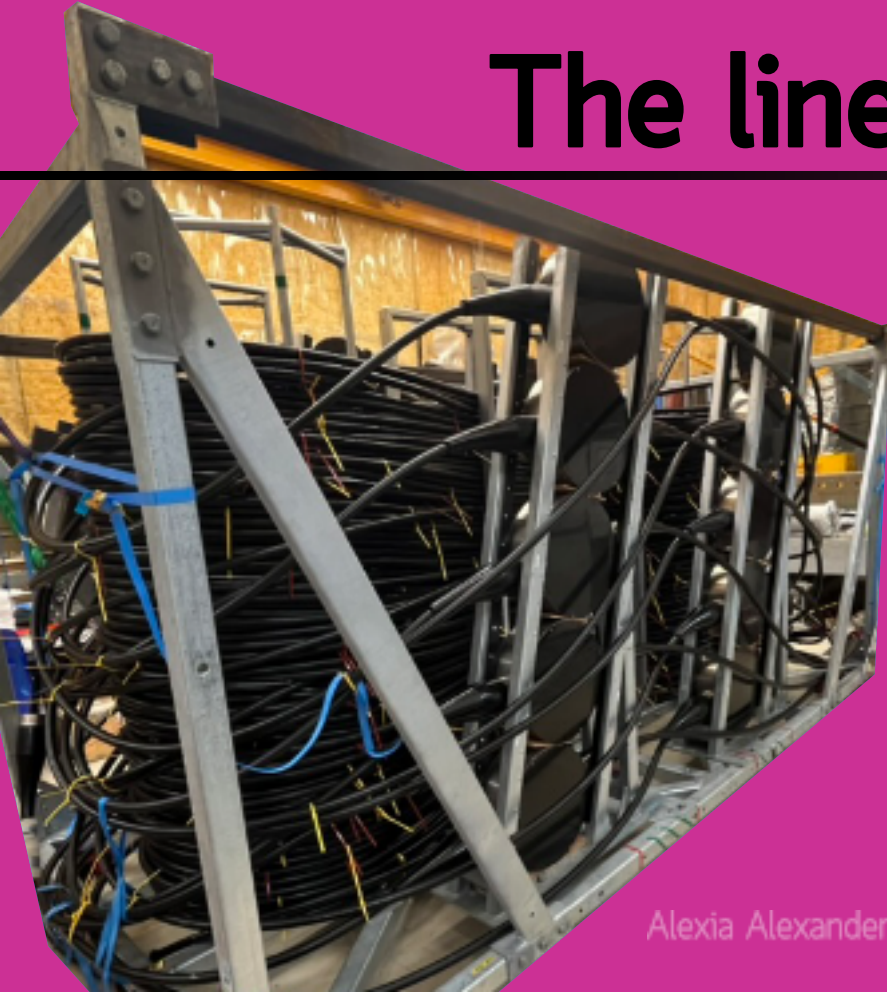
Can also look at sedimentation and biofouling via comparing up:down ratios.



The hemispheres

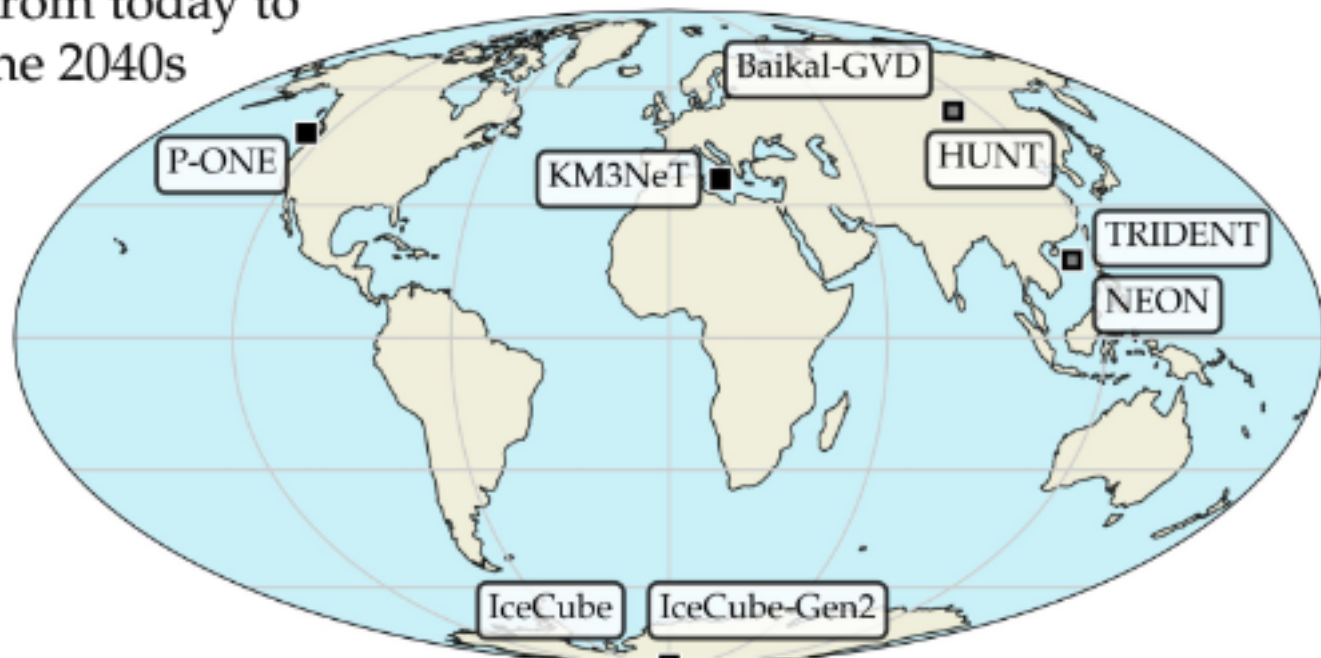


The line



The future...

From today to
the 2040s



Thank you!

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