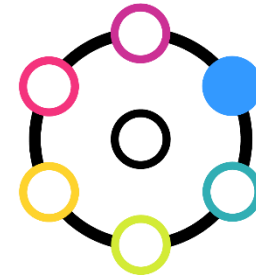




THE HENRYK NIEWODNICZAŃSKI
INSTITUTE OF NUCLEAR PHYSICS
POLISH ACADEMY OF SCIENCES



P-ONE

Pacific Ocean Neutrino Experiment: overview and recent developments

Swathi Karanth for the PONE collaboration

IFJPAN, swathi.karanth@ifj.edu.pl

PAiP 2025, February 21



Neutrino astronomy

- ❖ Multi-messenger astronomy
- ❖ Universe transparent to neutrinos
- ❖ Point straight to the source

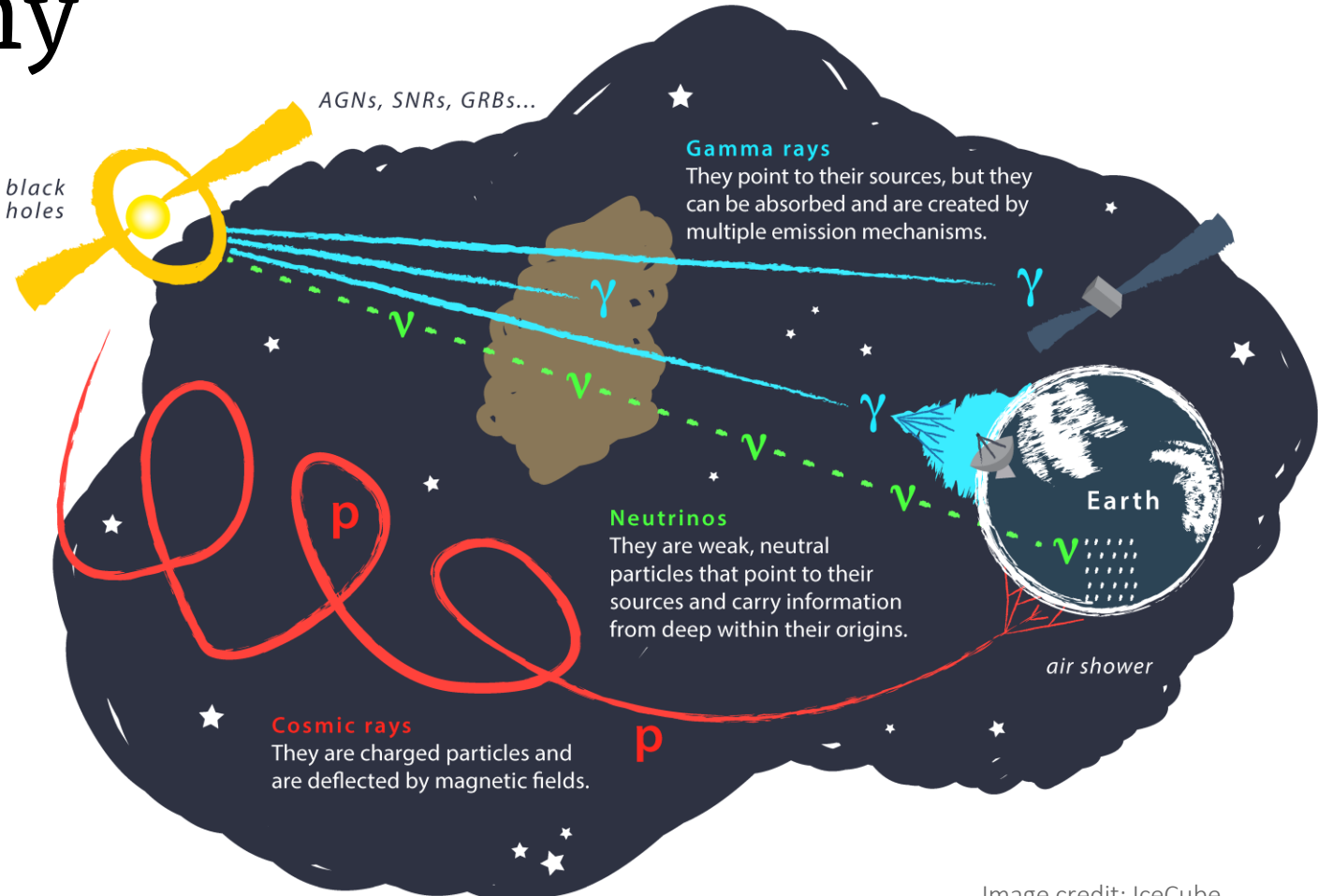
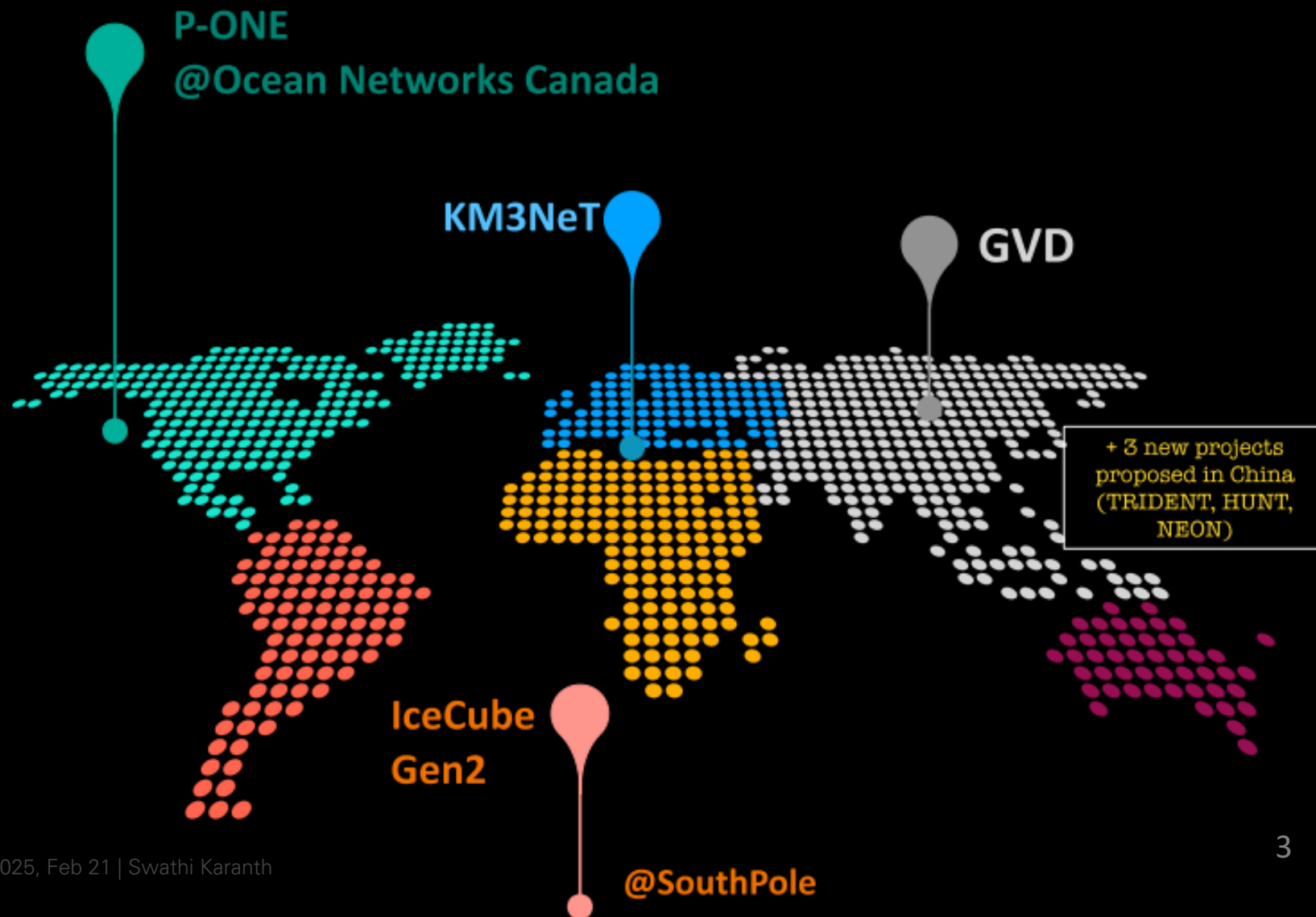


Image credit: IceCube



Neutrino telescopes

- ❖ IceCube: astrophysical neutrinos from
 - ❖ diffuse emission and identified sources
- ❖ Need more neutrinos
- ❖ Expand the Neutrino Net

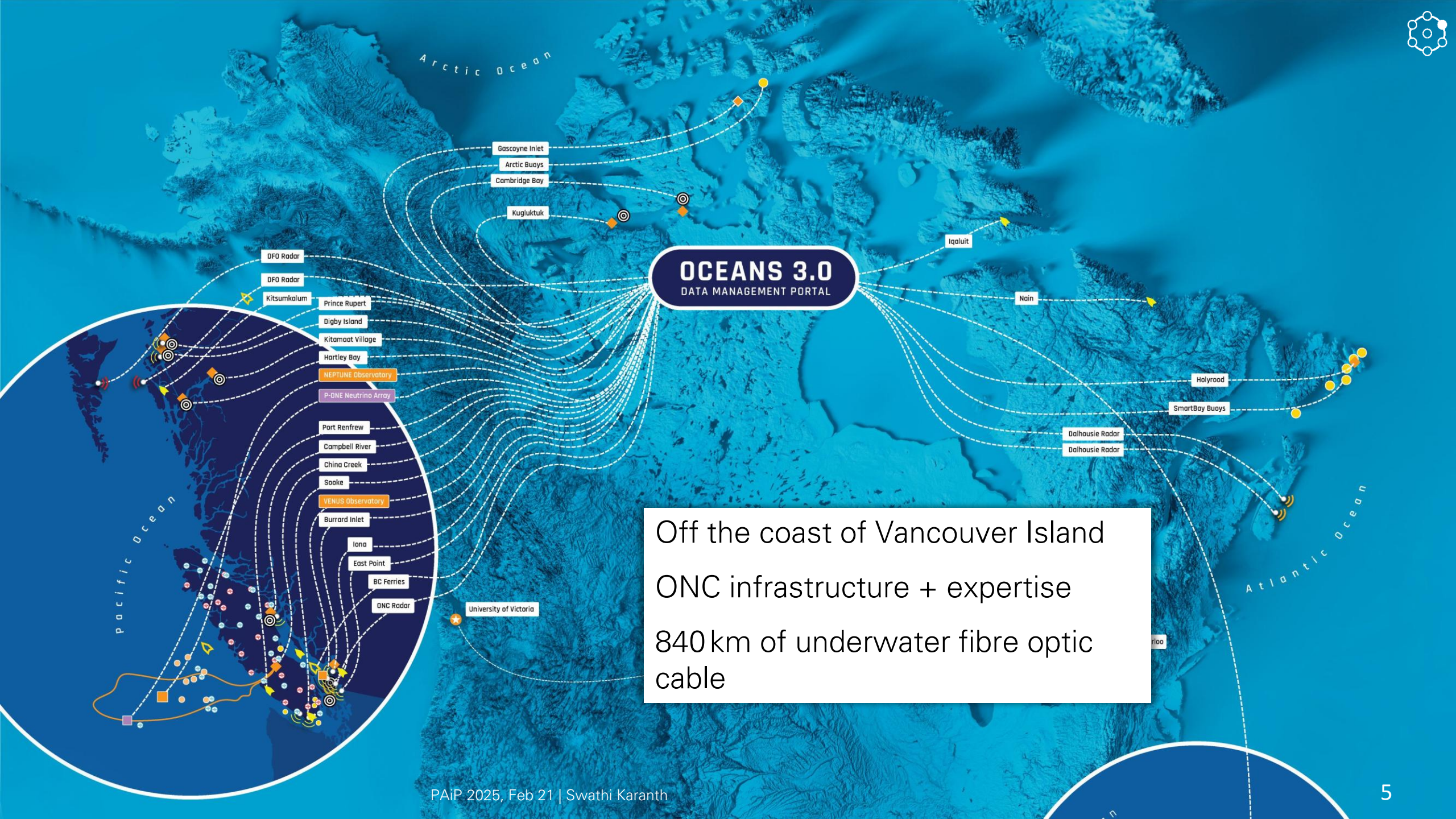


Pacific Ocean Neutrino Experiment



Exploring the
Universe from the
bottom of the Ocean

- ❖ Georgia Institute of Technology, USA
- ❖ Simon Fraser University, Canada
- ❖ Michigan State University, USA
- ❖ University of Alberta–Edmonton, Canada
- ❖ Queen’s University, Canada
- ❖ University College London, UK
- ❖ University of Chicago, USA
- ❖ Duke University, USA
- ❖ Elmhurst University, USA
- ❖ Los Alamos National Laboratory, USA
- ❖ Technische Universität München, Germany
- ❖ Drexel University, USA
- ❖ TRIUMF, Canada
- ❖ Ocean Networks Canada, Canada
- ❖ IFJPAN

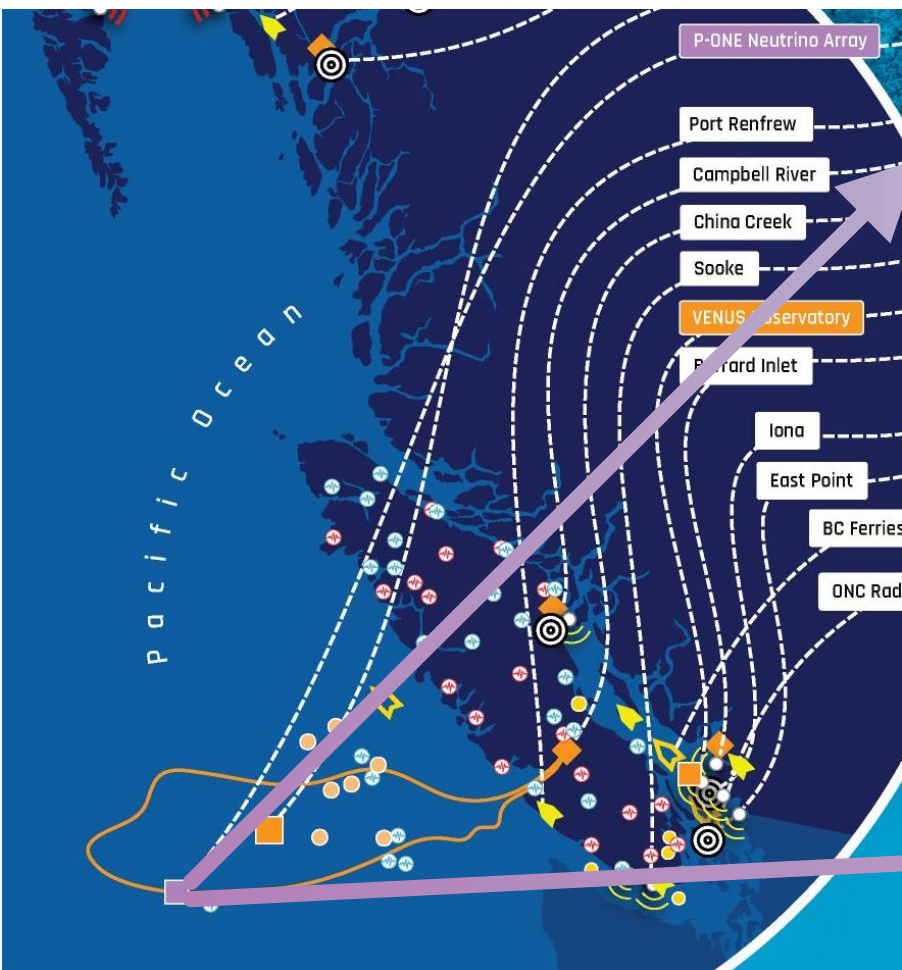


OCEANS 3.0
DATA MANAGEMENT PORTAL

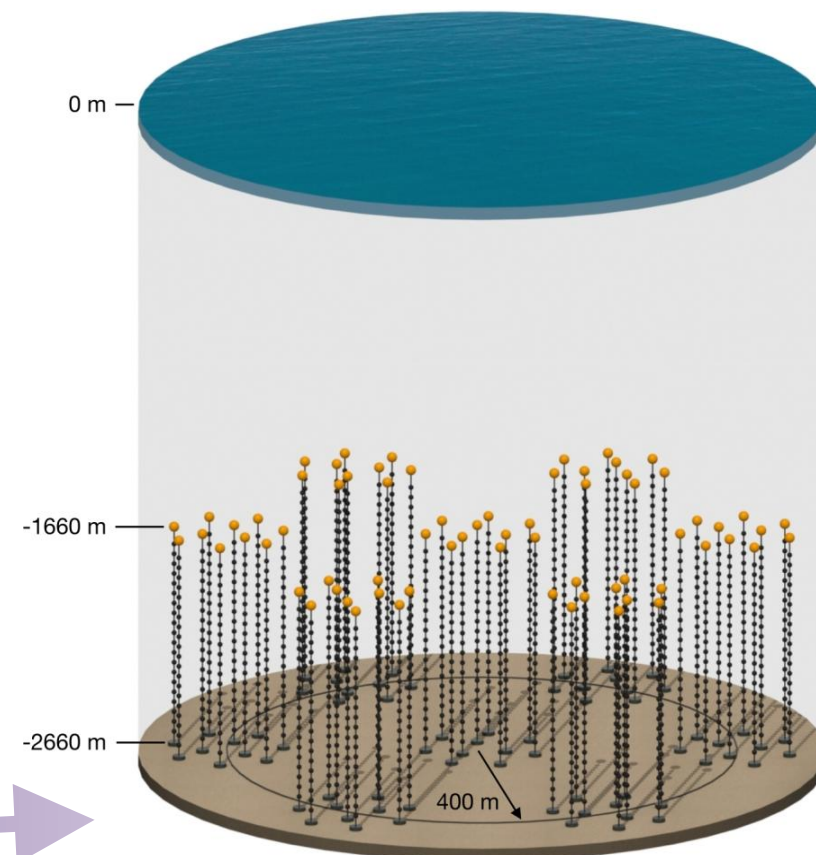
Off the coast of Vancouver Island
ONC infrastructure + expertise
840 km of underwater fibre optic
cable



Pacific Ocean Neutrino Experiment

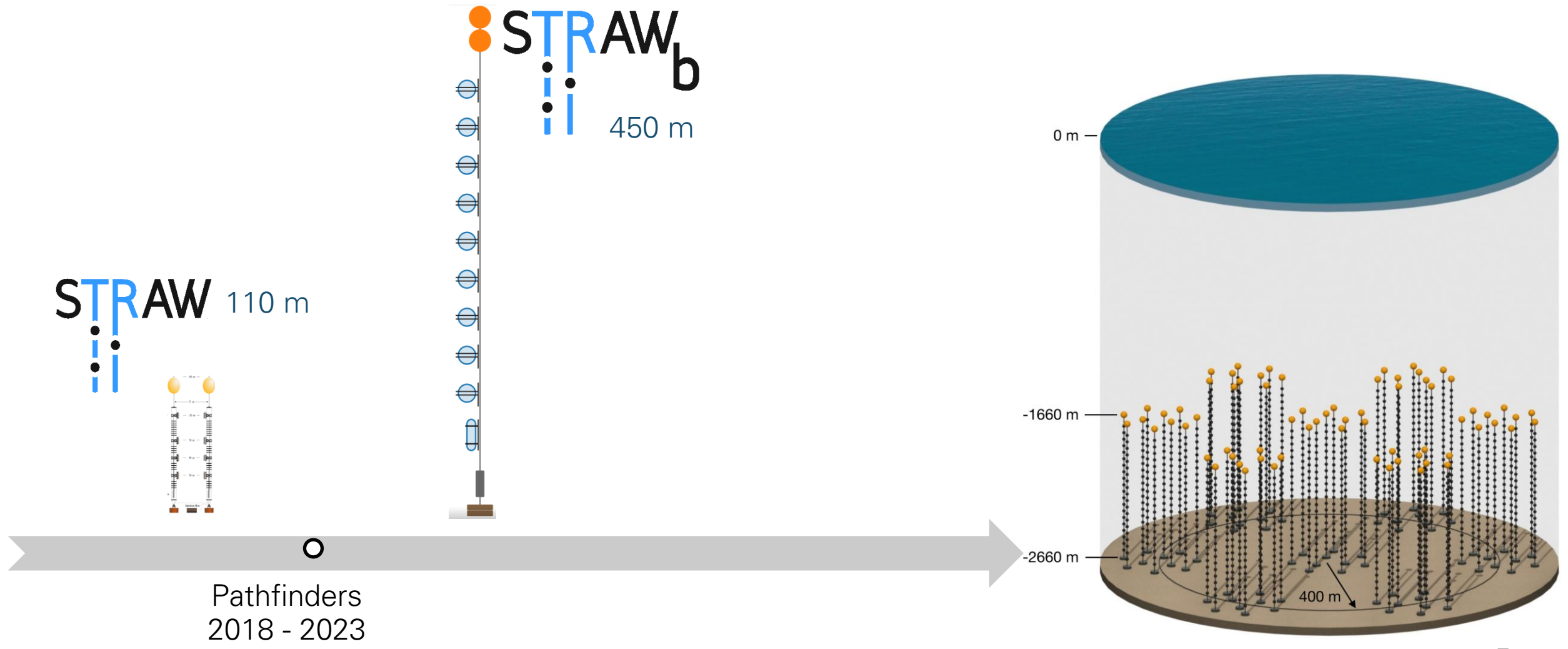


- ❖ Cascadia Basin
 - 2°C year around
 - Low currents (0.1 m/s)
- ❖ Cubic km volume telescope concept
 - 7 clusters
 - 10 strings in each cluster
 - 20 modules per string



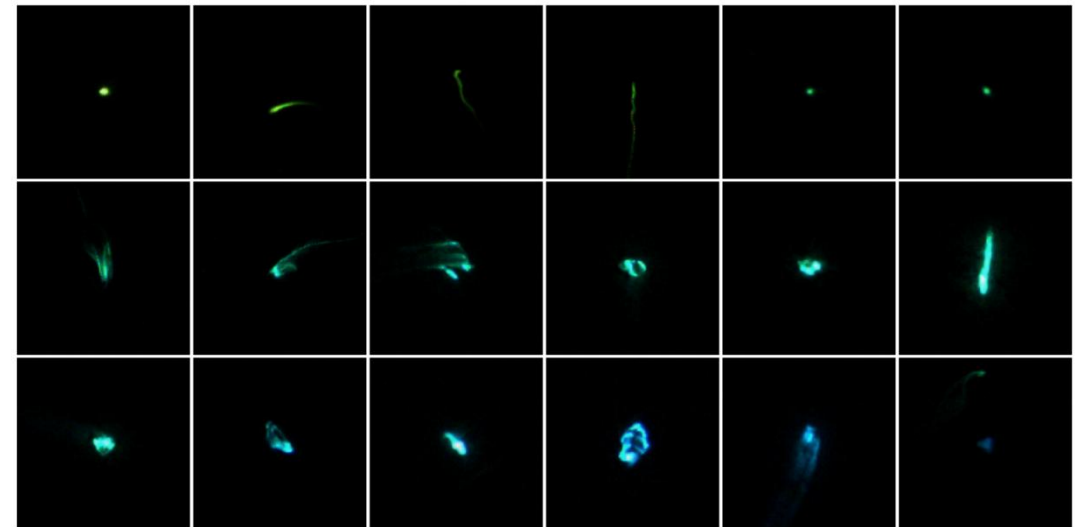
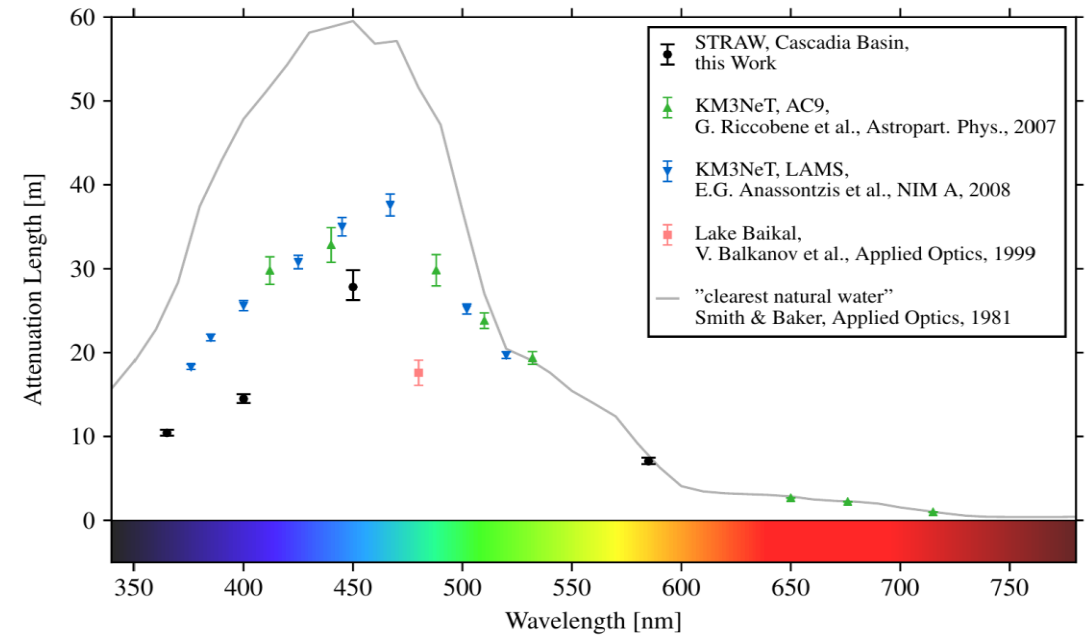


P-ONE project timeline: so far



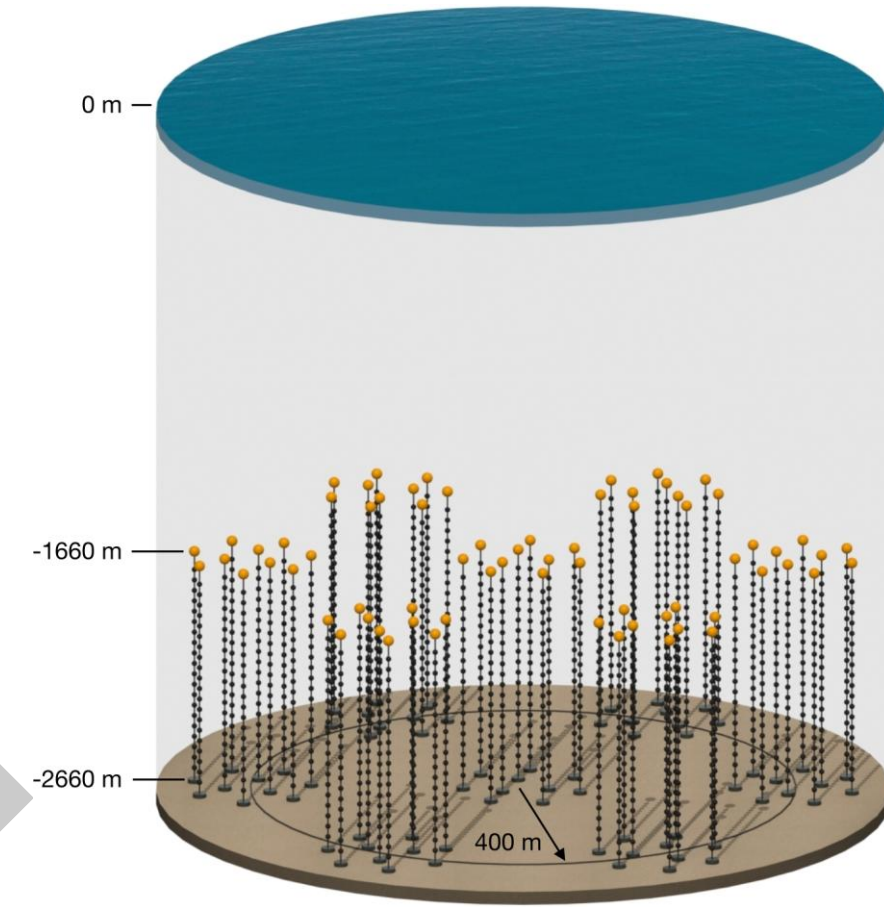
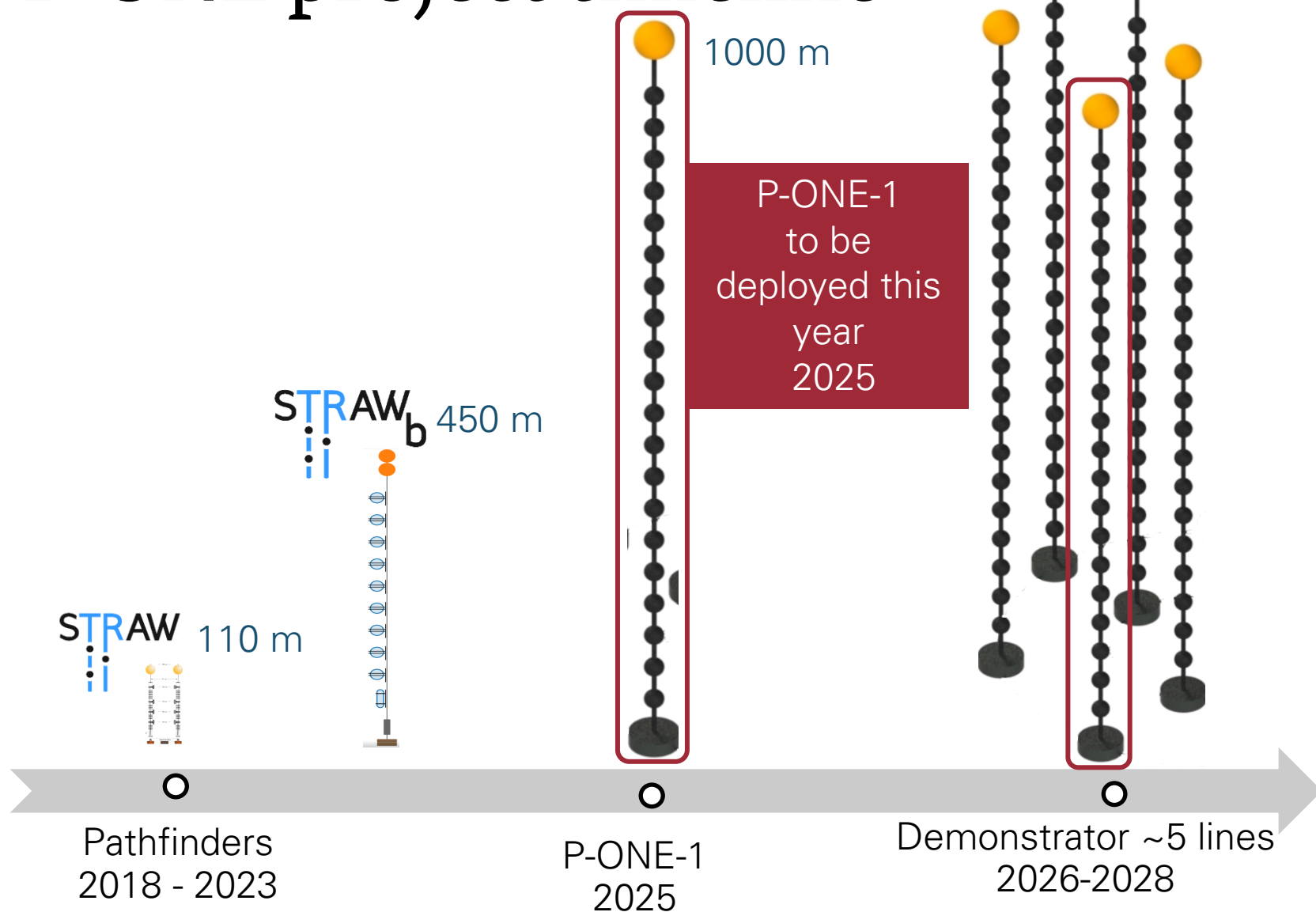
Pathfinders: probing the site for P-ONE

- ❖ STRings for Absorption length in Water – STRAW 5-years operation (98% uptime)
- ❖ Attenuation length $\sim 30\text{m}$ @ 420nm
- ❖ K-40 background quantified
- ❖ Bioluminescence, sedimentation and biofouling identified as main challenges





P-ONE project timeline





P-ONE-1 overview and objectives

- ❖ First line of P-ONE
- ❖ Optical and calibration module development
- ❖ Sub-ns time synchronization
- ❖ Development and proof of deployment concept
- ❖ Collect as much data as possible

Provides benchmark for new technology to be used in P-ONE





P-ONE group at IFJ PAN

- ❖ Paweł Malecki (staff),
- ❖ Konrad Kopański (staff),
- ❖ Wojciech Noga (PhD student),
- ❖ Rafał Wroński (PhD student),
- ❖ Shreya Sharma (PhD student),
- ❖ me (post-doc).



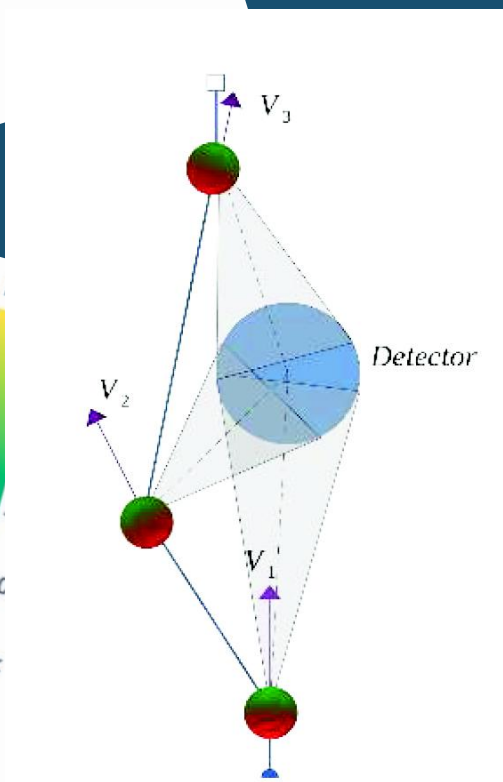
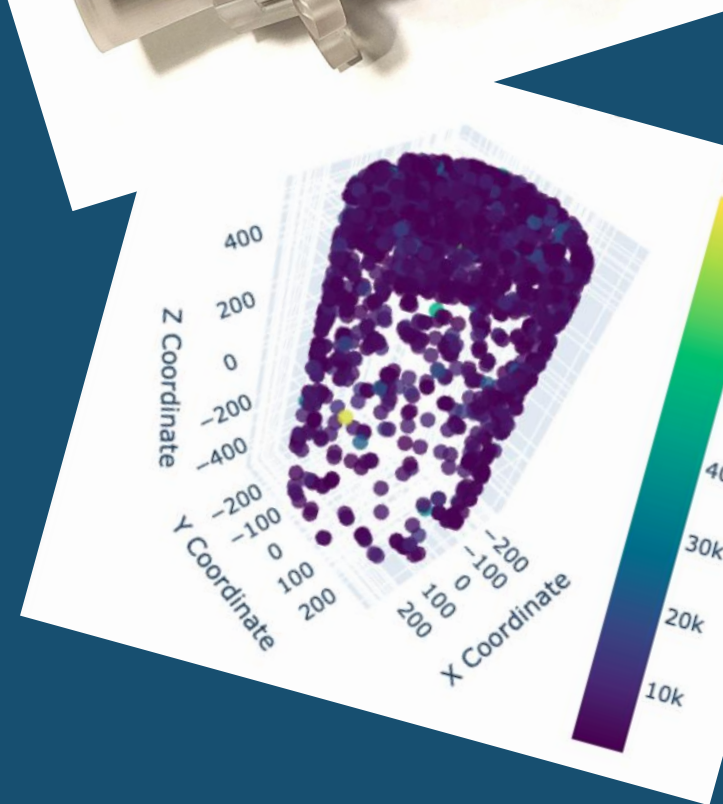
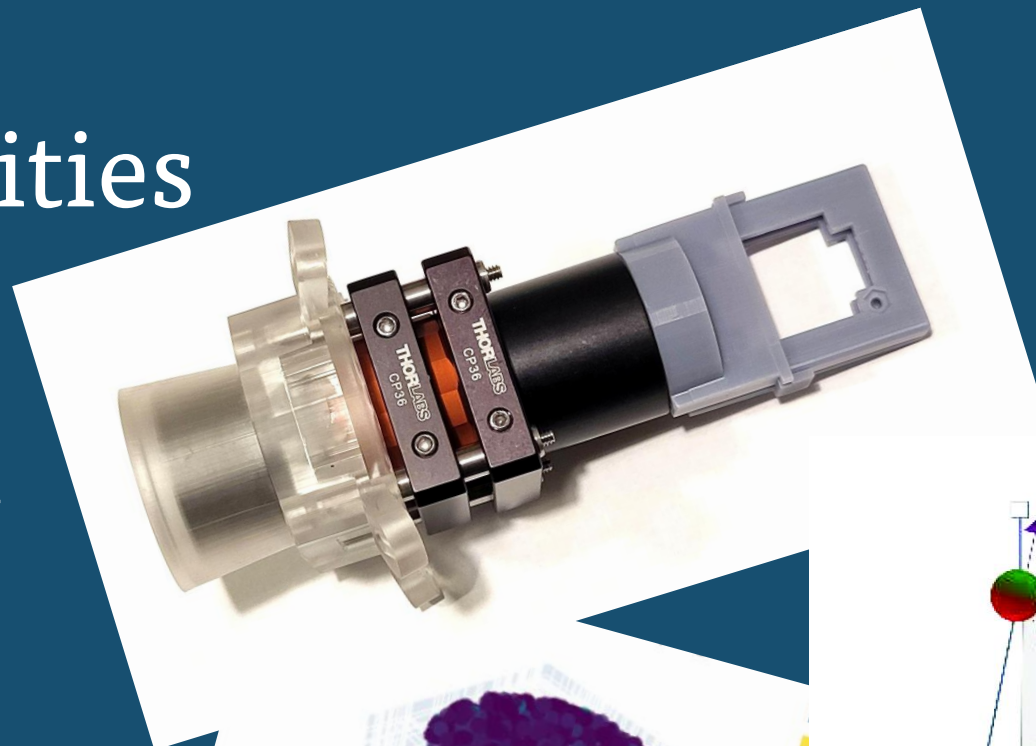
Funding: SONATA BIS (2M PLN 2023-2028)

Look forward to open positions on INSPIRE



P-ONE group: our activities

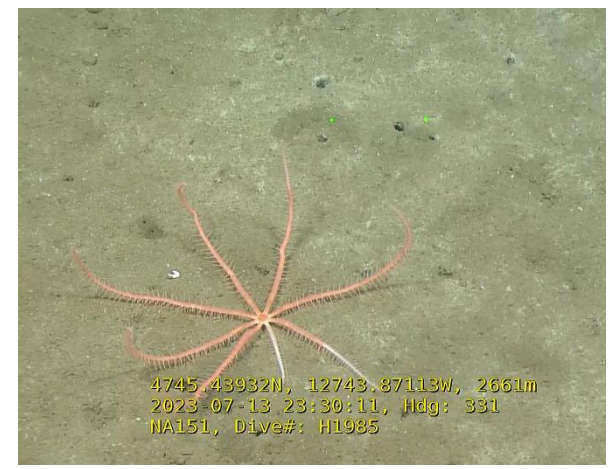
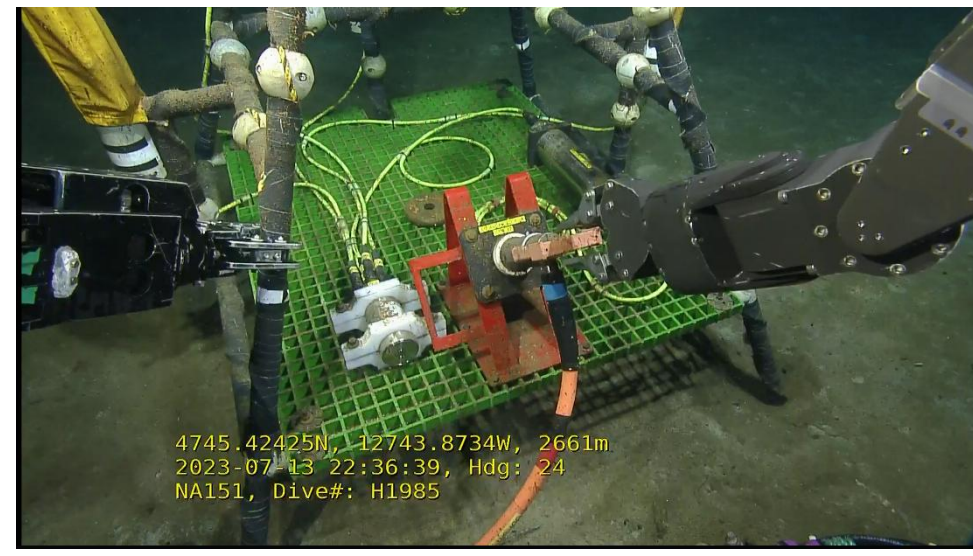
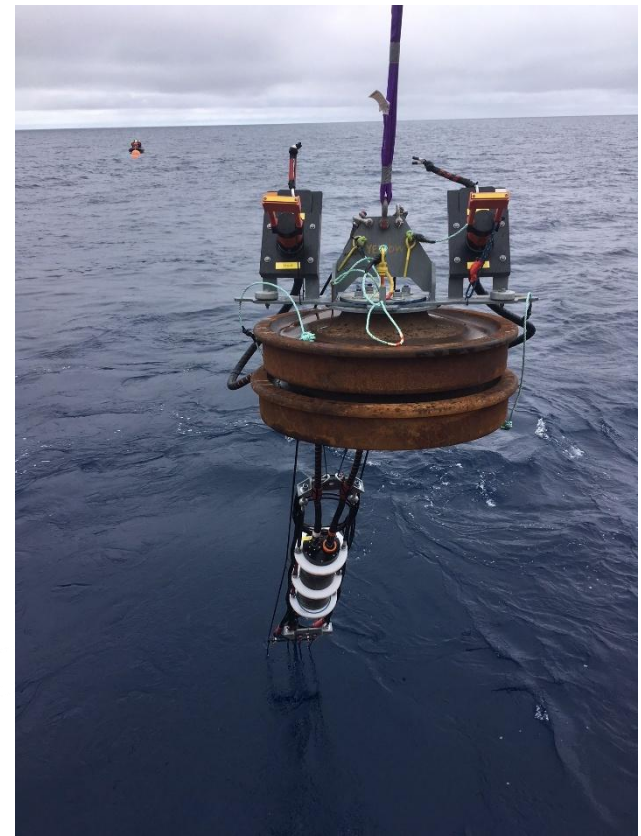
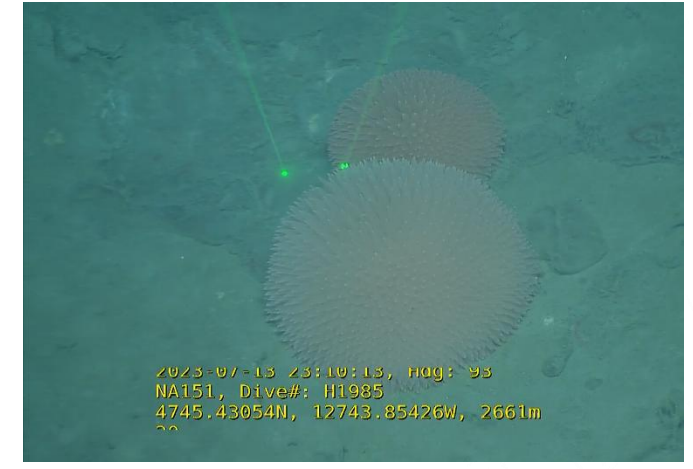
- ❖ Laser calibration system
- ❖ Development and validation of fast photon propagation simulation - Pretorian
- ❖ Geant4 detector simulations - Machine learning based cascade generator
- ❖ Analysis and simulations for muon observations with first line



Summary



- ❖ P-ONE – an exciting potential for new discoveries and observations
- ❖ Infrastructure and deployment support from ONC simplifies the development
- ❖ P-ONE-1 – deployment **2025** – crucial milestone for a future km³ array in the Pacific Ocean



All pictures from ONC

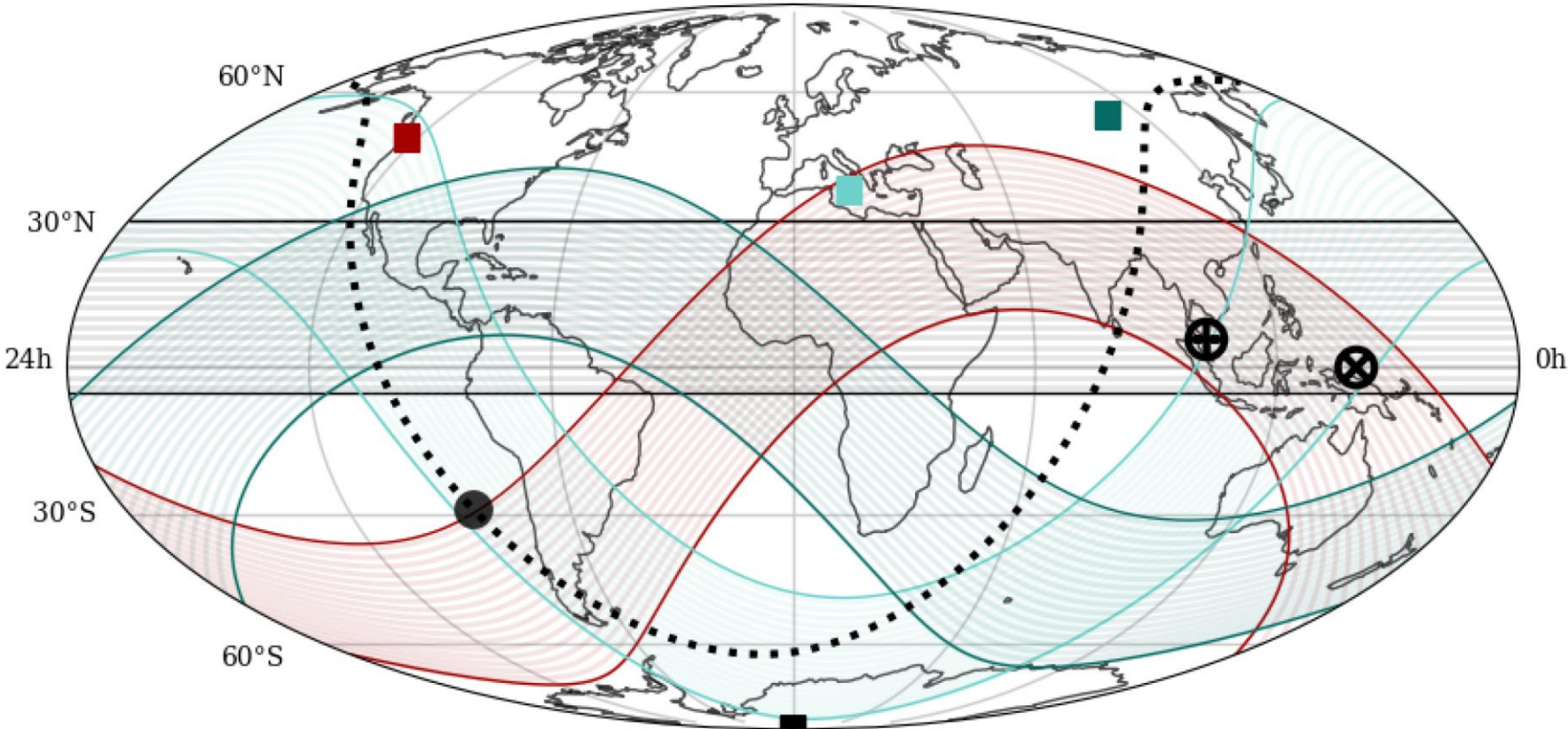


ADDITIONAL SLIDES



Neutrino telescopes – sky coverage

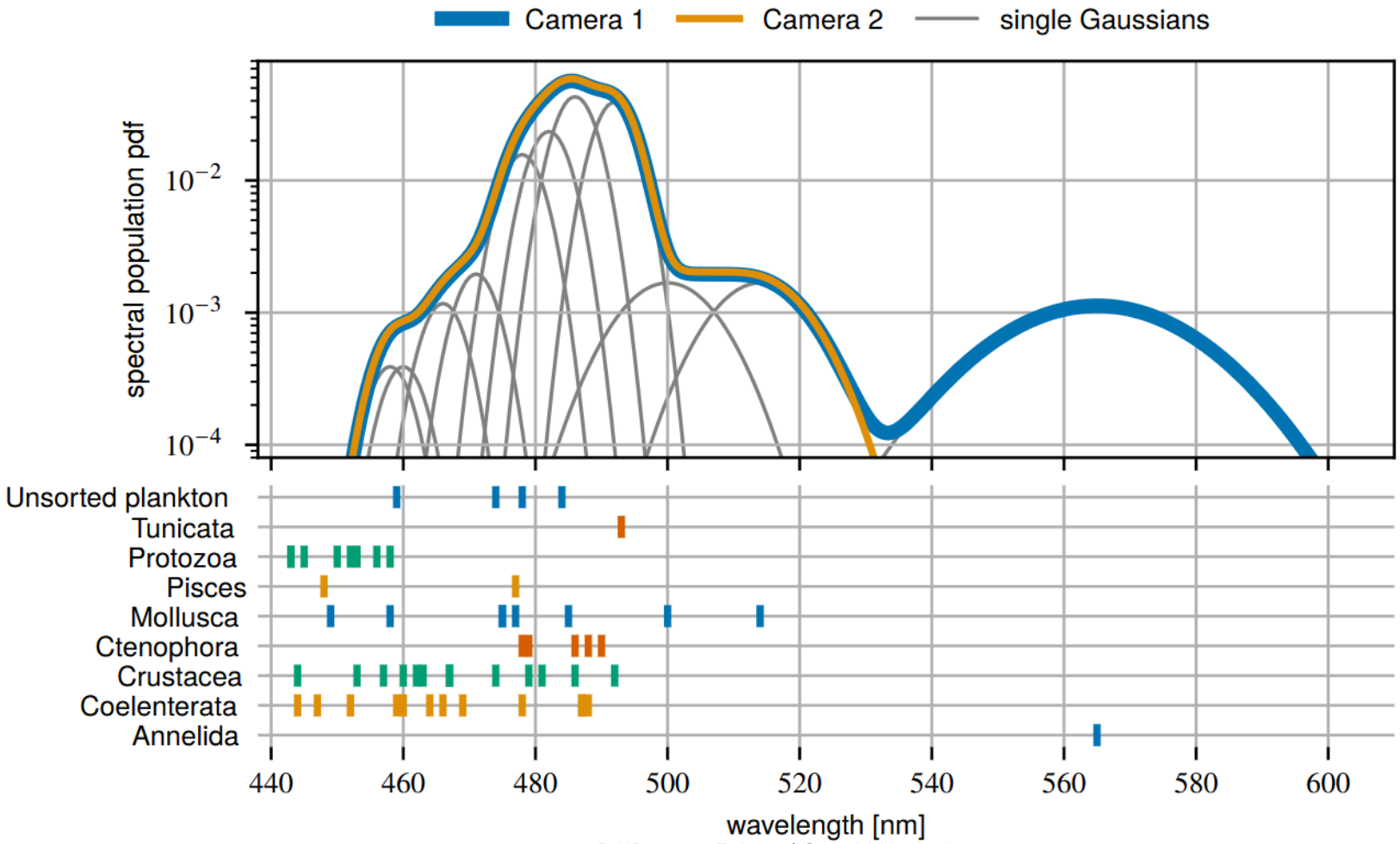
- ⊕ TXS 0506+056
- ⊗ NGC 1068
- Galactic center/plane
- IceCube
- P-ONE
- KM3NeT
- Baikal-GVD



<https://github.com/PLEnum-group/Plenum>



Spectral bioluminescence population



PoS (ICRC2023) 1166



P-ONE calibration and optical module _{P-OM}

❖ Optical module

- ❖ 16 PMTs and optical flashers
- ❖ Modular, spring loaded mounting structure
- ❖ Optical gel pads used to increase light yield

❖ Calibration module

- ❖ Dual purpose: optical and position calibration
- ❖ Includes a camera with a fisheye lens
- ❖ monitor bioluminescence and sediments

