

<http://www.pacific-neutrino.org>



THE PACIFIC OCEAN NEUTRINO EXPERIMENT

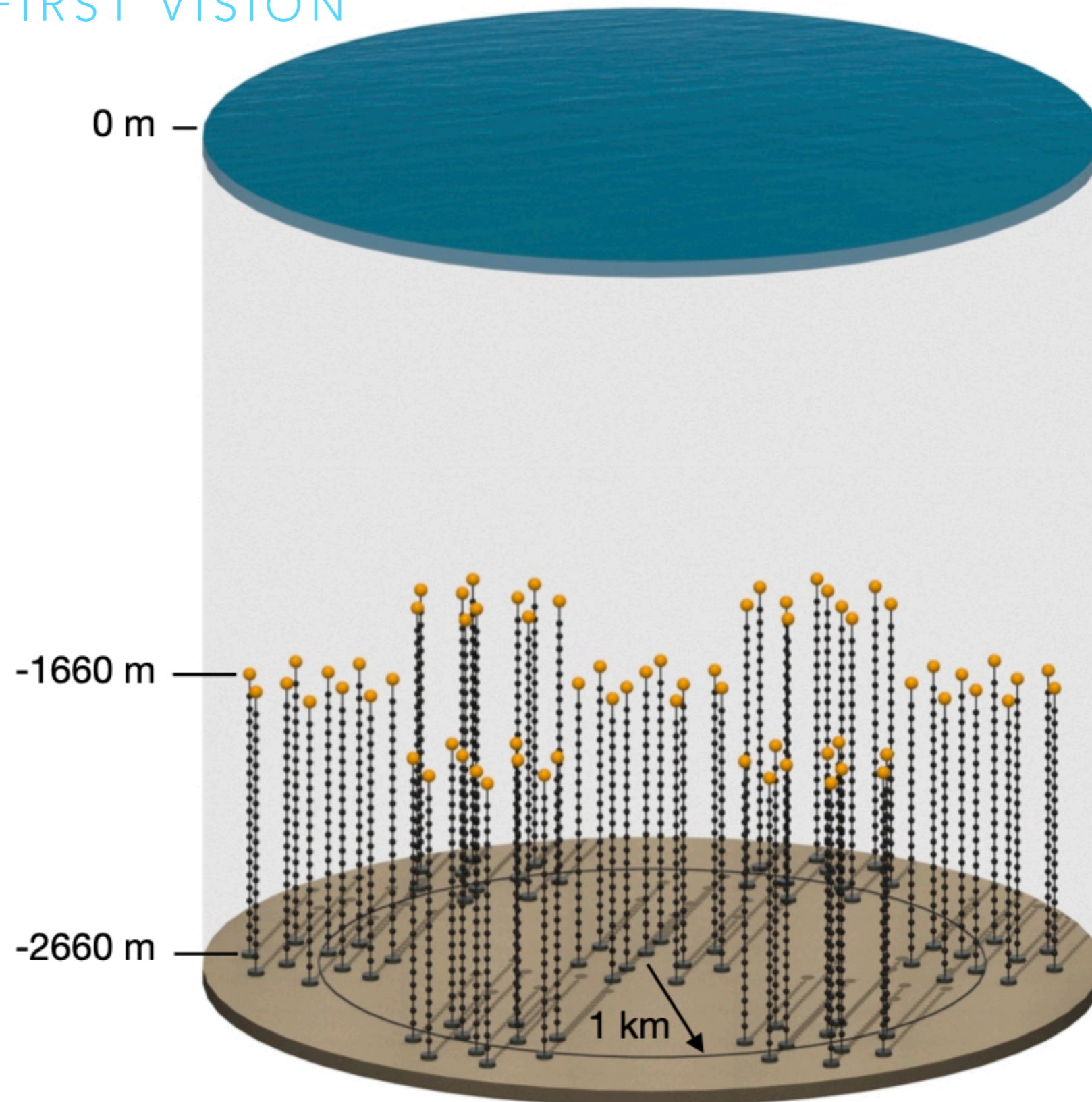
ELISA RESCONI FOR THE P-ONE COLLABORATION



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THE PACIFIC OCEAN NEUTRINO EXPERIMENT

FIRST VISION



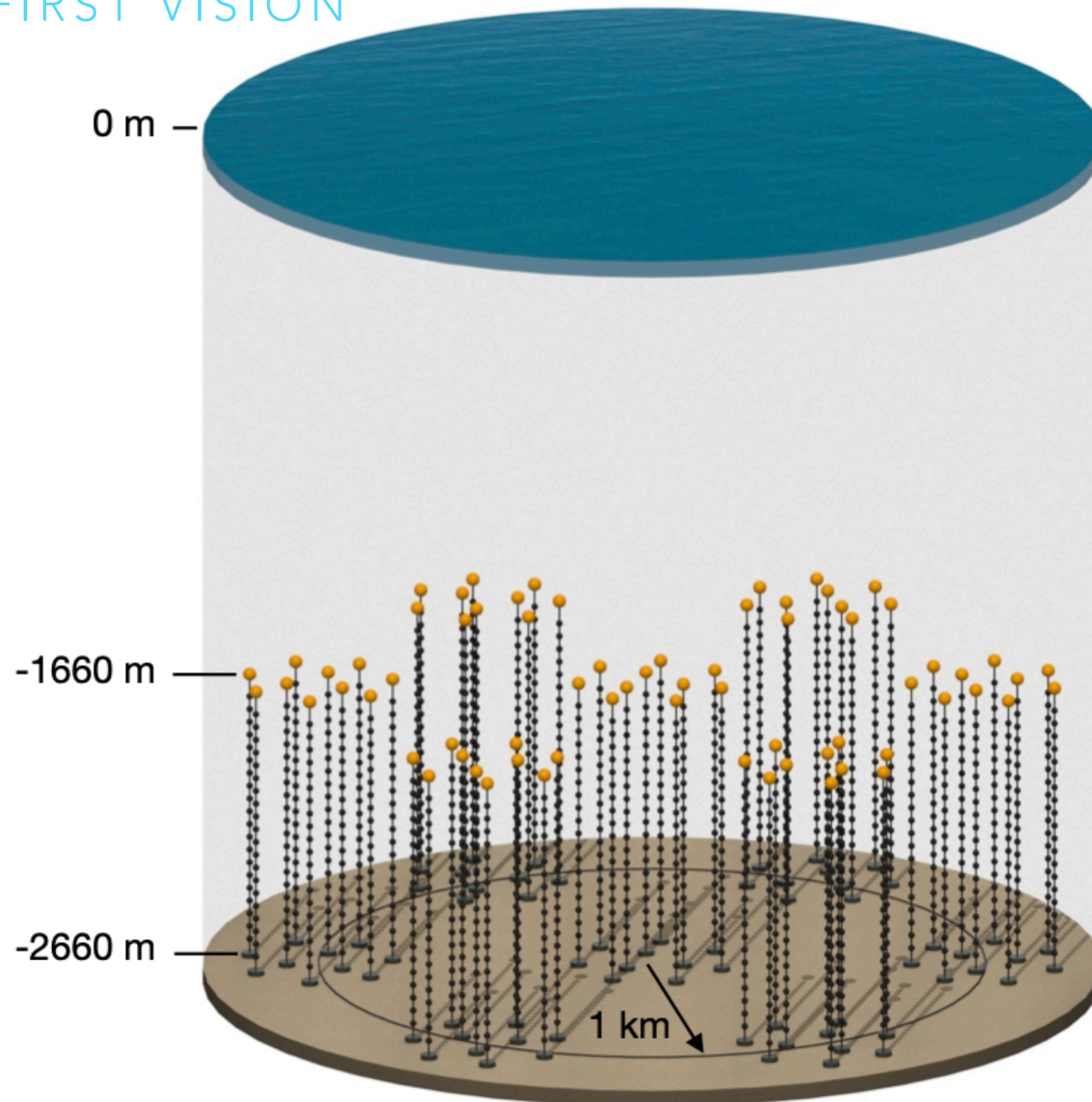
- 3D array of instrumented vertical line, IceCube style;
- mPMT optical sensors, KM3NeT style;
- clusters of instrumented vertical lines, GVD style.

What is new about P-ONE?

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THE PACIFIC OCEAN NEUTRINO EXPERIMENT

FIRST VISION



- 3D array of instrumented vertical line, IceCube style;
- mPMT optical sensors, KM3NeT style;
- clusters of instrumented vertical lines, GVD style.

What is new about P-ONE?

**First Neutrino Telescope
hosted by an existing
large scale oceanographic
infrastructure:
Ocean Networks Canada**



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E. RESCONI

THE INTERNET-CONNECTED OCEAN OCEAN NETWORKS CANADA (UNIVERSITY OF VICTORIA)

<https://www.oceannetworks.ca>

<https://data.oceannetworks.ca/home>

Cabled ocean observatory: North East Pacific Time-series Underwater Networked Experiment (**NEPTUNE**), completed in 2009, multidisciplinary subsea system.

- 800 km loop of fibre-optic cables;
- Highly reliable underwater operations distributed to 5 nodes;
- Each node:
 - high-speed data link (up to 4 Gb/s per node);
 - high power (~8 kW/node);
 - read data in real time at high time resolution.

Installation of the scientific instrumentation: *plug and play*.

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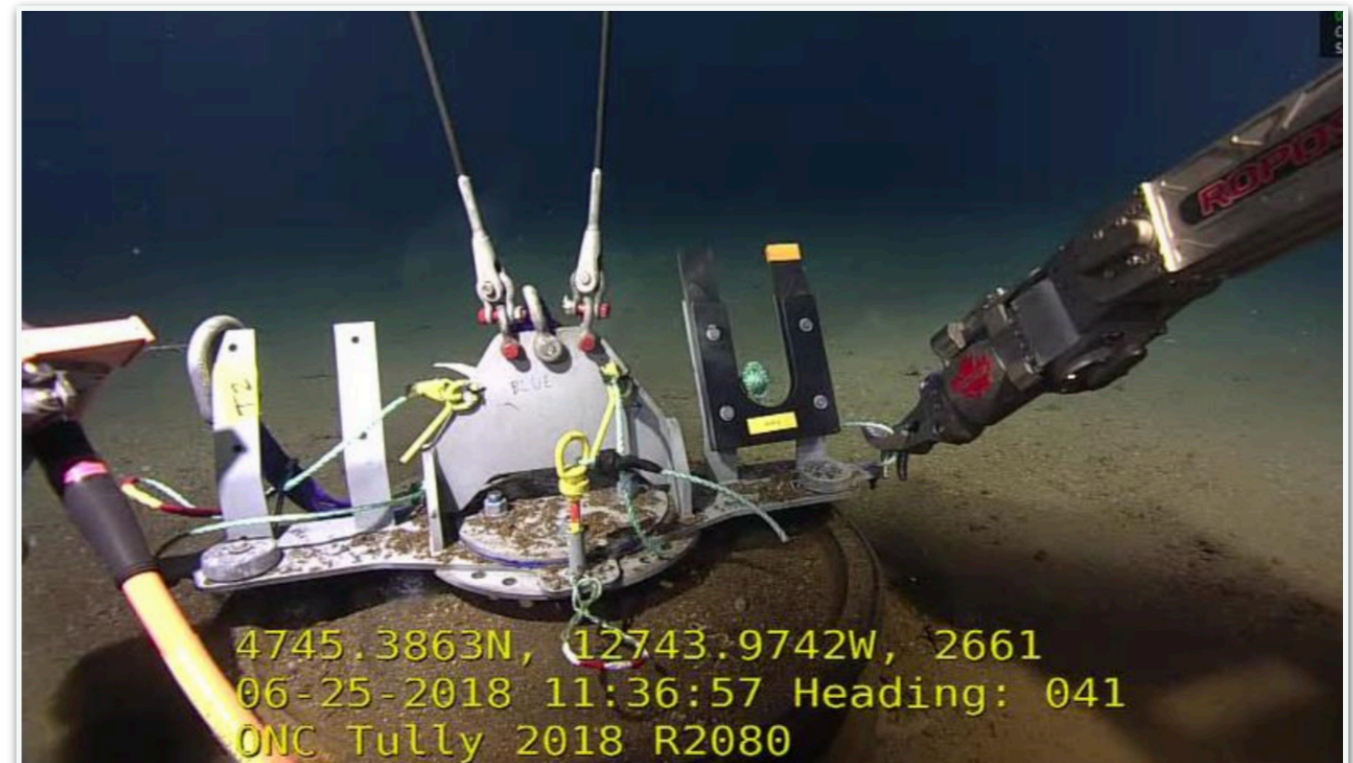
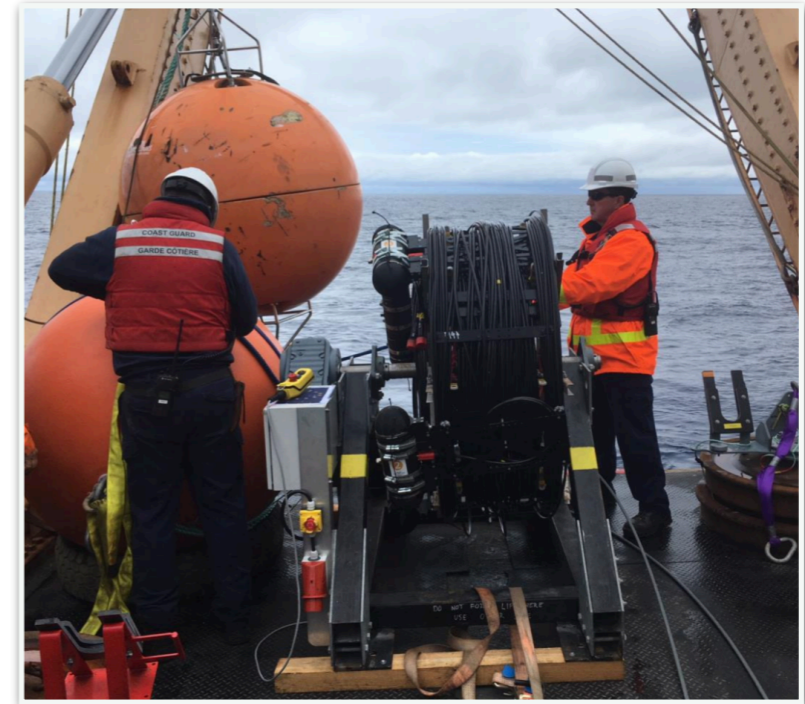
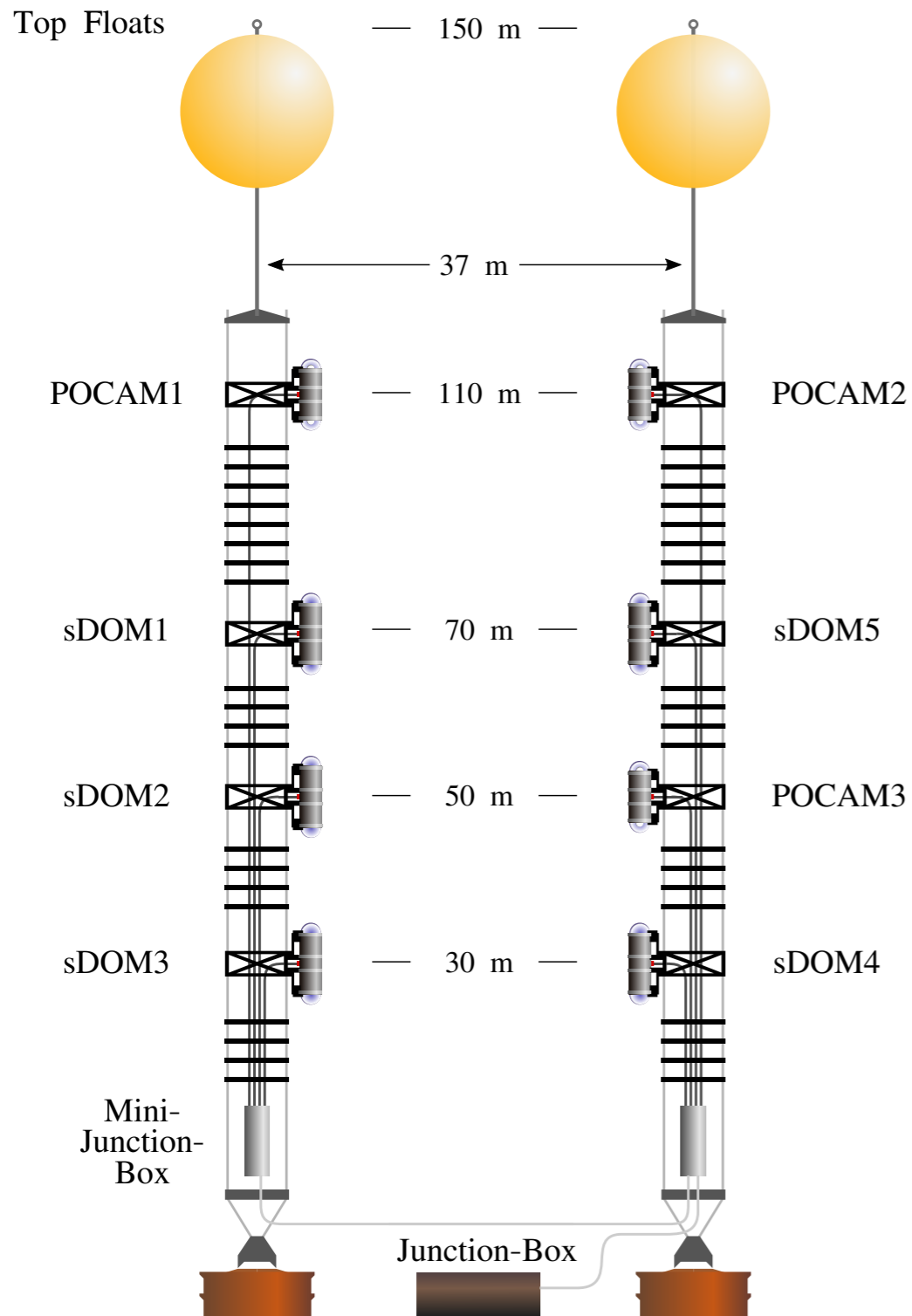
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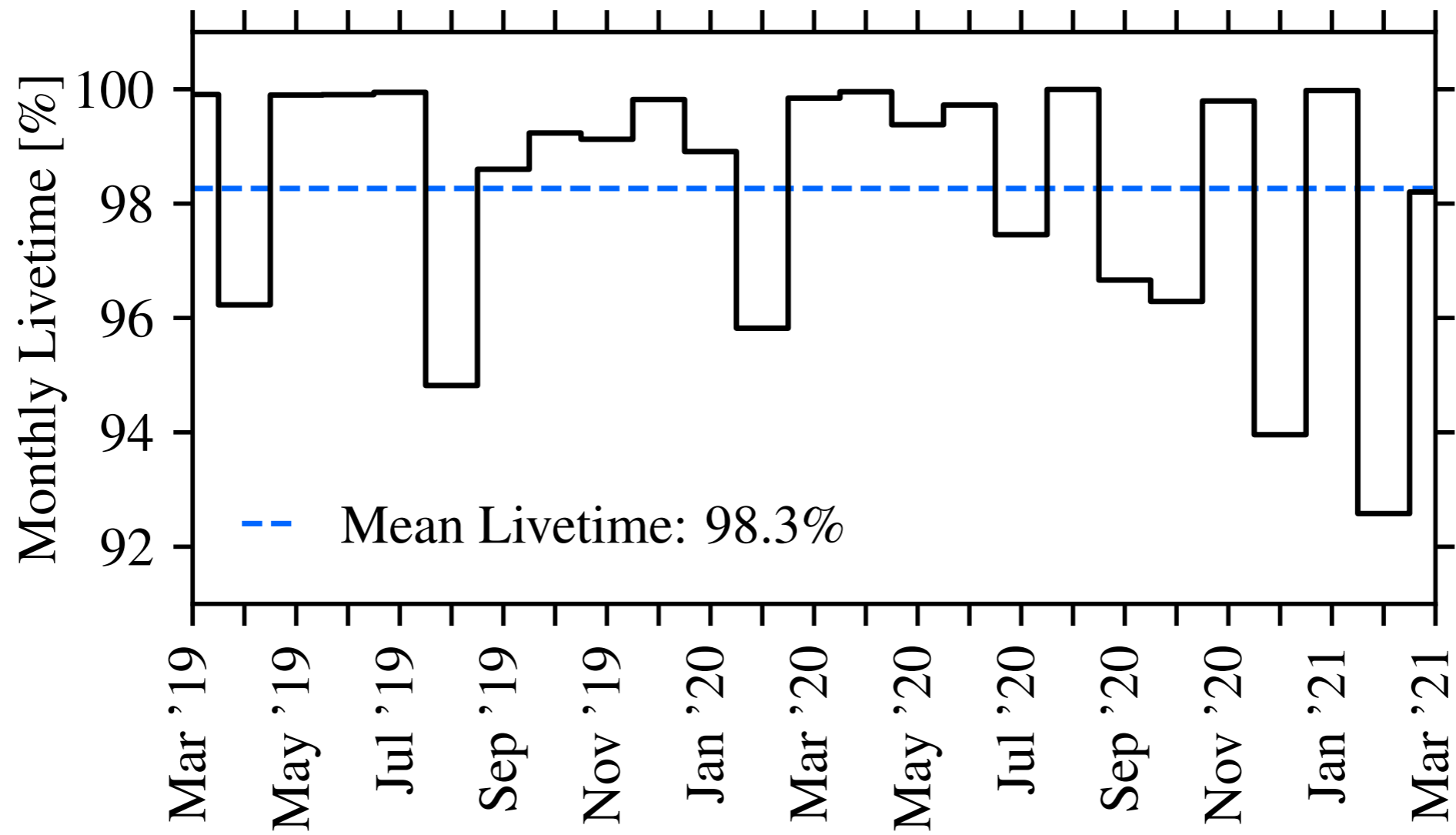
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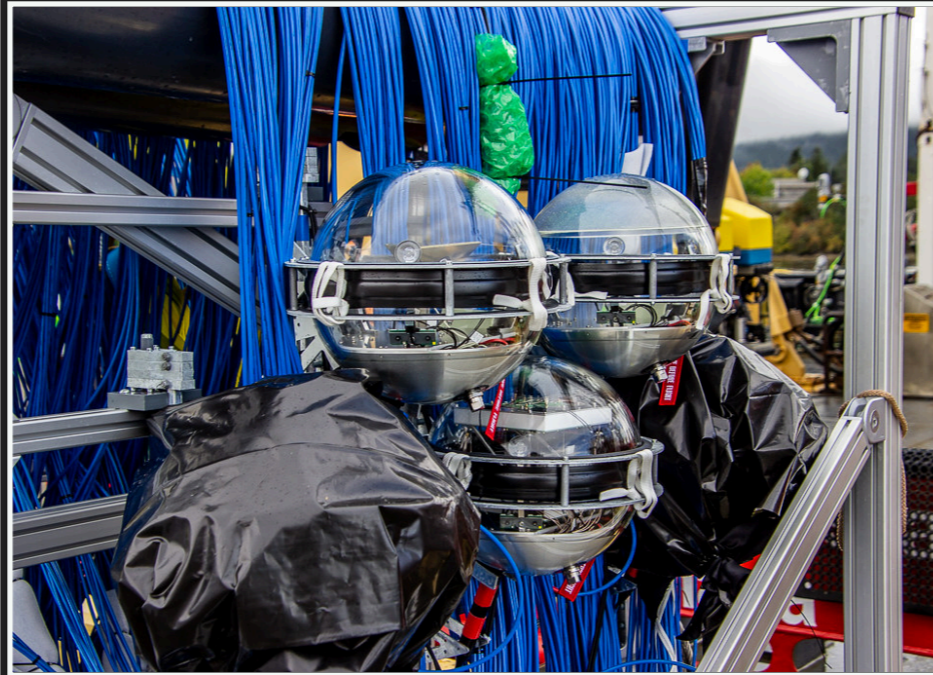
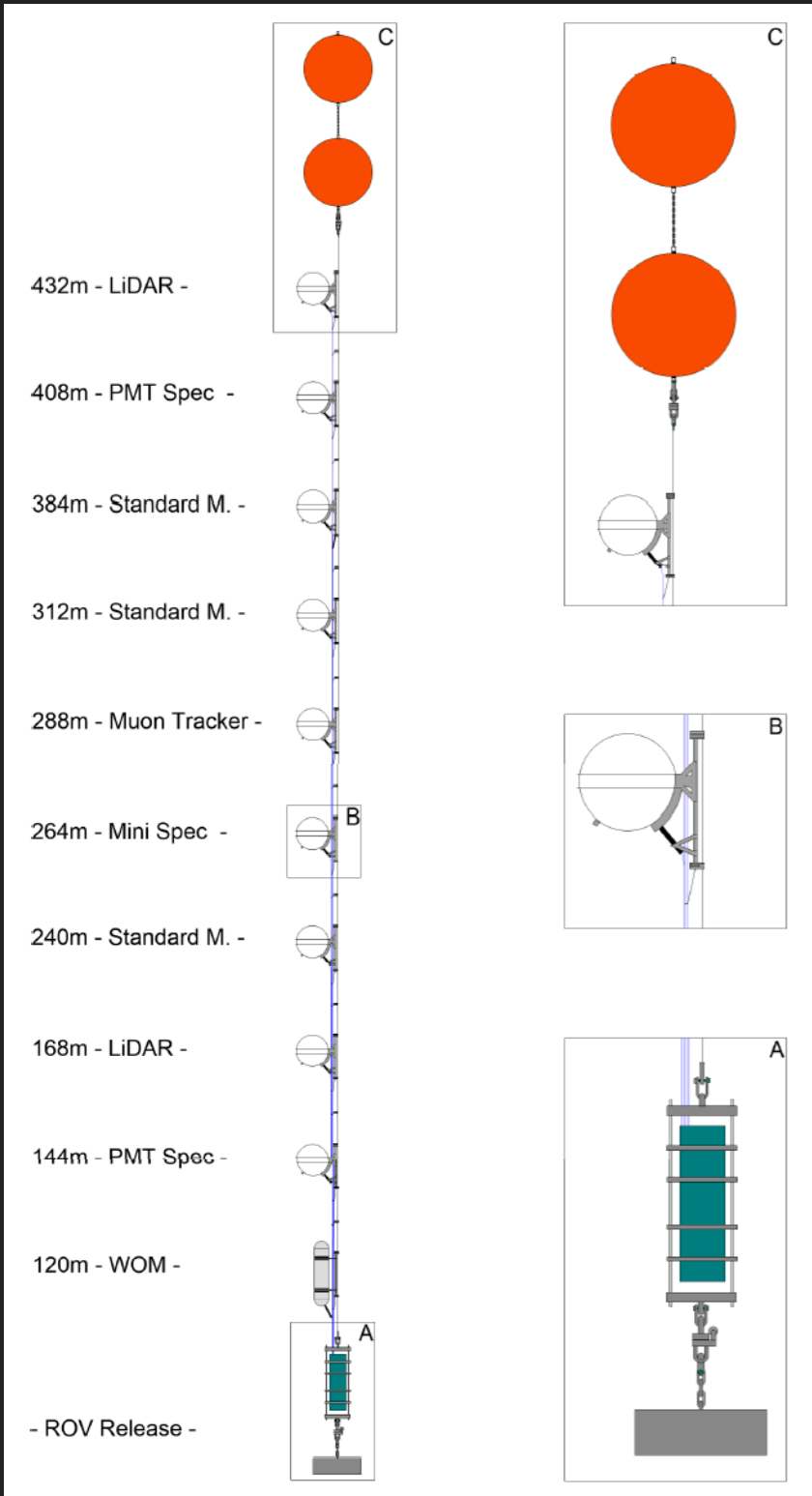
TWO PATHFINDER MISSIONS (2018, 2020)



TWO PATHFINDER MISSIONS (2018, 2020)

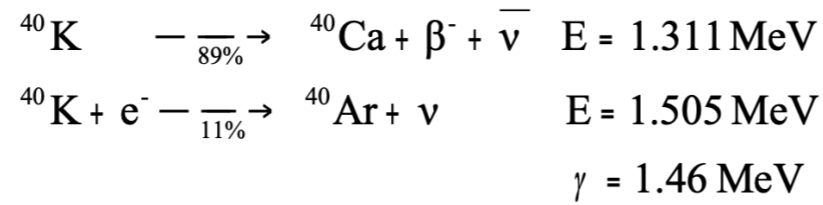


OPTICAL PROPERTIES INVESTIGATION TWO PATHFINDER MISSIONS (2018, 2020)



OPTICAL PROPERTIES INVESTIGATION TWO PATHFINDER MISSIONS (2018, 2020)

Result No.1: ^{40}K in situ measurement

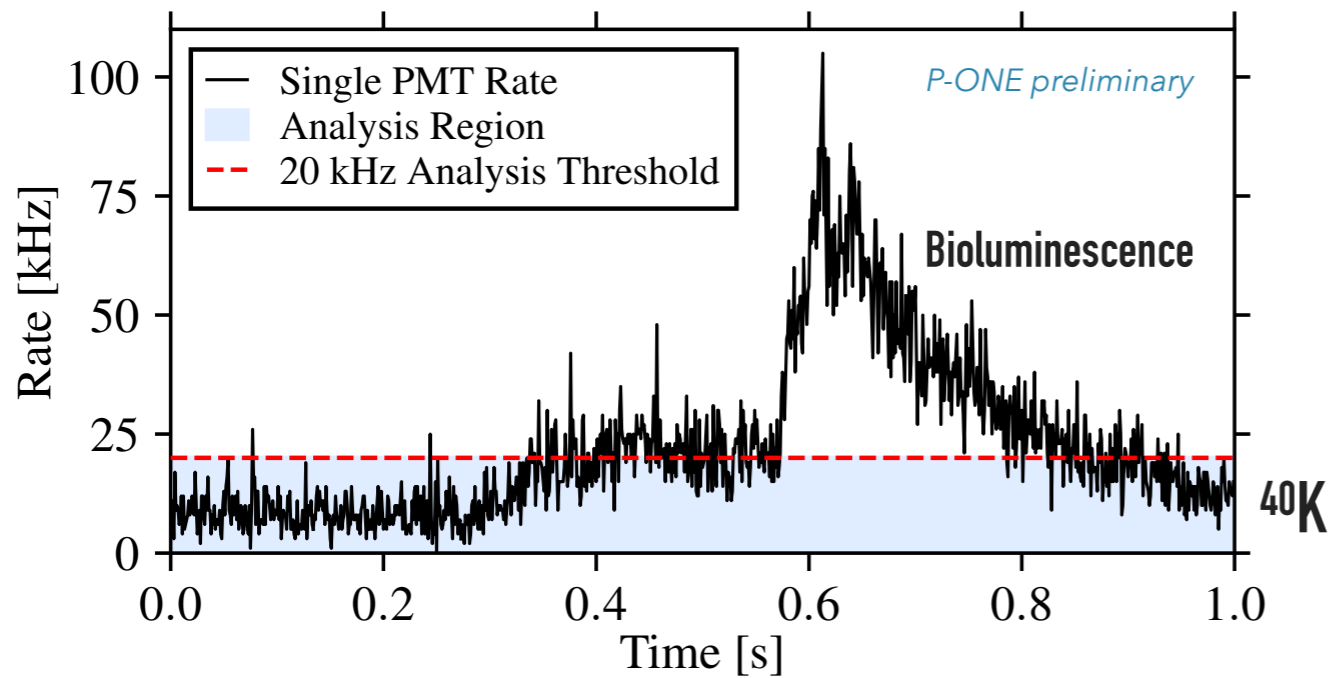


Long-term monitoring of the ANTARES optical module efficiencies using ^{40}K decays in sea water

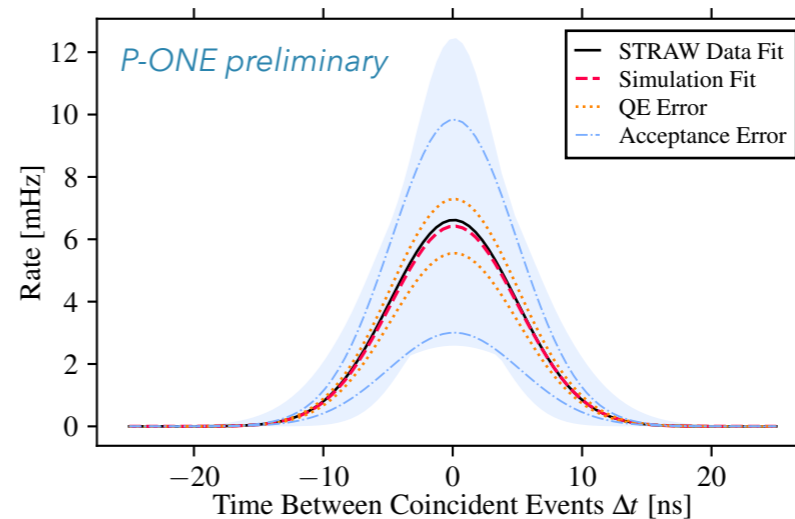
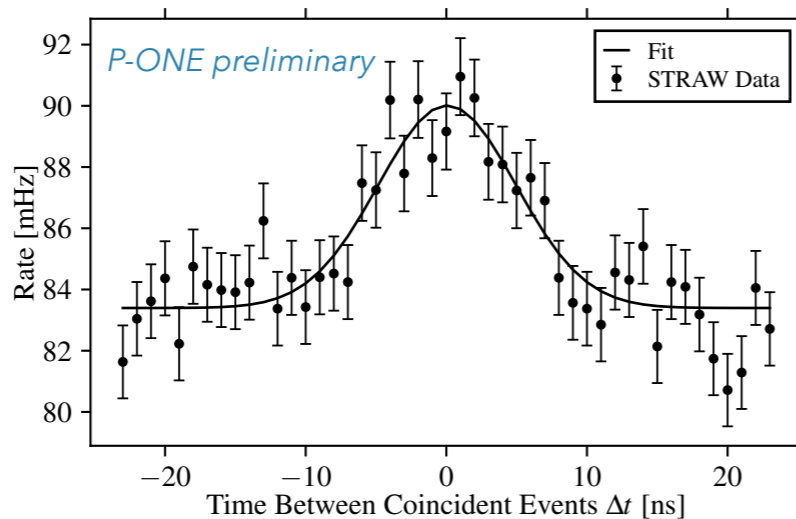
The ANTARES Collaboration

A. Albert, M. André, [...] J. Zúñiga

The European Physical Journal C **78**, Article number: 669 (2018) | [Cite this article](#)

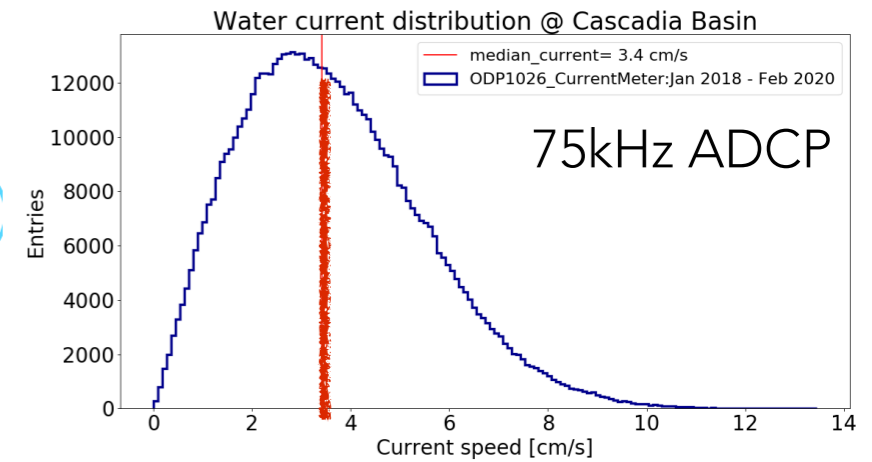


SALINITY FROM THIS WORK: $2.7 \pm 1.5\%$
 SALINITY FROM ONC: $3.482 \pm 0.001\%$
 SALINITY AT ANTARES SITE: 3.844%

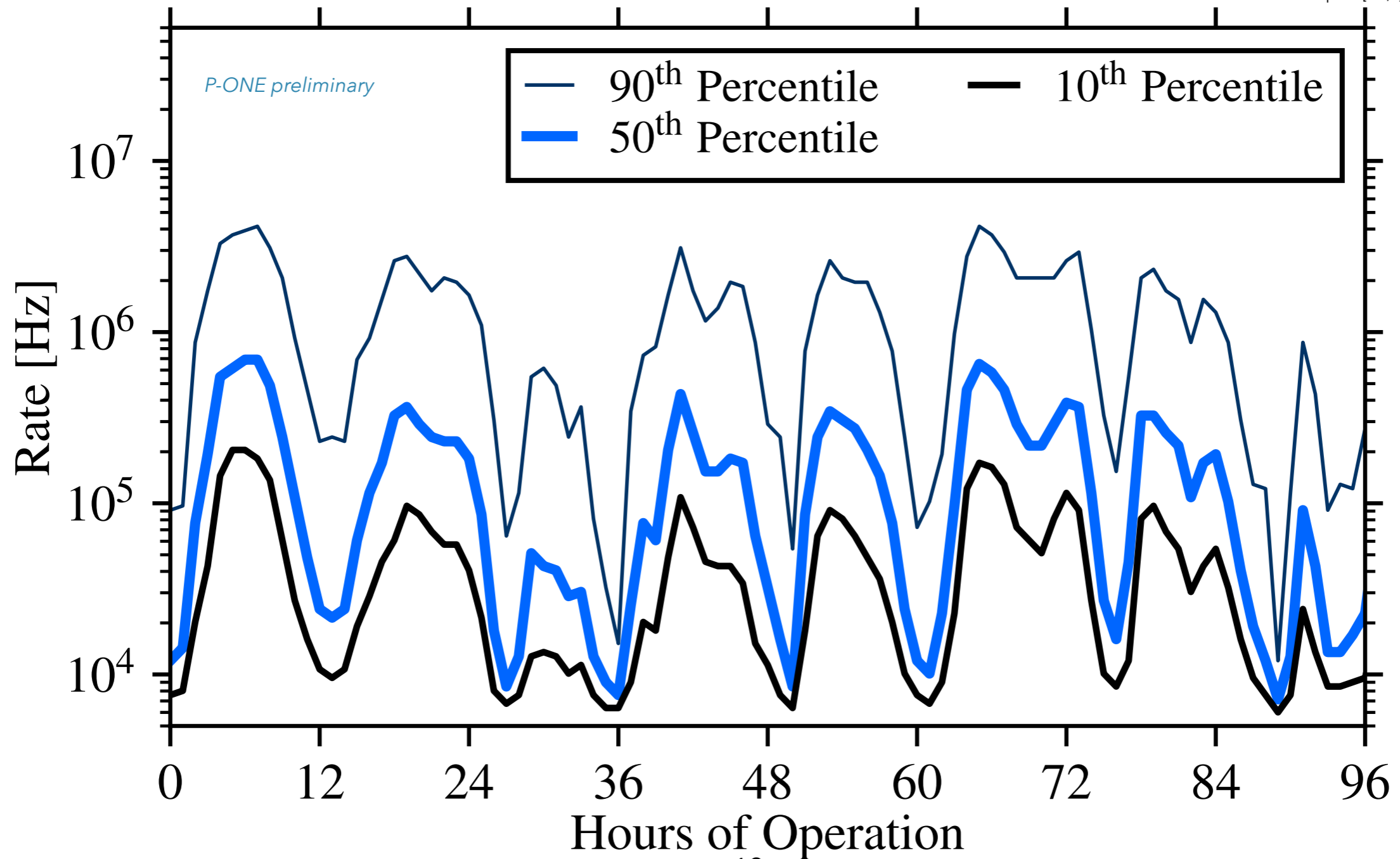


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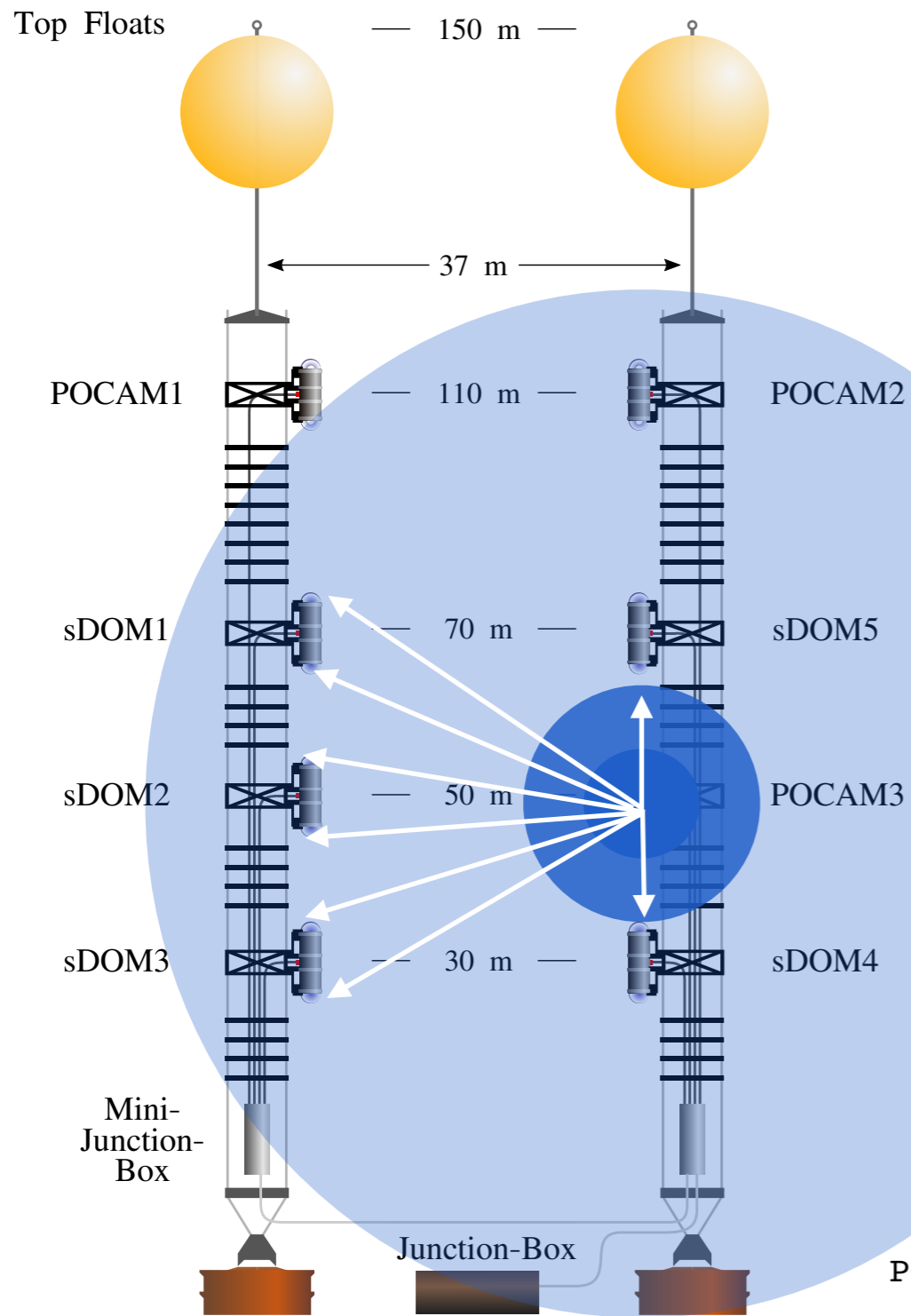
OPTICAL PROPERTIES INVESTIGATION TWO PATHFINDER MISSIONS (2018, 2020)



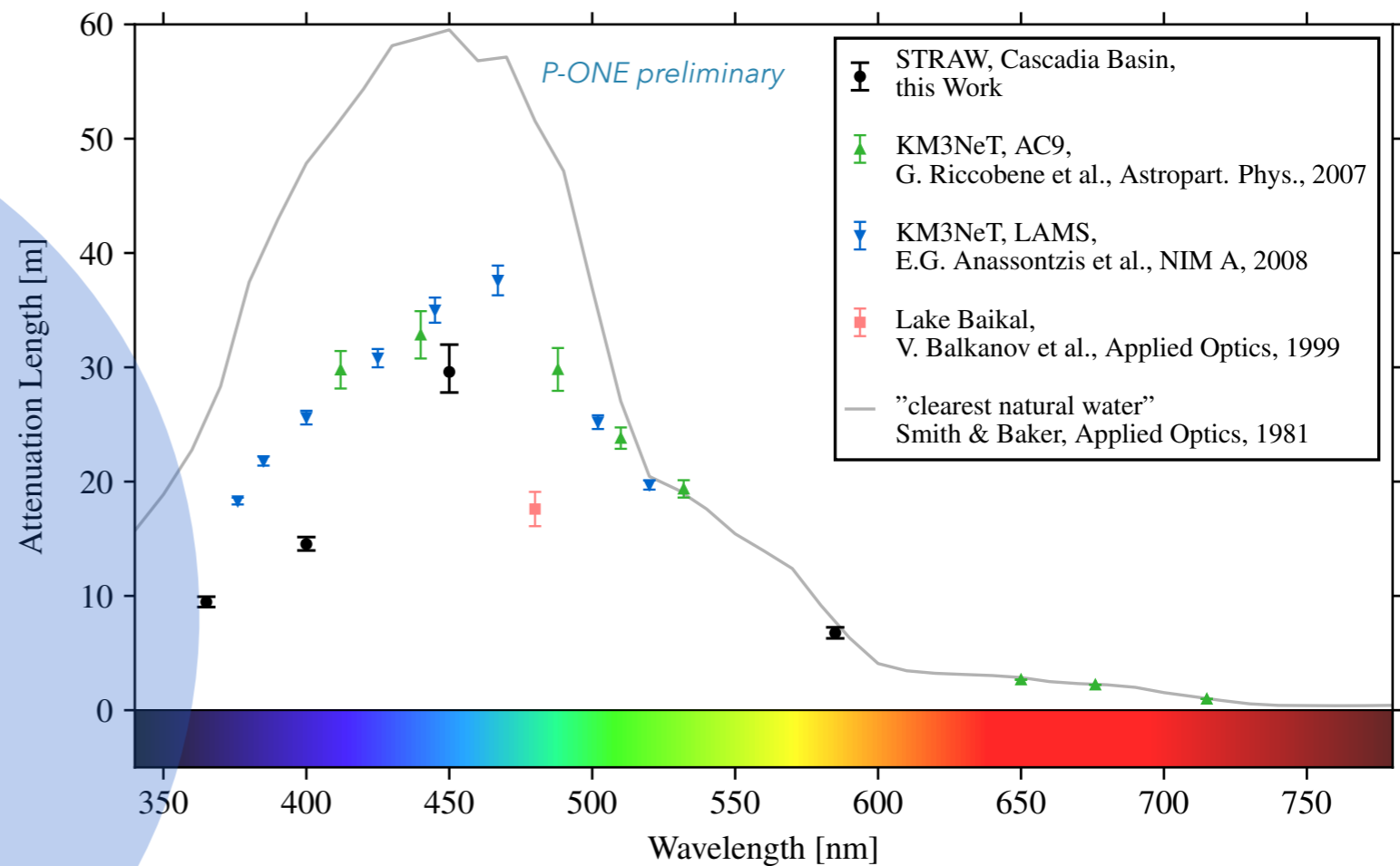
Results No.2: Bioluminescence modulated as the ocean's tides



OPTICAL PROPERTIES INVESTIGATION TWO PATHFINDER MISSIONS (2018, 2020)



Result No.3: Attenuation length



POCAM, PoS(ICRC2021)1149, N. Khera, F. Henningsen, et al.

INTERDISCIPLINARY STUDIES, BACKGROUND MODELLING SPECIALISED SENSORS: PMT SPECTROMETER



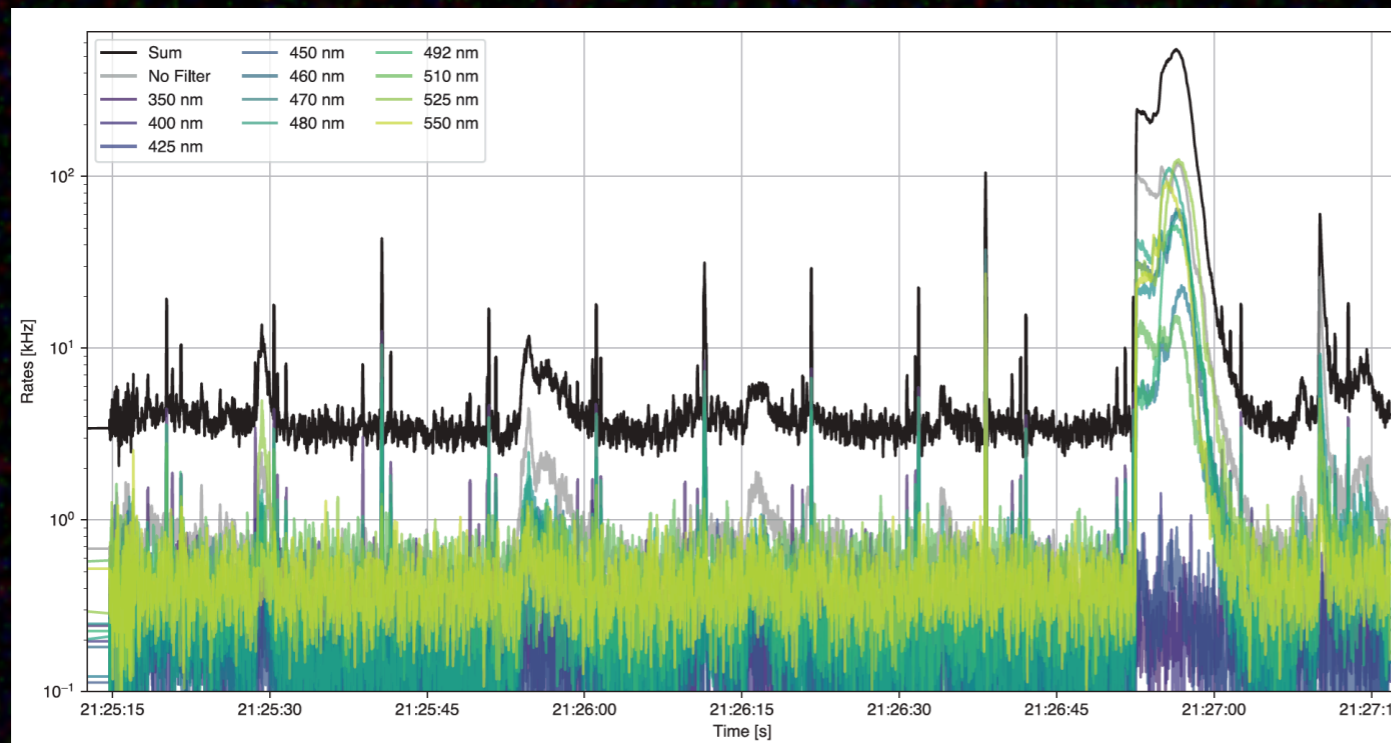
P-ONE preliminary

OPTICAL PROPERTIES INVESTIGATION TWO PATHFINDER MISSIONS (2018, 2020)

Picture of a bioluminescent animal (1 min exposure)



Emission spectrum of the same bioluminescent animal; bioluminescence simulation on-going effort from



S. Meighen-Berger, L. Ruohan, G. A. Wimmer, Bioluminescence modeling for deep sea experiments, submitted to Deep-Sea Research

INTERDISCIPLINARY: OCEANOGRAPHY, MICROBIOLOGY,
CLIMATE CHANGE RELATED STUDIES

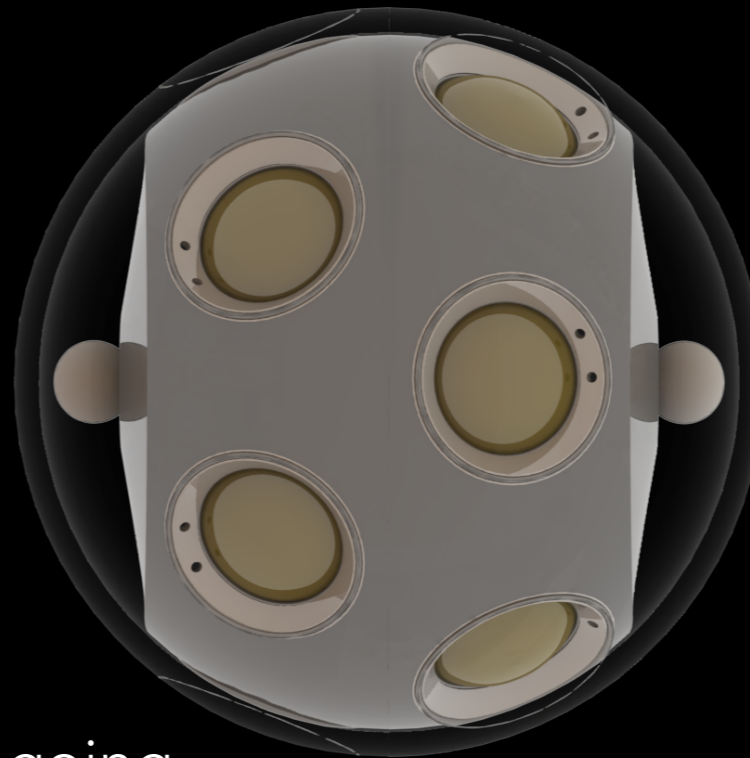
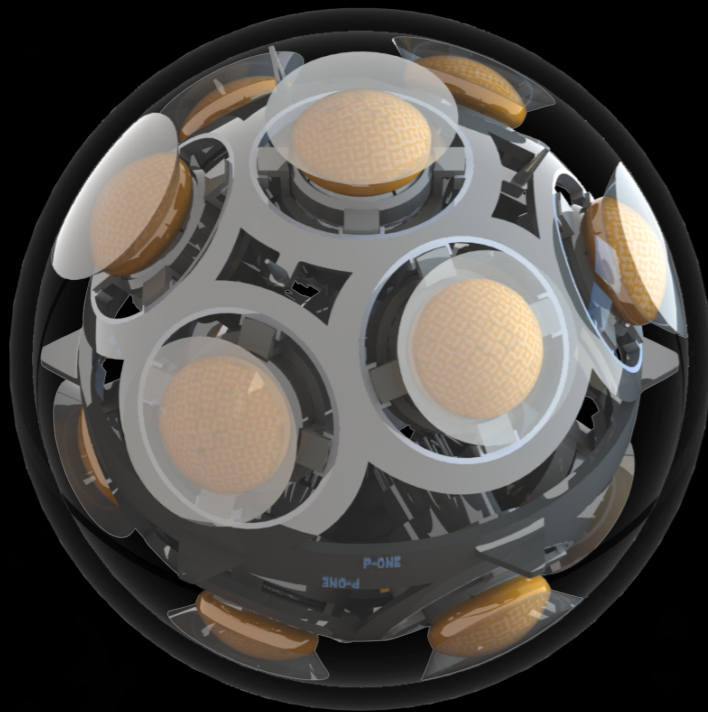
- ☑️ ONC supports of sea operations: plug and play;
- ☑️ ONC supports of slow control, data monitoring, communication, outreach, diversity, CO2 neutrality ... great partner;
- ☑️ Cascadia basin -2.6 km deep site ambient background, comparable to other sites;
- ☑️ Cascadia basin -2.6 km attenuation length comparable to other sites.

We can!

BUILD P-ONE: STEP 1 THE PROTOTYPE LINE (750-1000 METERS)

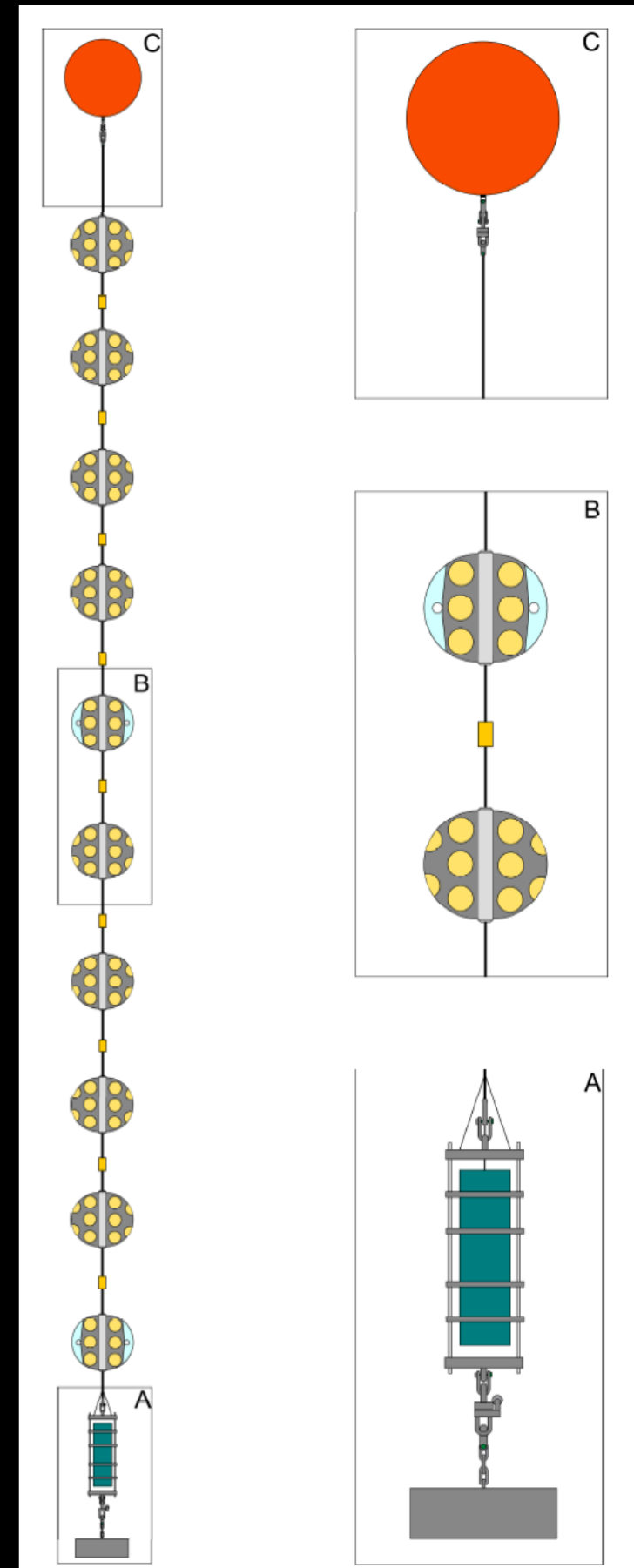
18-20 optical sensors

2-5 calibration modules

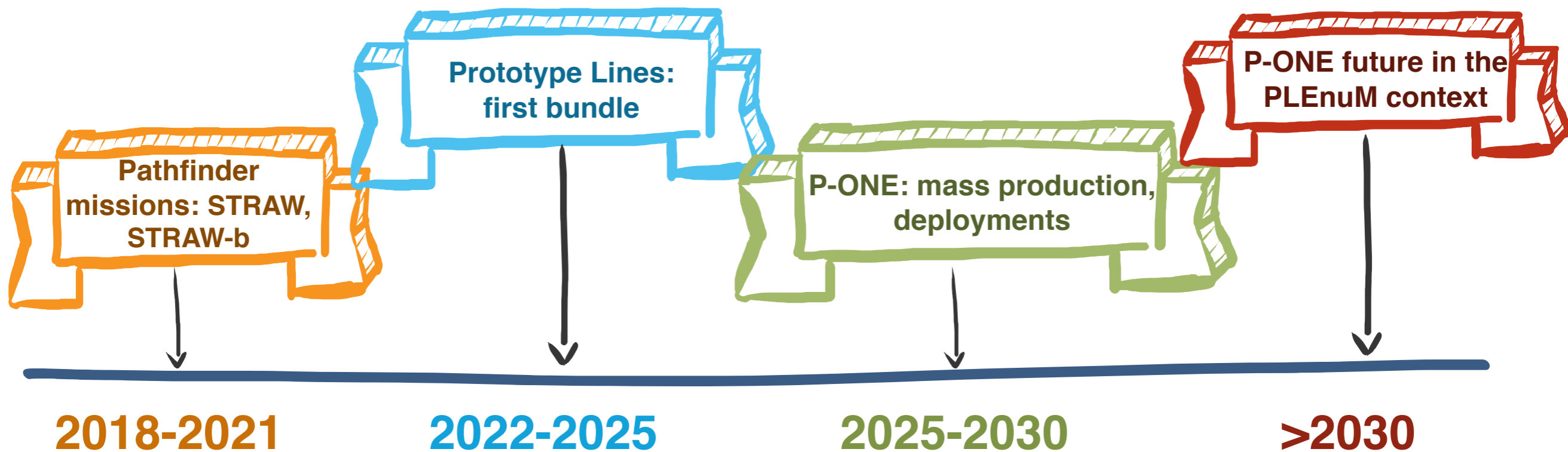


Prototypes: on going

Cable outreach on-going;
Mini-junction box (triggering system): under design;
Time synchronisation system: under design.



BUILD P-ONE: TIMELINE

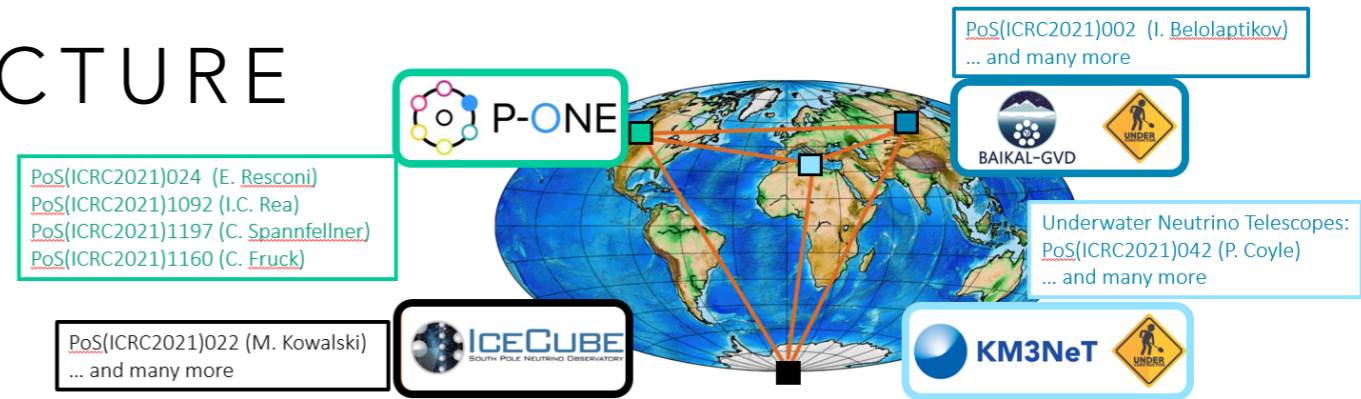


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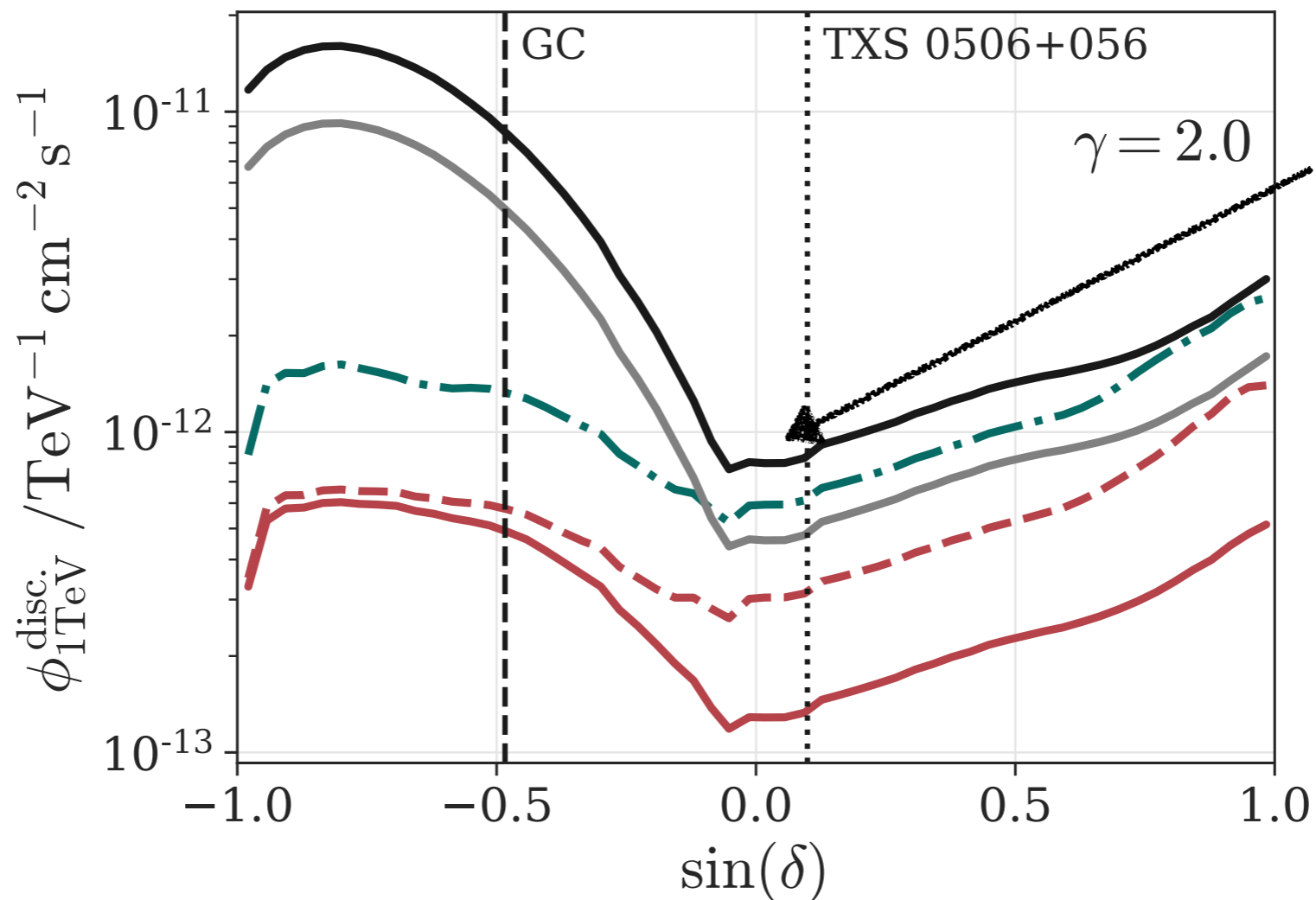
E. RESCONI

P-ONE IN THE GLOBAL PICTURE

PLENUM



- IceCube (10yr)
- IceCube + P-ONE (10yr)
- IceCube (20yr)
- - - IceCube + PLE ν M-1 (10yr)
- IceCube + PLE ν M-2 (10yr)



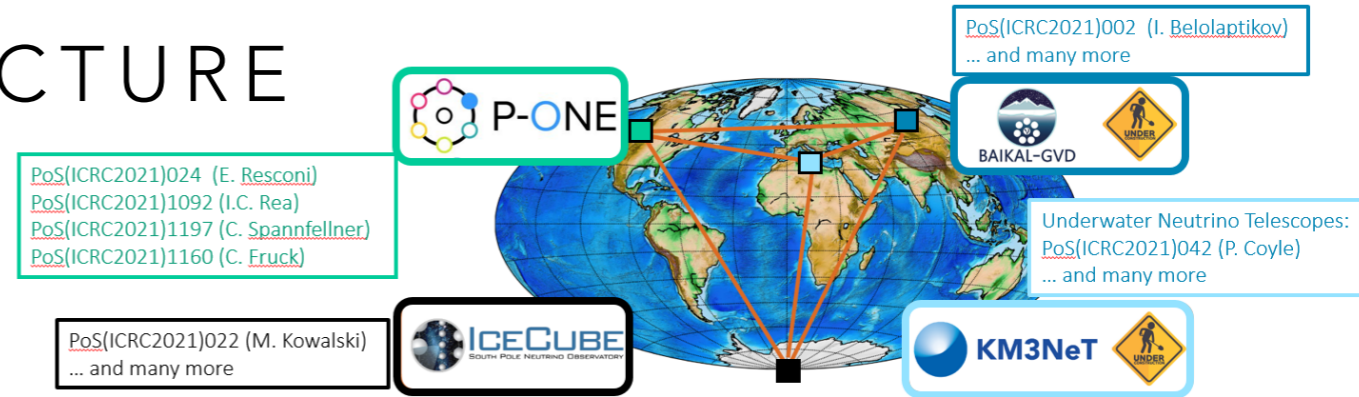
FIRST HINTS OF SOURCES FROM ICECUBE

ICRC'21.

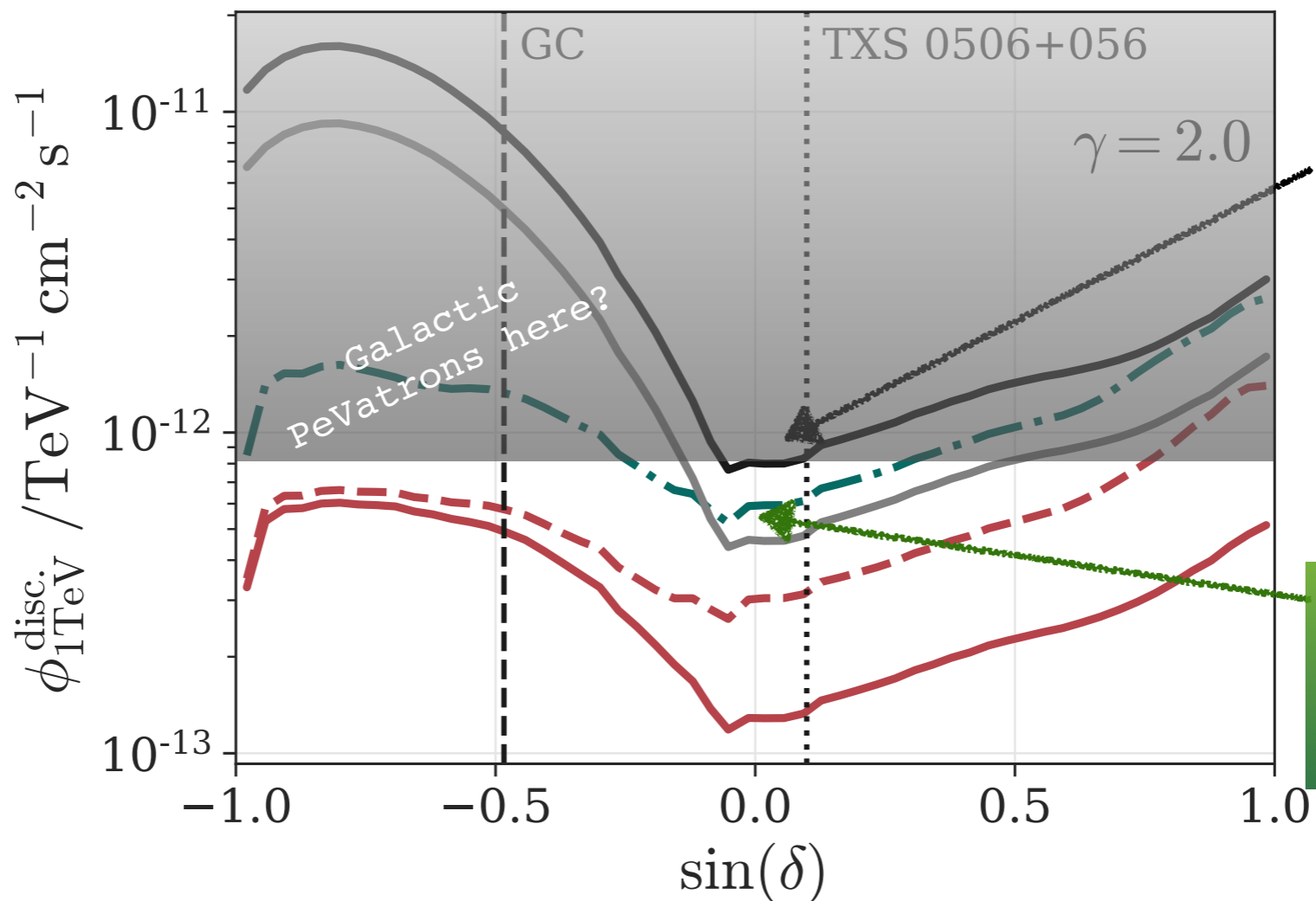
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FIRST HINTS OF SOURCES FROM ICECUBE

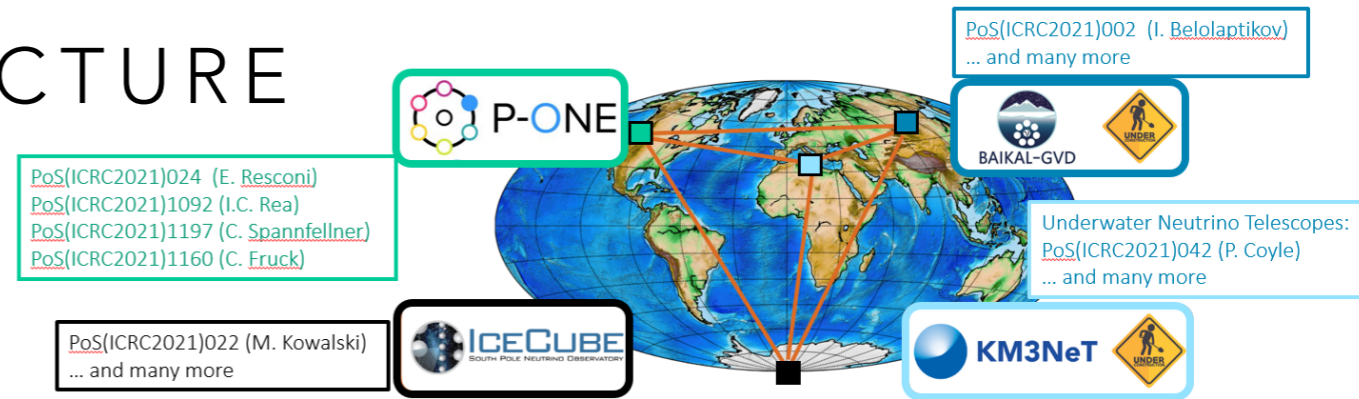
+ONE NEUTRINO TELESCOPE IN THE NORTH

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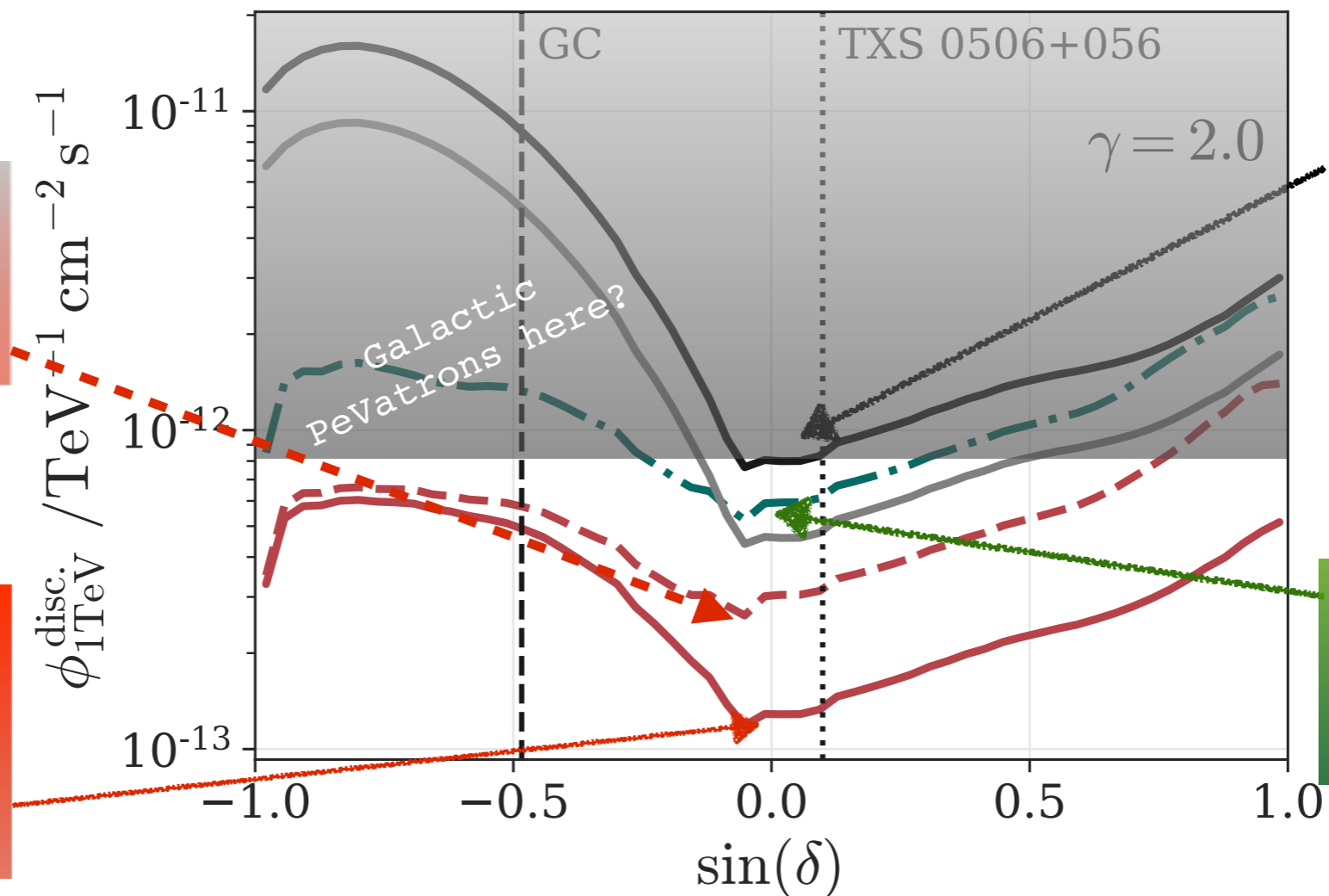
P-ONE IN THE GLOBAL PICTURE

PLENUM



Exposure!

- IceCube (10yr)
- IceCube + P-ONE (10yr)
- IceCube (20yr)
- - - IceCube + PLE ν M-1 (10yr)
- IceCube + PLE ν M-2 (10yr)



+ 3 NEUTRINO TELESCOPES IN THE NORTH

+ 3 NEUTRINO TELESCOPES IN THE NORTH + GEN2

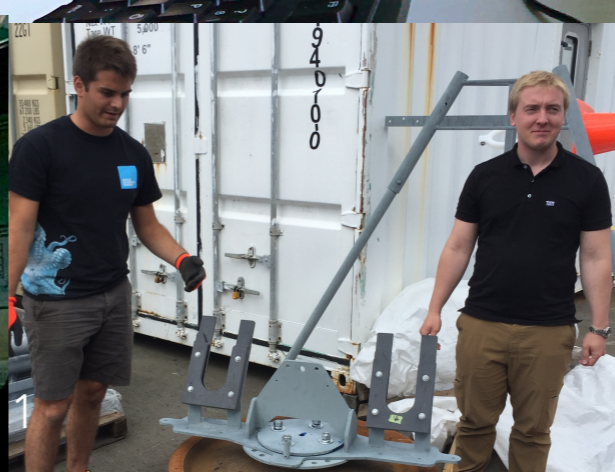
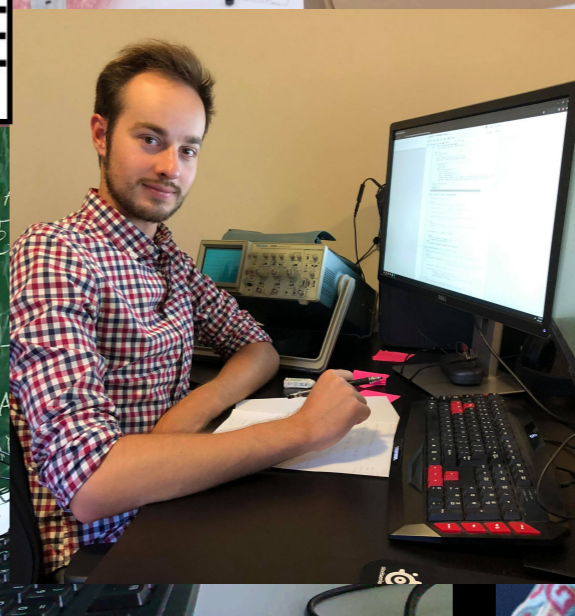
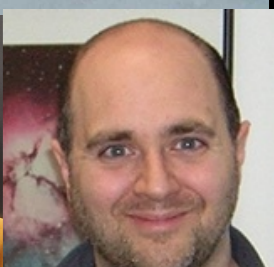
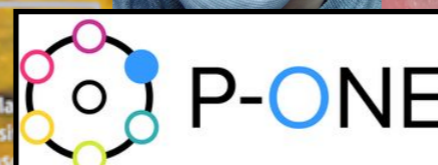
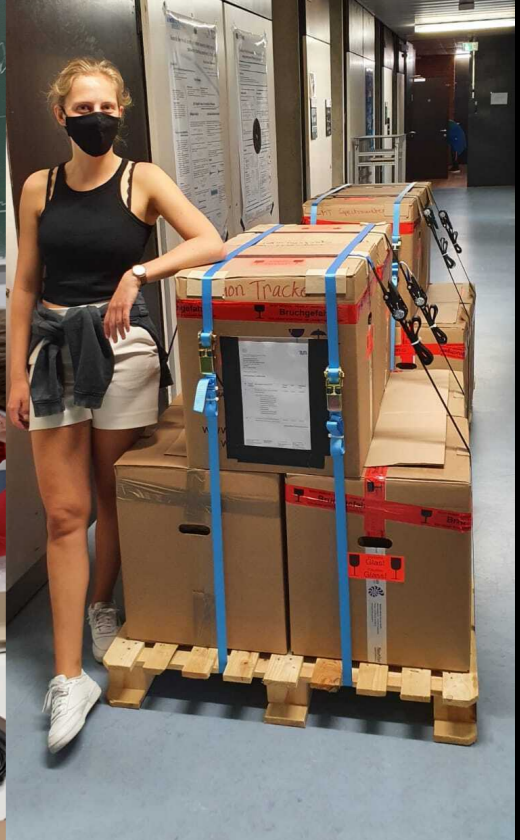
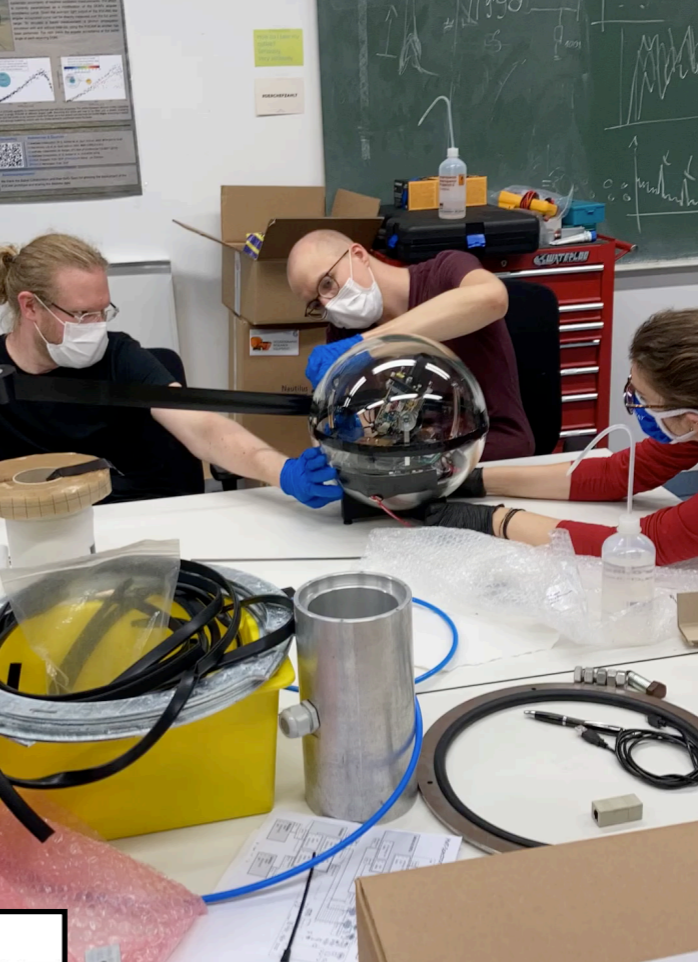
FIRST HINTS OF SOURCES FROM ICECUBE

+ ONE NEUTRINO TELESCOPE IN THE NORTH

IN SUMMARY

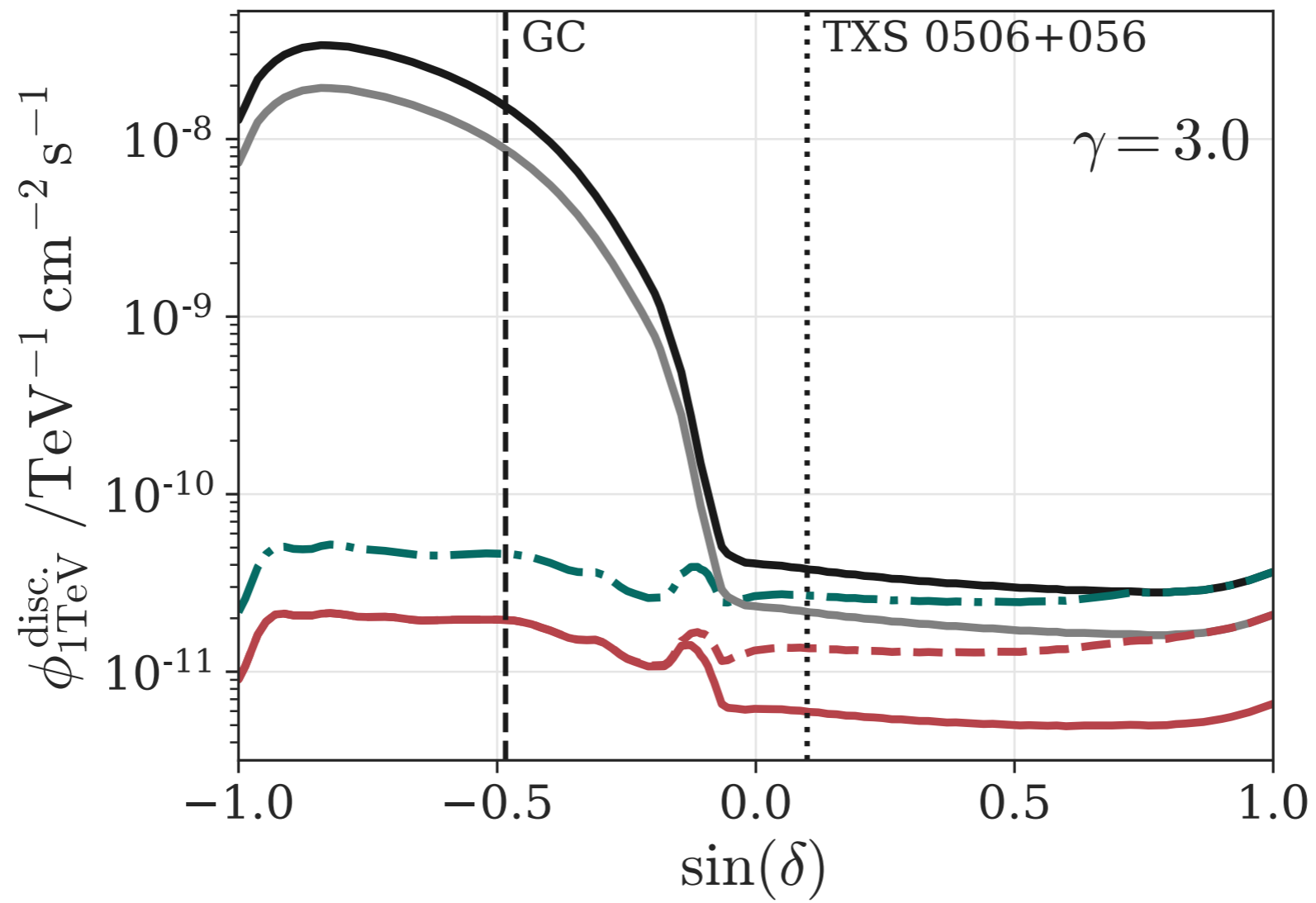
WHY A NEW NEUTRINO TELESCOPE?

Because We can
Exposure exposure exposure



Backup

- IceCube (10yr)
- IceCube + P-ONE (10yr)
- IceCube (20yr)
- - IceCube + PLE ν M-1 (10yr)
- IceCube + PLE ν M-2 (10yr)

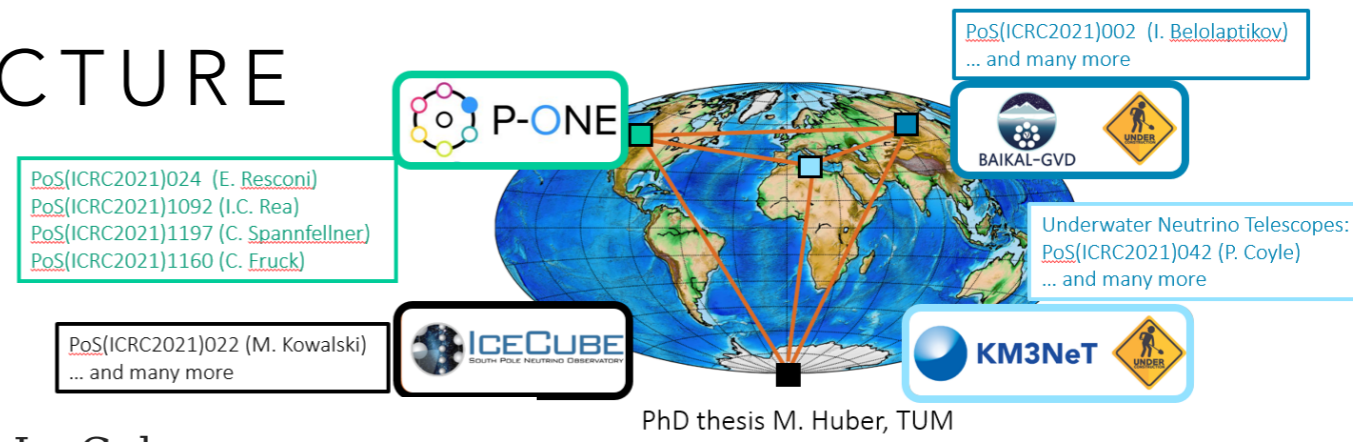


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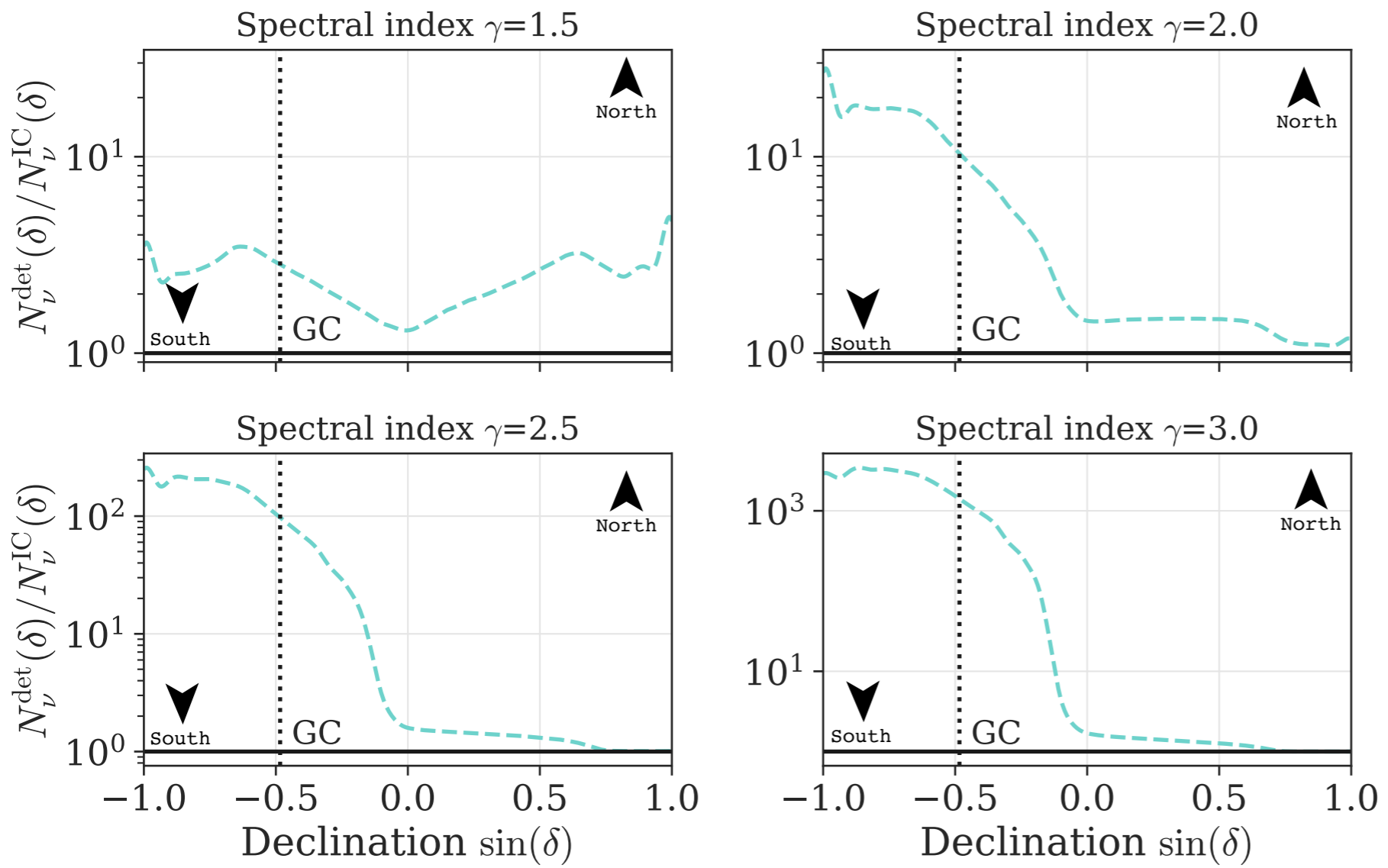
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P-ONE IN THE GLOBAL PICTURE

PLENUM



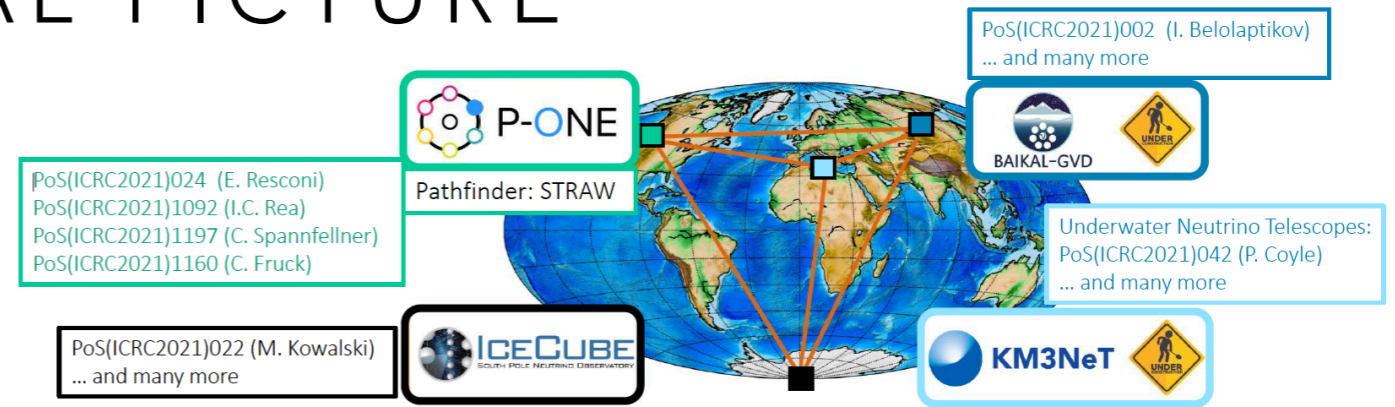
--- IceCube + det. at P-ONE location — IceCube



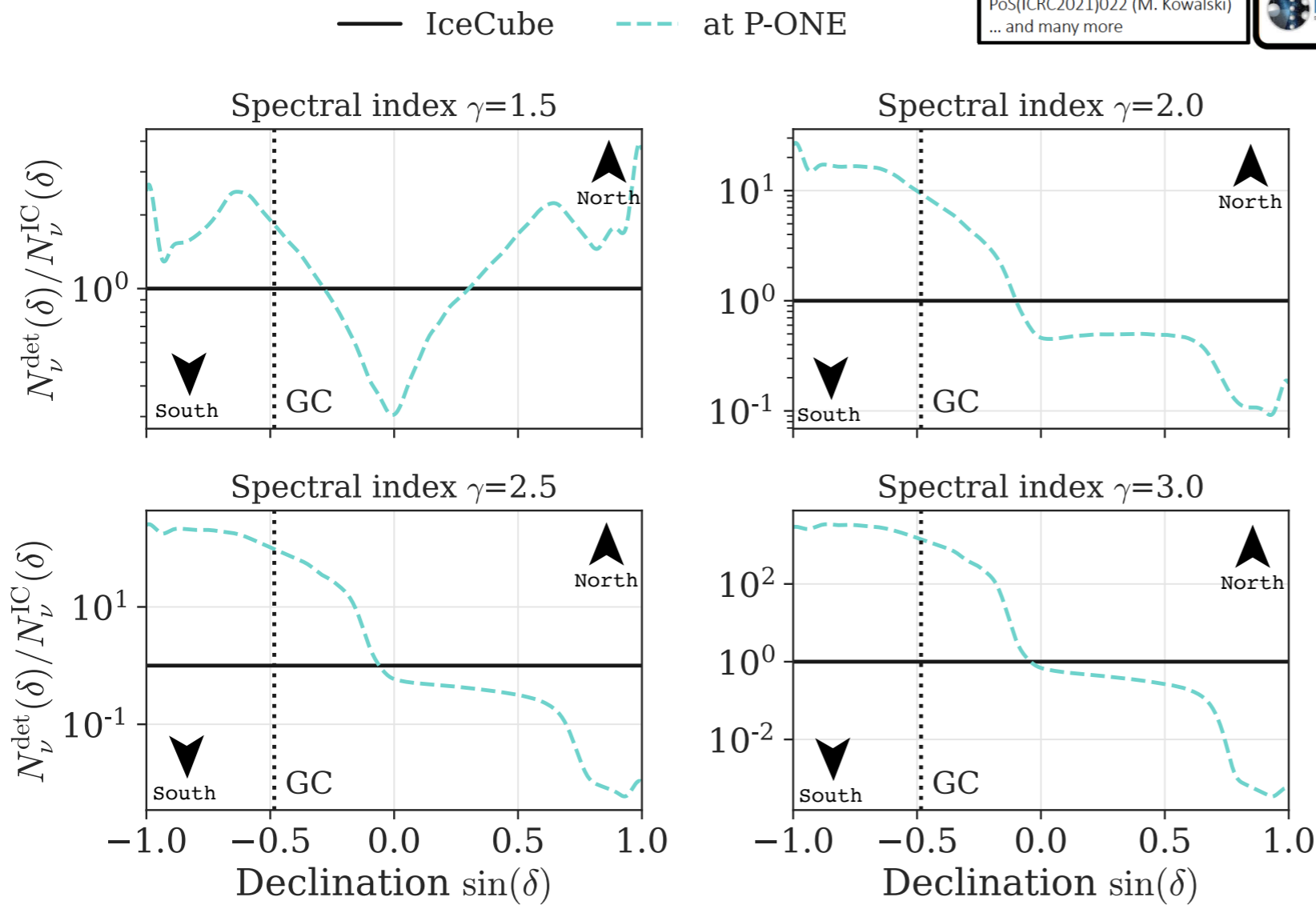
Assumption: P-ONE ~ IceCube
Impact: P-ONE will boost exposure to the Southern Sky by order of magnitudes.

P-ONE IN THE GLOBAL PICTURE

PLENUM



PhD thesis M. Huber, TUM



Assumption: P-ONE \sim IceCube
Impact: P-ONE will boost exposure to the Southern Sky by order of magnitudes.

IN SUMMARY

- ▶ IceCube is opening the high energy neutrino sky with great success.
- ▶ More and larger neutrino telescopes are mandatory to progress in the exploration at the highest energies.
- ▶ P-ONE is a new, scalable neutrino telescope based on
 - ▶ learned lessons from IceCube, GVD, KM3NeT/Antares;
 - ▶ first time @ an existing large scale oceanographic infrastructure, Ocean Networks Canada.
- ▶ NEPTUNE node of Cascadia Basin (-2.6 km), optically qualified.
- ▶ New dedicated sensors installed in 2020, more studies of the Pacific ocean.
- ▶ P-ONE prototype line(s) started, target deployment 2023.

**P-ONE as a catalyzer of a planetary neutrino monitoring system
open to multi-observatory and multi-messengers**