P-ONE
Pacific Ocean Neutrino Explorer

Kilian Holzapfel
for the P-ONE team

M. Boehmer, C. Fruck, R. Gernhäuser, A. Gärtner, F. Henningsen, K. Krings,
K. Leismüller, L. Papp, I. C. Rea, E. Resconi, C. Spannfellner, Ocean Networks Canada

HEP2019
High Energy Neutrino Astronomy

Existing/under construction Detector arrays for neutrino astronomy are GVD, KM3Net, IceCube and each target an instrumented volume of ~1 km³

So far, a single astrophysical object (TXS0506+056) associated with neutrino emission which was triggered by a single event after 8 years of observation. In archival IceCube data, more neutrinos have been found from this source.

Detector volume needs to be increased by ~2 orders of magnitude for astronomical high energy neutrino observations like in Gamma-ray astronomy

Possible solution:
- Complete GVD, KM3NeT, and extend IceCube (Gen2)
- Connect the high-level analysis
- Operate all the neutrino telescope coherently as one distributed infrastructure
- Explore new sites, e.g. ONC**

* P-ONE = Pacific Ocean Neutrino Explorer, ** ONC = Ocean Networks Canada
High Energy Neutrino Astronomy

At high energy $> 60$ TeV: field of view at the horizon at a specific moment in time.
- GVD, KM3NeT, IceCube and P-ONE
A New Site in Canada?

Cascadia Basin, a part of the NEPTUNE Observatory, operated and deployed by ONC
- Plane with a depth of 2660 m
- Site is already equipped with a sub-sea network and power infrastructure

Existing infrastructure allows connection with low exertion

Pathfinder 1: STRAW*
- Deployment 06/2018 and in operation

Pathfinder 2: STRAW-b - 1 string - 2020

Future vision
Phase 1: P-ONE - 10 strings - 2023
Phase 2: P-ONE - 70 strings
  - full configuration (under design)
Phase 3: connect to other telescopes
  - PLENUM**

ONC - Ocean Networks Canada
- An initiative of the University of Victoria
- ~10 years of experience with deep-sea deployments and operations
- Operating many different projects in different locations
- All projects are accessible through an internet connection

*STRAW = Strings for absorption in water, **PLENUM = Planetary Neutrino Monitor
**STRAW**

**STRAW — STRings for Absorption length in Water**

**Goals**
- Measurement of the **absorption length**
- Monitoring of the **background**, e.g. bioluminescence
- Gain experience and knowledge in deep see deployments

**The Detector**
- 2 strings with a total height of 150 m
- **3 light sources** - POCAM
- **5 light sensors** - sDOM, straw Digital Optical Module

- Alignment of the strings could be adjusted after the deployment by the ROV
- Geometry allows measurements with several different distances from 20 m to 90 m
STRAW - Deployment

- The **full assembled string is spooled on a motorised reel** to allow transportation and deployment with a **minimal work offshore**
- Rotational anchor to **align the strings with the ROV**
- **Visual inspection** of the whole detector with high-resolution cameras at the ROV

**Successful deployment in June 2018**
- All modules are working
- Constant monitoring of background and movement
STRAW - Preliminary Results

- Monitoring of the background shows a **periodic signal**, most likely bioluminescence induced by the current. Detailed analysis is done by I. Rea.

- The first result for the attenuation length: 31.4 m ± 3.0 m (stat.) ± 5.0 (sys.) for 465 nm.

First results look promising!

**Outlook**
- Waiting for confirmation by AC9 measurements
- Analysis for diff wavelengths ongoing
- Cross-check analysis for attenuation length ongoing

![Pyrosome close to a sDOM](image)

Plots: C. Fruck (TUM)
P-ONE — Simulation

Simulation to study the sensitivity of different geometries

Parameters
- 10 strings
- ~800 m long
- ~120 m spacing
- 20 modules per string
- Volume = .1 km$^3$

Plots: K. Krings (TUM)
P-ONE — Simulation

Simulation to study the sensitivity of different geometries

Parameters
- 10 strings
- ~800 m long
- ~120 m spacing
- 20 modules per string
- Volume = .1 km$^3$

Plots: K. Krings (TUM)
OUTLOOK — Long Term P-ONE

**P-ONE first cluster**
- 2020 deployment of pathfinder 2
  - A single string, 500 m long, 10 modules
- Construction of P-ONE 2022-23
- 2024 deployment of P-ONE

**Long term P-ONE**
- Combination of 7 10-string-units/P-ONE (similar to cluster in GVD)
- Volume = 2.5 km³
- 70 strings

Image: E. Resconi (TUM)
Thank you for your attention