



XIX Neutrino Telescope Workshop

Pacific Ocean Neutrino Experiment (P-ONE)

Pathfinder and prototype line development

C. Spannfellner for P-ONE collaboration

TUM – Experimental Physics with Cosmic Particles



P-ONE flash contribution following the parallel session talk given by Matthias Danninger on 23/2/2021



P-ONE – a new complementary telescope





Image: M. Huber



Ocean Networks Canada



OCEAN NETWORKS CANADA

Discover the ocean. Understand the

P-ONE | C. Spannfellner | Technical University Munich

ENUS Observatory







P-ONE

Optical characterisation of deployment site

R&D on optical modules, further characterisation Pacific Ocean Neutrino Experiment



STRAW – 1st pathfinder mission

- **Objective:** Measure optical properties and verify deployment of strings
- Deployed July 2018 in Cascadia Basin in collaboration with ONC
- Operational with a **duty cylce of around 98%**
- Concept of 2 lines and 2 different optical modules:
 - 3x POCAM: Emission of nanosecond light pulses
 - 5x sDOM: Measurement of incident light via 2 PMTs



Image: K. Holzapfel



STRAW – preliminary results



P-ONE | C. Spannfellner | Technical University Munich





Images: ONC, TUM



STRAW-b – 2nd pathfinder mission

- R&D for P-ONE, further background characterisation, verification of attenuation length ٠
- 3 standard modules with p/T/H ping signal ٠ 312m - Standard M. -288m - Muon Tracker -7 specialized modules • 264m - Mini Spec -• 2x PMT spectrometers 240m - Standard M. -Deployment Background • Stand-alone spectrometer 168m - LiDAR -Muon Tracker 144m - PMT Spec Attenuation Length • 2x LiDARs 120m - WOM -External module - WOM







STRAW-b successfully deployed on 27th Sept. 2020, data commisioning ongoing

Images: ONC, TUM

24.02.2021

P-ONE | C. Spannfellner | Technical University Munich



P-ONE – prototype line concept

- **Definition of task:** Construction and deployment of a P-ONE mooring line as first installation of the final P-ONE detector. The prototype line shall verify the working principle, deployment technique, and be the blue print for the following mooring lines.
- Instrument types:
 - P-ONE Digital Optical Module
 - P-ONE Calibration Module
- Please note: Very early development stage, all illustrations are preliminary studies!





P-ONE – prototype line modules



Optical Module | Preliminary concept study

- PMT selection just started
- Readout benefits from STRAW projects



Calibration Module | Image: POCAM for ICU

- Calibration module will be branch of POCAM
- Analog electronics directly adaptable



The Pacific Ocean Neutrino Experiment

202

May

19

[astro-ph.HE]

arXiv:2005.09493v1

M. Agostini⁶, M. Böhmer⁶, J. Bosma¹⁰, K. Clark⁹, M. Danninger¹⁰, C. Fruck⁶, R. Gernhäuser⁶, A. Gärtner^{3,6}, D. Grant², F. Henningsen^{6,8}, K. Holzapfel⁶, M. Huber⁶, R. Jenkyns¹¹, C. B. Krauss³, K. Krings⁶, C. Kopper², K. Leismüller⁶, S. Leys⁴, P. Macoun¹¹, S. Meighen-Berger⁶, J. Michel⁵, R.W. Moore³, M. Morley¹¹, P. Padovani⁷, T. Pollmann⁶, L. Papp⁶, B. Pirenne¹¹, C. Qiu¹¹, I. C. Rea⁶, E. Resconi⁶, A. Round¹¹, A. Ruskey¹¹, C. Spannfellner⁶, M. Traxler^{1,4}, A. Turcati⁶, J. P. Yanez³.

¹Helmholtzzentrum für Schwerionenforschung (GSI) Planckstrasse 1, 64291 Darmstadt, Germany
²Department of Physics and Astronomy, Michigan State University, East Lansing, MI 48824, USA
³Department of Physics, University of Alberta, Edmonton, Alberta, Canada T6G 2E1
⁴Department of Biological Sciences, University of Alberta, Edmonton, Alberta, Canada, T6G 2E9
⁵Institut für Kernphysik, Goethe Universität, 60438 Frankfurt, Germany
⁶Department of Physics, Technical University of Munich, D-86748 Garching, Germany
⁷European Southern Observatory, Karl-Schwarzschild-Str. 2, D-85748 Garching, Germany
⁸Max-Planck-Insitut für Physik, D-80805 Munich, Germany
⁹Department of Physics, Engineering Physics & Astronomy, 64 Bader Lane, Queen's University, Kingston, ON, Canada, K7L 3N6
¹⁰Department of Physics, Simon Fraser University, 8888 University Drive Burnaby, B.C. Canada, V5A 186

¹¹Ocean Networks Canada, University of Victoria, Victoria, British Columbia, Canada

Thank you for the attention! There are many more involved!



Backup



ONC – Ocean Networks Canada



- Provide deep sea infrastructure (**NEPTUNE**)
- \sim 800km loop with 5 nodes
- High-speed data link (up to 10GB/s)
- High power (9kW/node)
- "Plug and Play" basis provides modularity



ONC – Ocean Networks Canada





STRAW – preliminary results

- Attenuation length
 - 365 nm: 9.4 m +/- 0.2 m.) +/- ~1.0 m (sys.)
 - 405 nm: 15.6 m +/- 0.7 m (stat.) +/- ~3.0 m (sys.)
 - 465 nm: **31.0** m +/- **1.0** m (stat.) +/- ~**6.0** m (sys.)
 - 600 nm: **5.0** m +/- **0.5** m (stat.) +/- ~**2.0** m (sys.)
- Background
 - Baseline with few kHz (40K and diffuse bioluminescence)
 - Bioluminescence bursts up to tens of MHz
- Note: Updated attenuation length results on slide 6



P-ONE | C. Spannfellner | Technical University Munich





STRAW – background



Two components:

Baseline with few kHz (40K and diffuse bioluminescence) & bioluminescence bursts up to tens of MHz (correlated to current)

24.02.2021

P-ONE | C. Spannfellner | Technical University Munich





POCAM – pulse drivers



Kapustinsky

- Controlled discharge of C via trigger pulse
- Behaviour determined by values of L and C



LiDAR-type pulse driver

- Controlled switching of GaN-FET
- Adjustable pulse width by delayed trigger input



POCAM – pulse drivers

Photon output (405nm):

- Kapustinsky (fast): 1e7 to 1e8 [1-2ns FWHM]
- Kapustinsky (def): 1e8 to 1e9 [5-8ns FWHM]
- LiDAR-type (5ns): 1e9 to 1e10 [4ns FWHM]
- LiDAR-type (25ns): 1e10 to 1e11 [6ns FWHM]







STRAW-b – readout electronics

- Photosensor signal is fed to PADIWA
 - Amplification and signal-shaping for TOT measurements
- TRB3sc (Trigger Readout Board)
 - Integrated readout system with FPGA and TDCs
 - Different thresholds adjustable for TOT measurement
- Communication via media converter and Odroid C2
 - Port-based VLAN is implemented isolates TRB3sc from SFP uplink
 - Monitoring of power consumption via I2C bus
 - Phobos carrier board establishes connection to TRB3sc





STRAW-b – instrument tray and module mechanics

• Instrument tray

- Built from aluminum profiles (weight: 1200kg (equipped))
- 5 modules can be stored on each side
- Communication cable (VEOC) is spooled in an eight
- Module mechanics
 - Protection of glass sphere via EPDM rubber layer
 - Click-in mechanism to merge with ferrules on wire rope





STRAW



P-ONE – detector concept

