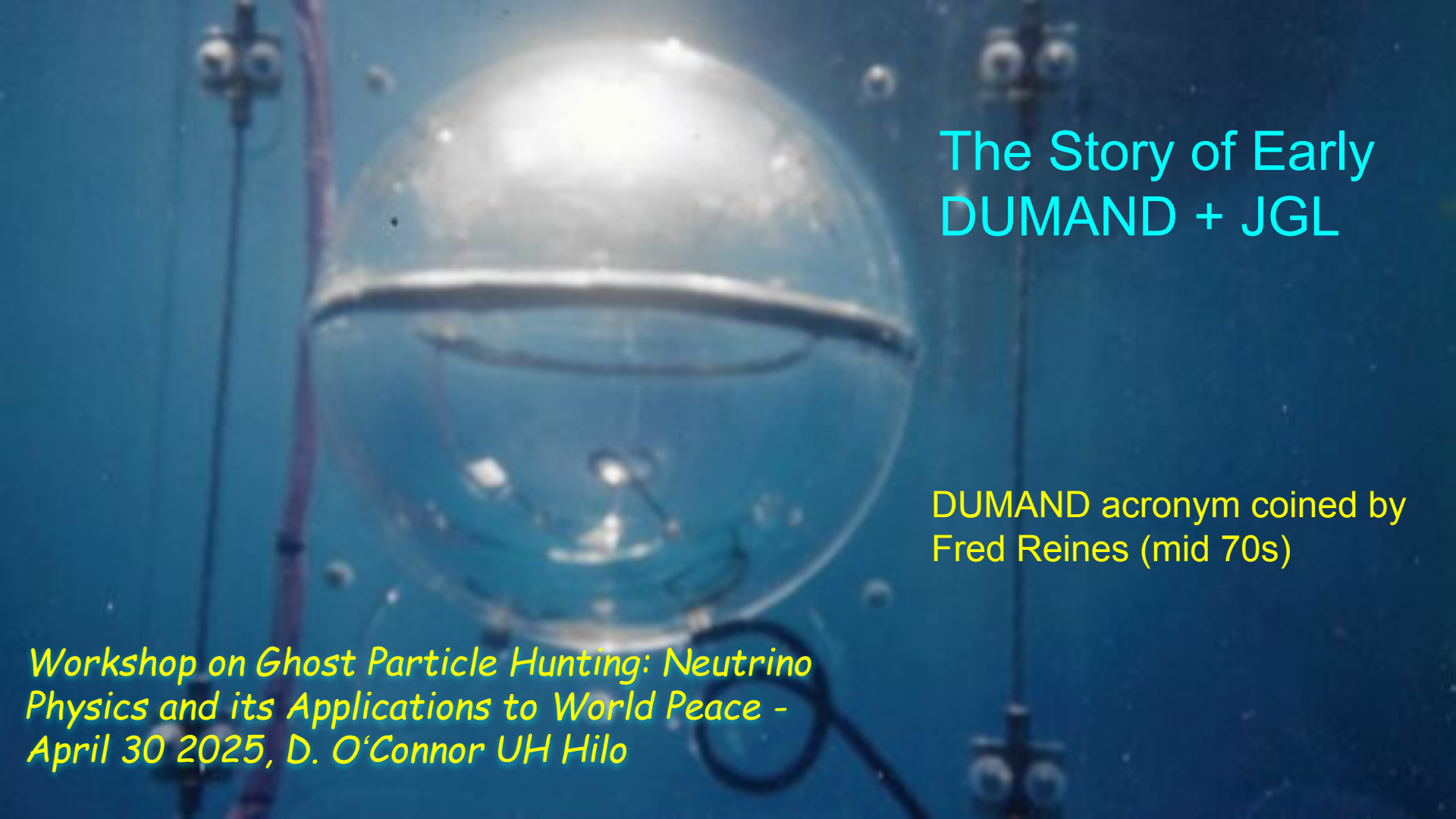


The Story of Early DUMAND + JGL

DUMAND acronym coined by Fred Reines (mid 70s)

Workshop on Ghost Particle Hunting: Neutrino Physics and its Applications to World Peace - April 30 2025, D. O'Connor UH Hilo

NOSC

«««««««««««««««««« = »»»»»»»»»»»»»»»»»»

Naval Ocean Systems Center

Agencies willing to take funding risk to support very different research … way outside their respective boxes

Beginnings

Series of Workshops on potential realization of Neutrino Astronomy mid 70s

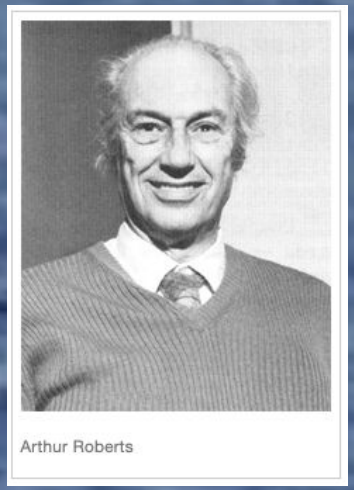
UH High Energy Physics Group becomes home to DUMAND Project with arrival in Hawaii of John Learned and Art Roberts circa 1980

Group Has:

* Particle Physics Experience
* Some underwater (not undersea) experience via JGL - Lake Chelan
* No Deep Sea Instrumentation Experience

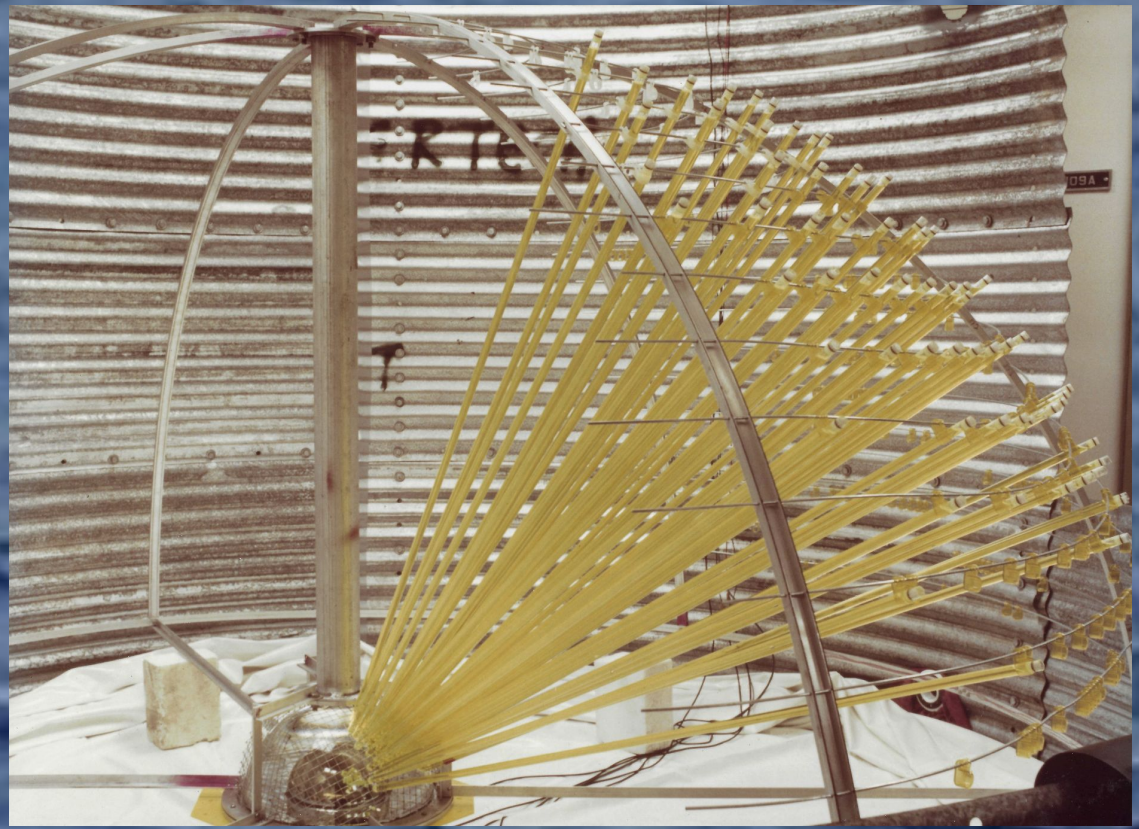
(mind: Most Marine Scientists and Oceanographers work fairly shallow waters…we were to find out…)

Prototype DUMAND Hardware - Sea Urchin - Art Roberts



Arthur Roberts

Deemed too fragile for ocean work



Early Efforts - DUMAND I

I. **Muon String**

Blackinton et al., Proc. Neutrino 81, 2, 246 (1981)

II. **Background Light Measurements**

III. **SPS - Short Prototype String**

Muon String

*Blackinton et al., Proc. Neutrino 81, **2**, 246 (1981)*

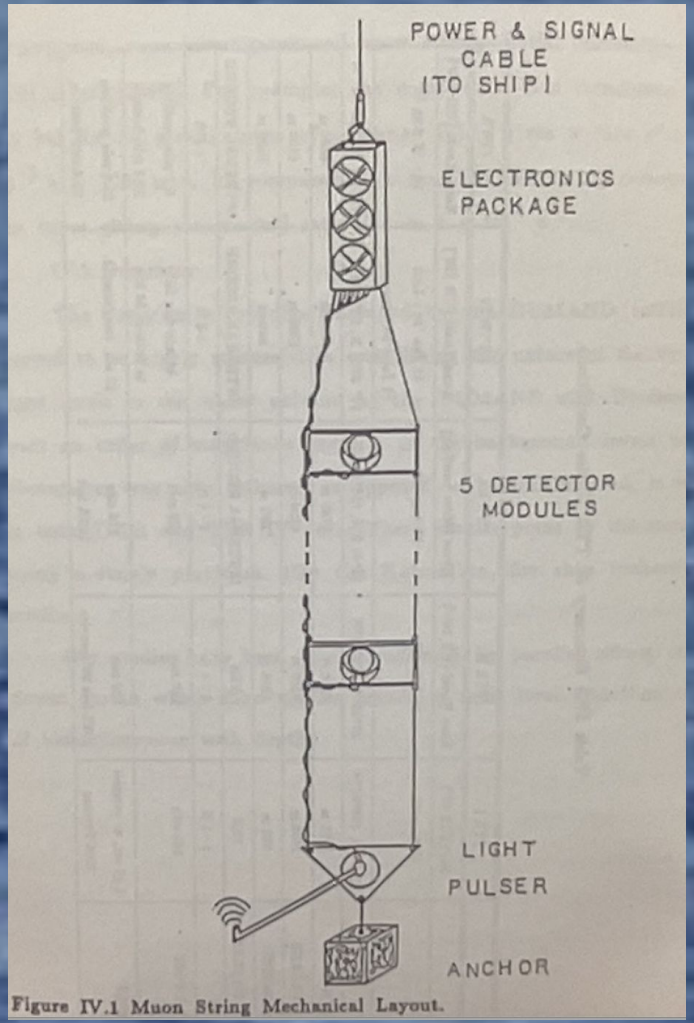


Figure IV.1 Muon String Mechanical Layout.

Muon String

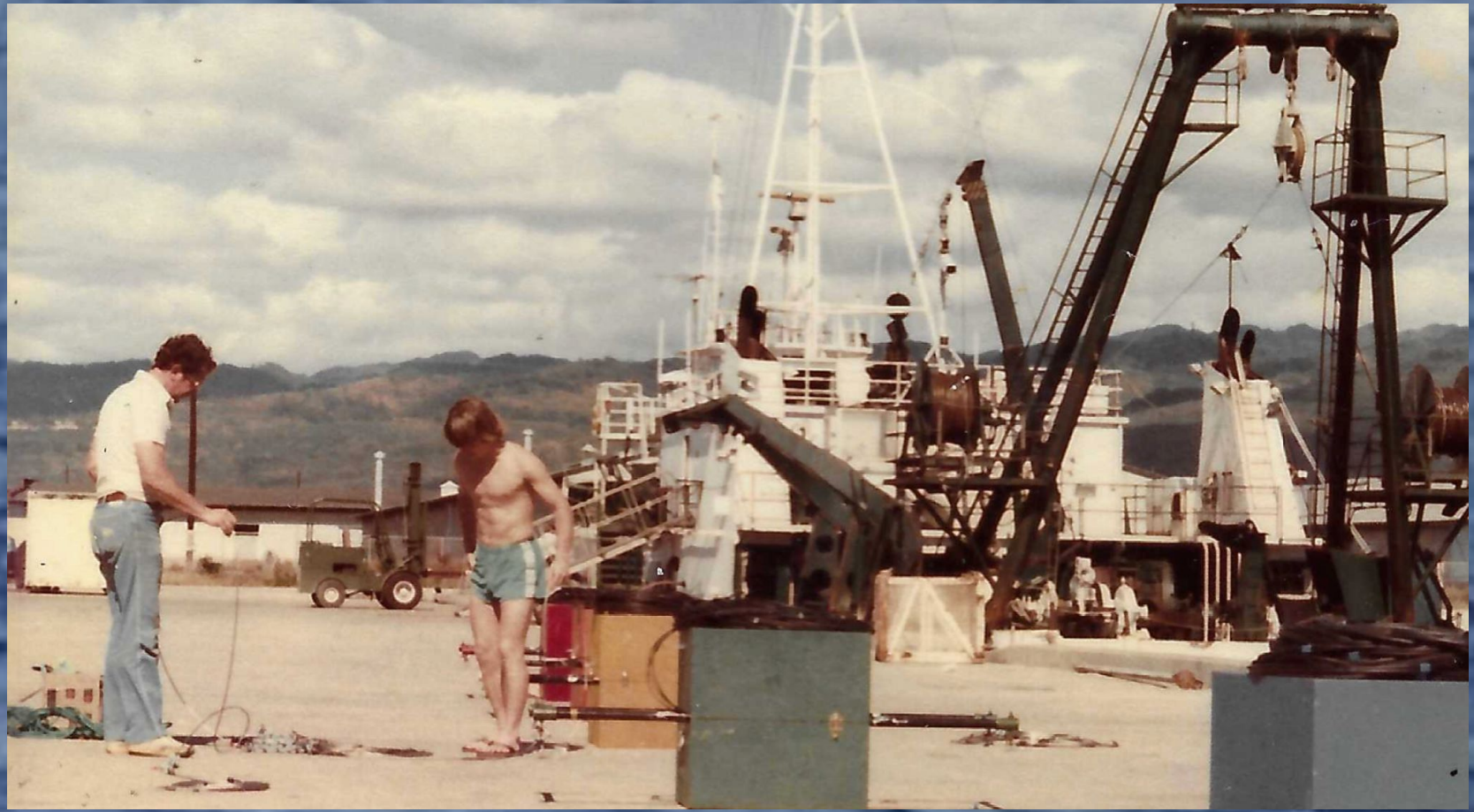
5 ea 13" EMI Phototubes in 17" Benthos Glass Housings

Stoplight: Two CAMAC crates, TERAK computer, 1200 baud RG-8 comm to surface

Cruises 1 & 2: Nov. '81, Jan. '82, successful Tests Kanakeoki

Muon String

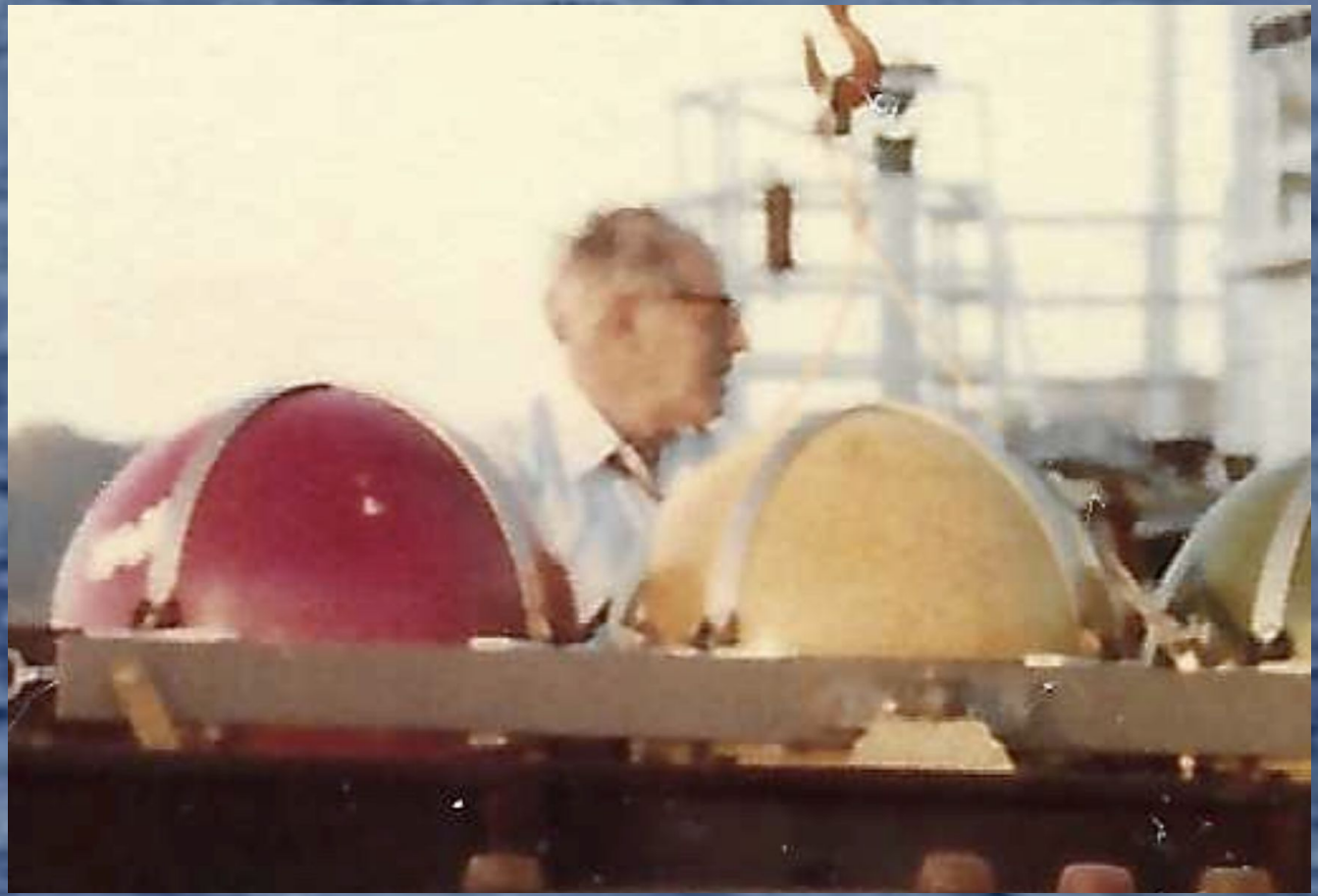
Muon String KK cruise



Muon String KK cruise

Muon String KK cruise

Muon String KK cruise



Muon String KK cruise

Muon String - "Data Taking Cruise" March '82

Depth 4800 meters*, estimated 2 week run

Ship = Navy / Merchant Marine "de Steiguer"

Muon String - de Steiguer

No Deck Layout Plans, A-Frame Height much shorter relative to Kanakeoki, Bridle shortened to lift instrument off deck

Skippers Orders - Stay in Circle [Brandner, Learned try to change, no cell phones]

Muon String - de Steiguer

Seas initially flat,
Deploy - electrical splice issue
Retrieve - fix splice
Deploy again to 2 km, seas picked-up
Drift South out of circle
Skipper fires up engines and steams North (without telling us)
Around 2 AM, PWG & DOC on shift, power lost again…
Retrieve AM

Lost at Sea - 7 March '82 - 19 deg 41.2' N, 156 deg 34.6' W

Muon String - Lessons

Know thy Ship

Background Light Levels at 2 km very high

Gorham, DIR - 13 - 82

Muon String - Lessons

Know thy Ship

Background Light Levels at 2 km very high

Gorham, DIR - 13 - 82

Q: What fraction of Background Light -

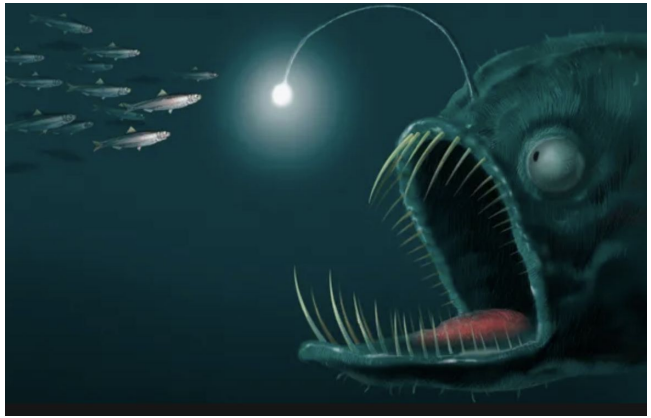
A.) Stimulated (vortex shedding of instrument due to surface coupling)

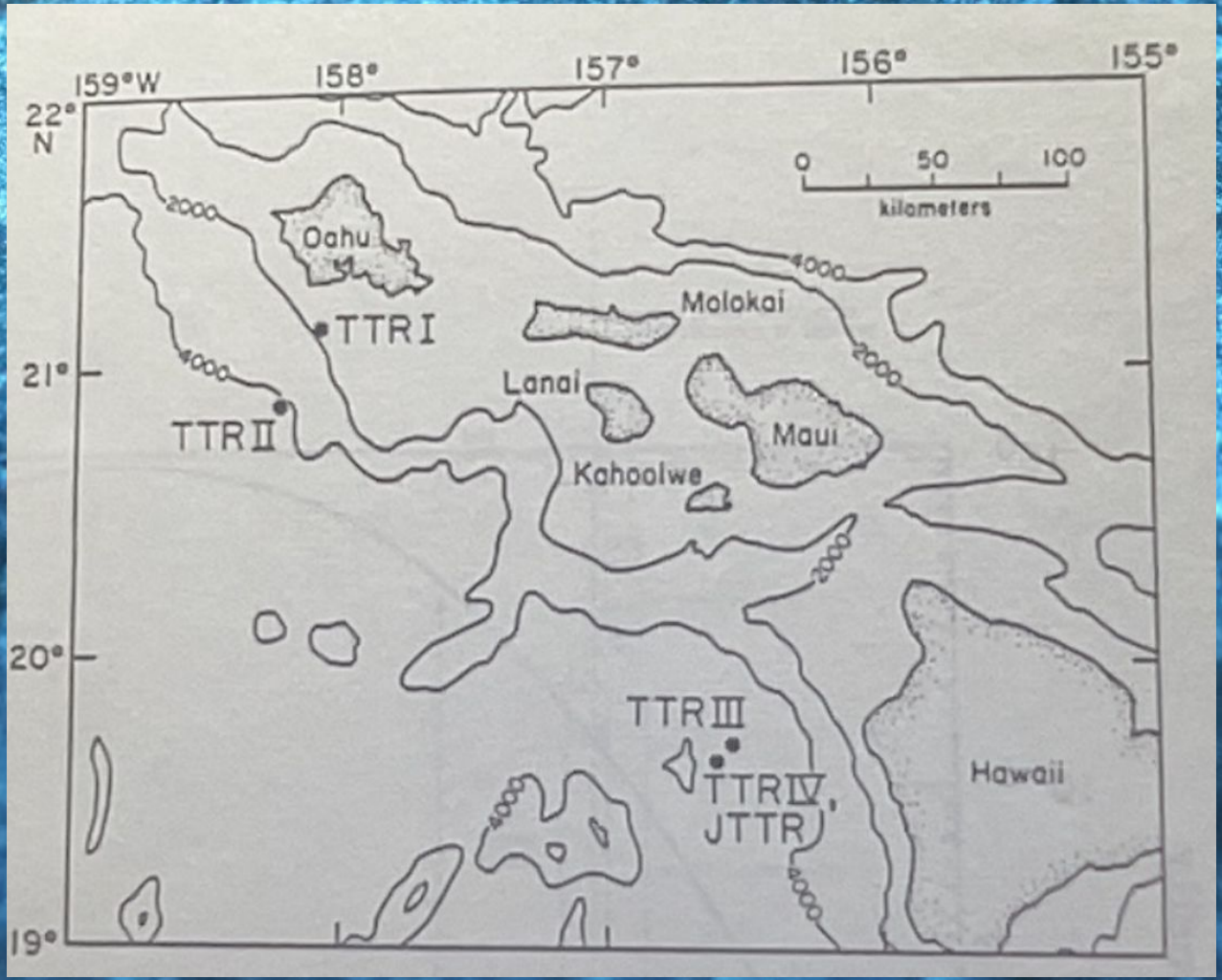
B.) Ambient

Bioluminescent Studies

Bioluminescent Studies Telemetering Transient Recorder - TTR

5 Cruises: TTR I, II, III and TTR IV + JTTR




159°W
158°
157°
156°
155°
22° N
21°
20°
19°
0 50 100
kilometers
2000
4000
Oahu
TTR I
Molokai
Lanai
Maui
Kahoolwe
TTR II
TTR III
TTR IV,
JTTR
Hawaii

Bioluminescent Studies

TTR

TTR I [O'Connor DIR-15-83]

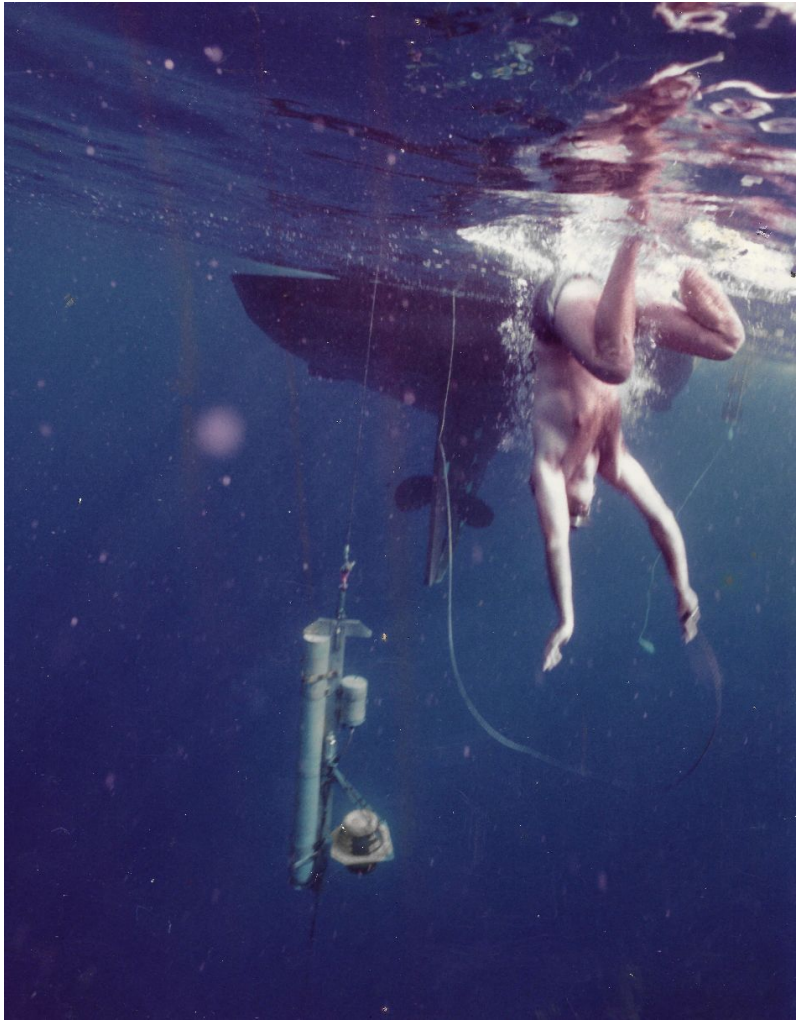
TTR III [Bradner et al., Deep-Sea Research, **34**, No. 11, 1831 (1987).]

Result:

1.) First abyssopelagic measurement of biolight

1.) at 4300 meters depth median light level = 20 x K^{40}, still ship coupled.

2.) Descent levels < Ascent levels… data very different = stimulated?



Bioluminescent Studies
TTR

TTR IV – Untethered to Surface – need to monitor ambient, unstimulated conditions

TTR IV – Untethered to Surface – need to monitor ambient, unstimulated conditions

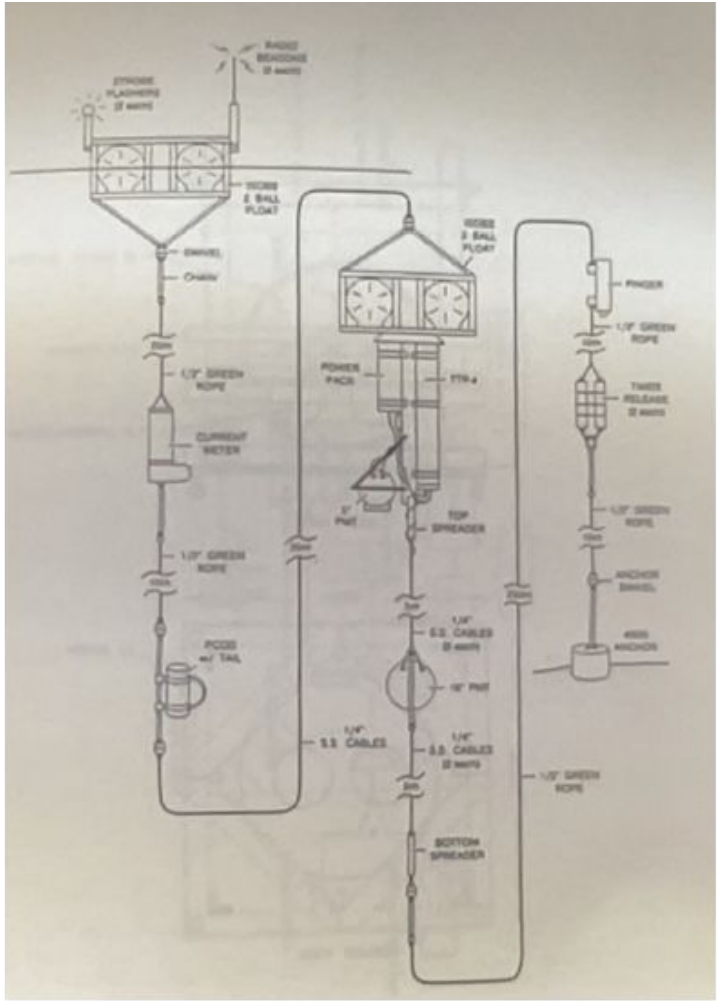
TTR IV

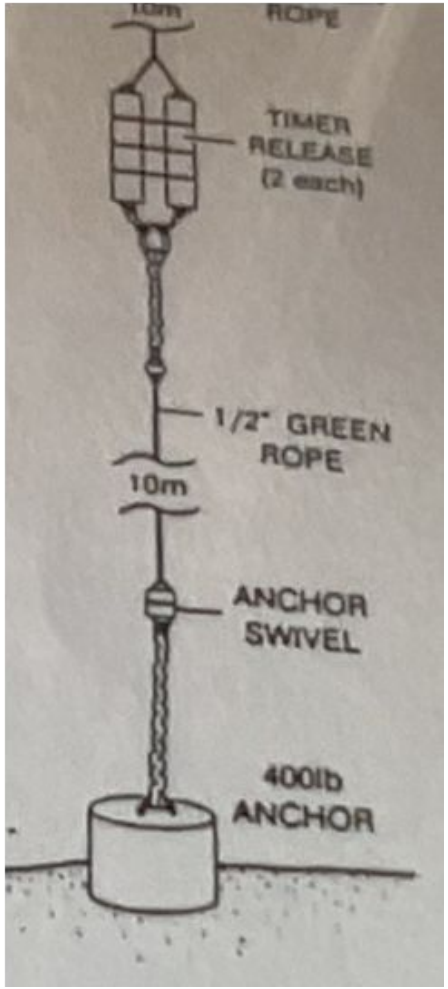
Recall mean ocean depth 4000 m

DUMAND site – 4800 m

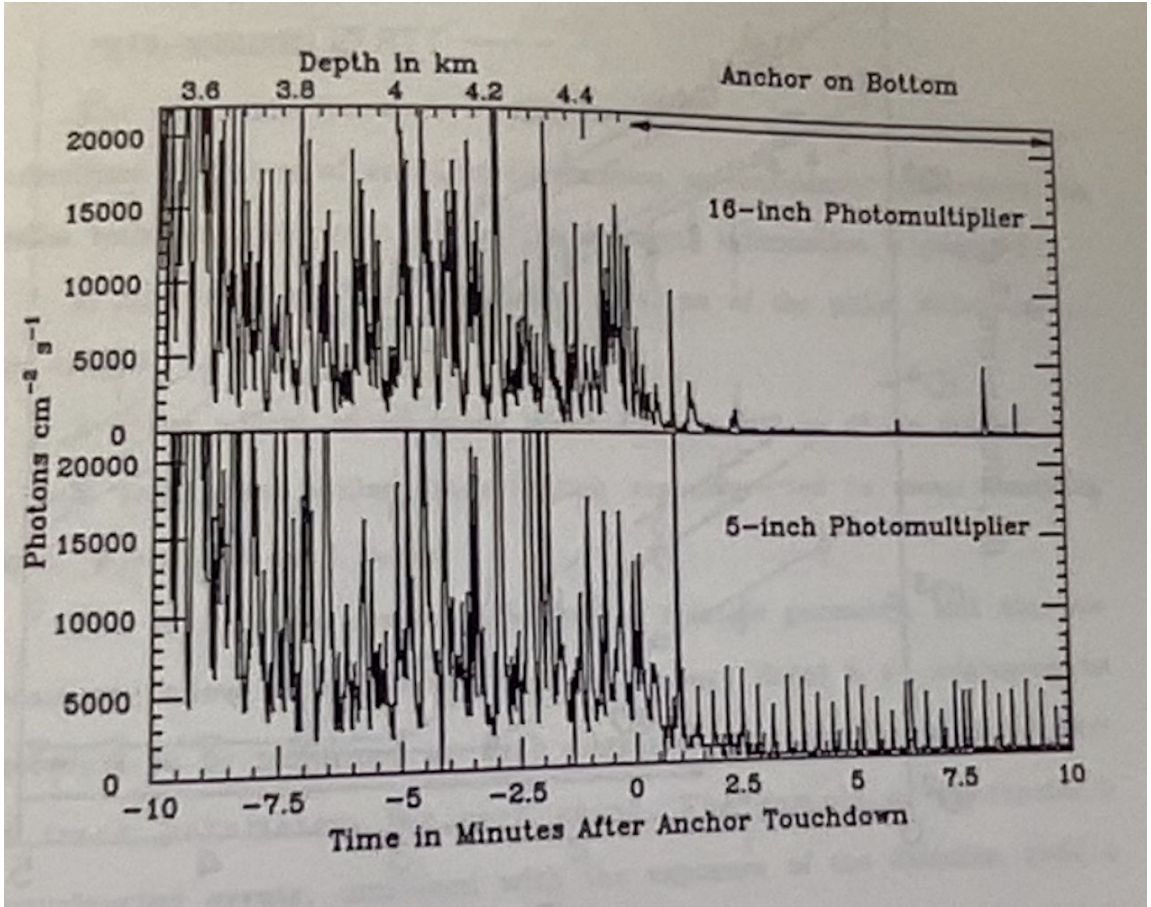
Double Hang-Fire … Instrument NOT recovered

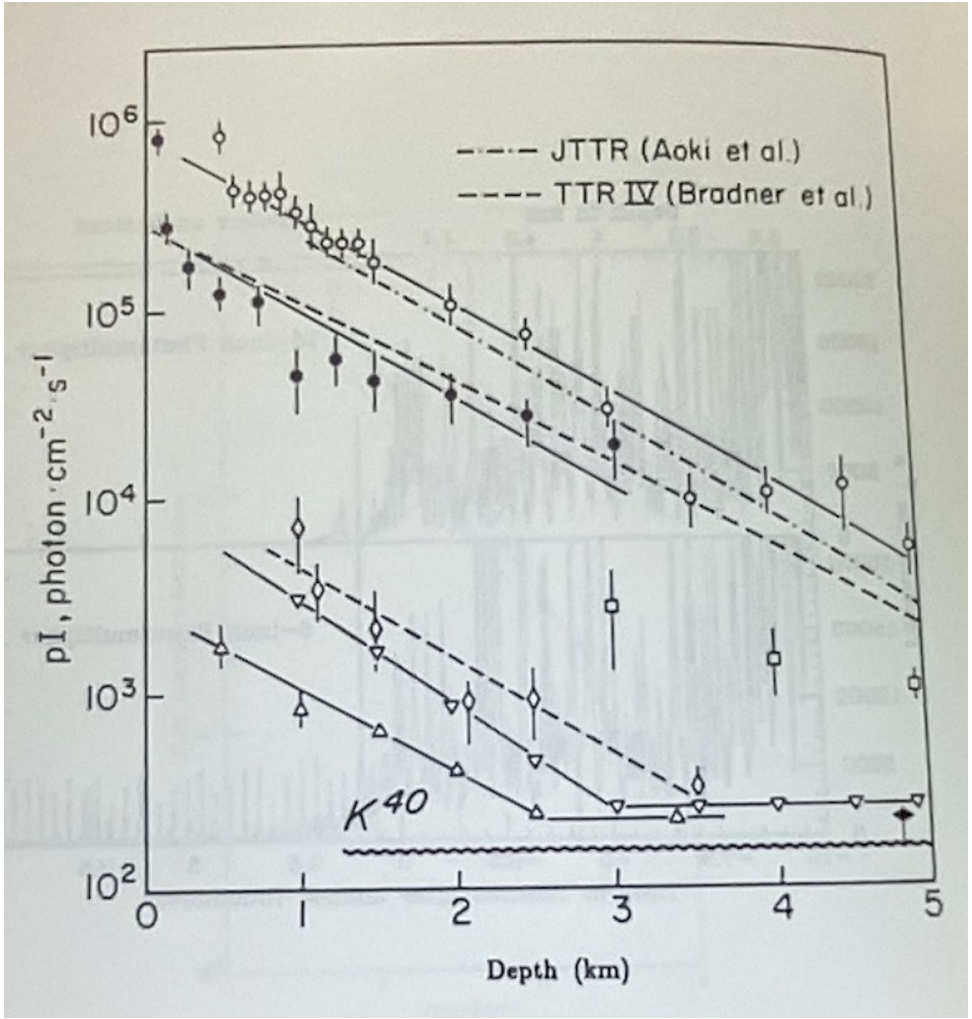
11 Jan. ‘84





However: TTR IV Recovered 17 July ‘85 by Scripps Institute of Oceanography

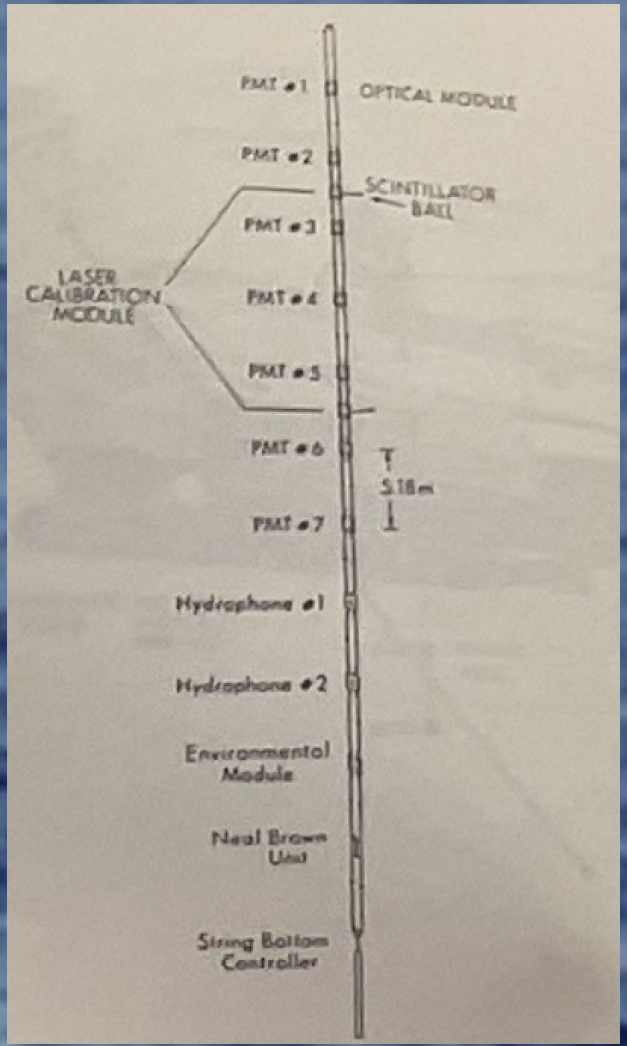




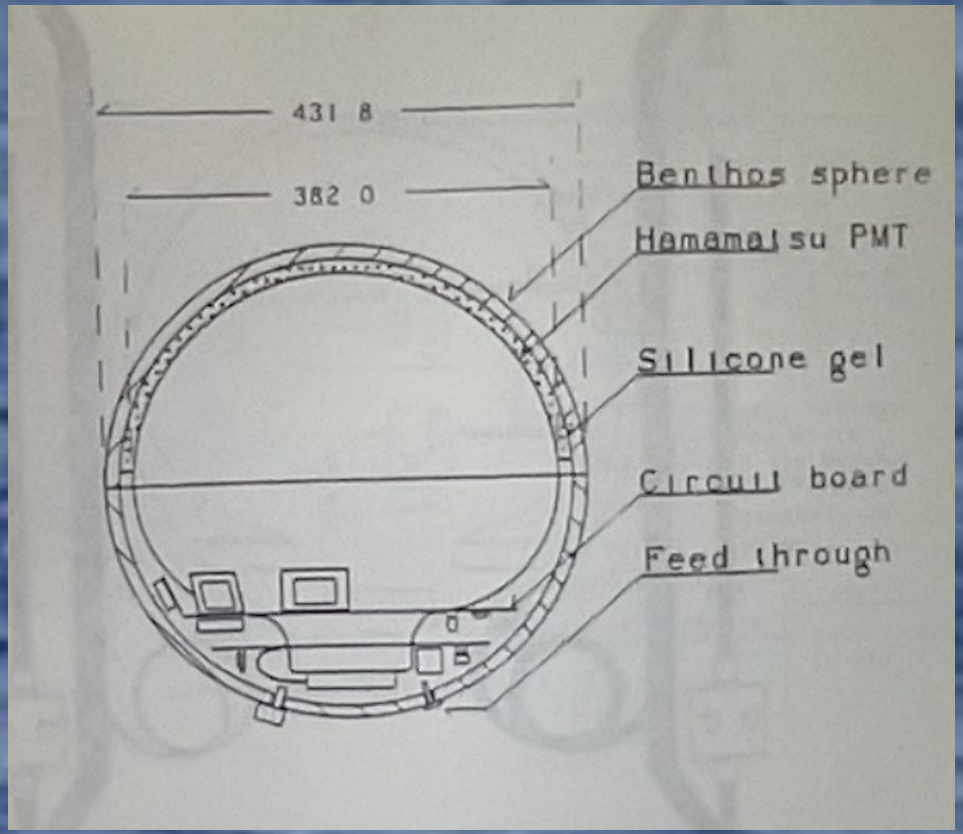
Result: Background 2 x K^{40}

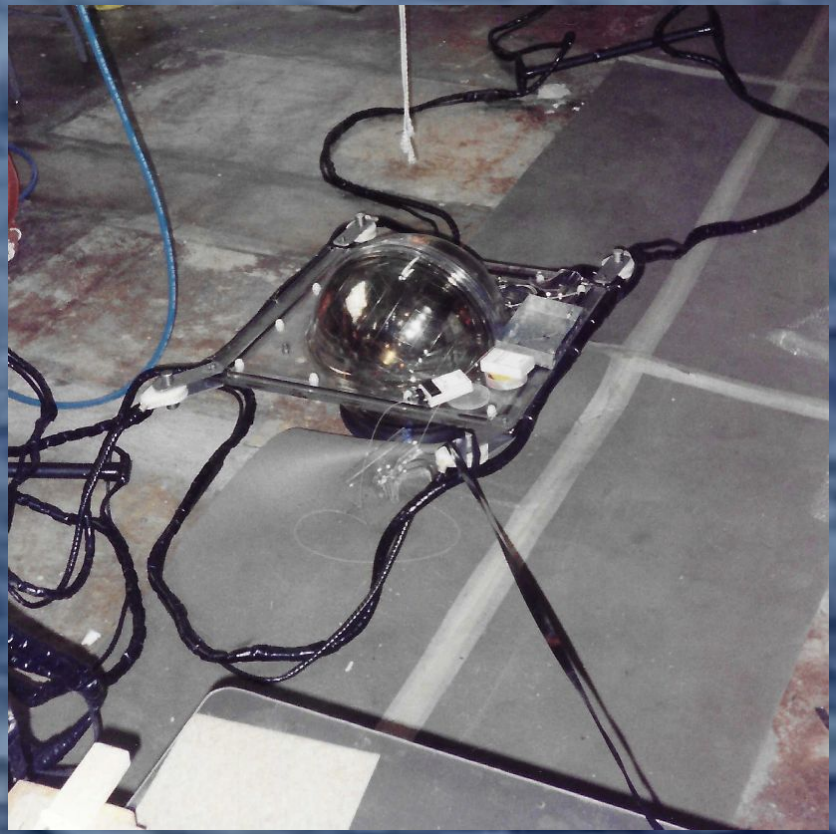
Short Prototype String SPS

Short Prototype String SPS

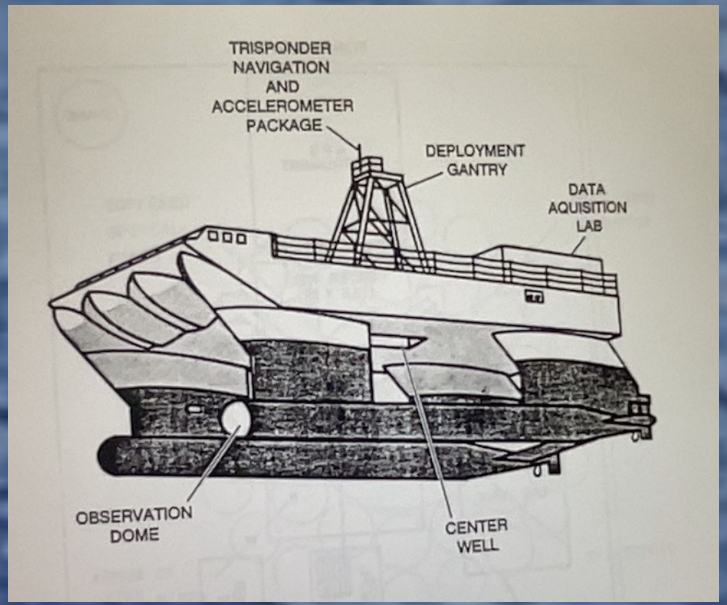


Short Prototype String SPS



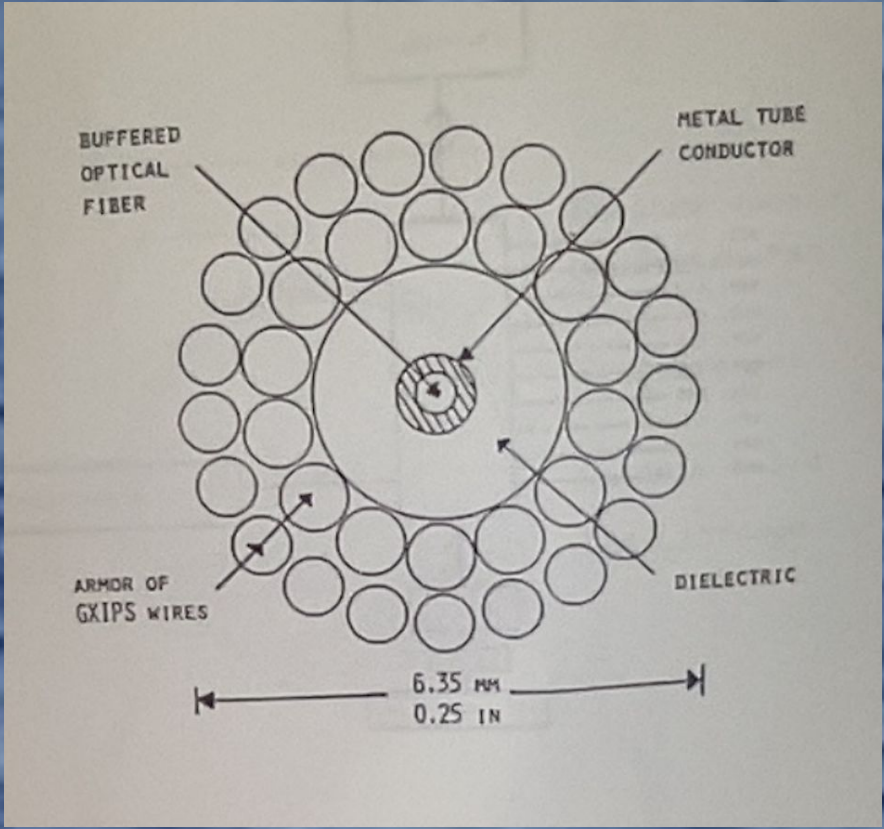


Kaimalino SWATH Vessel

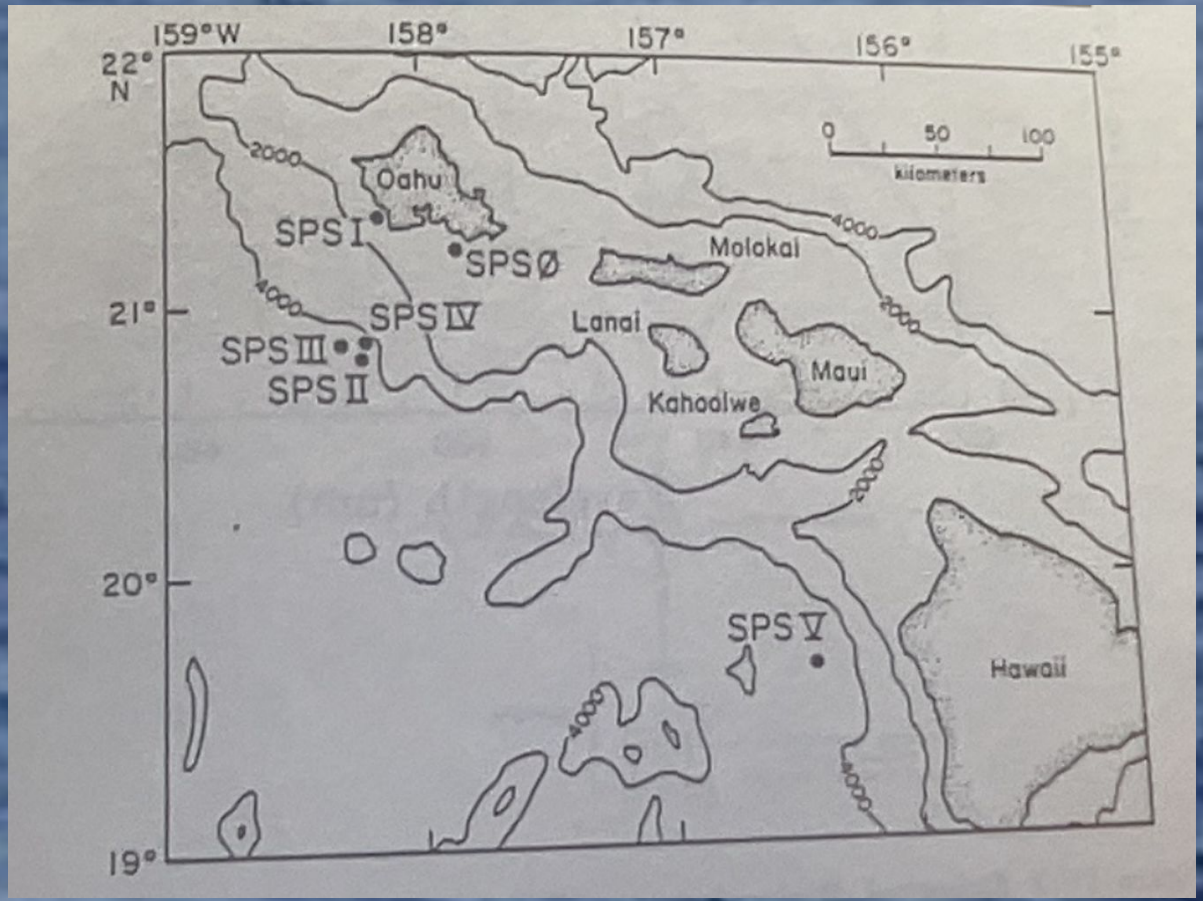


Kaimalino Stability and Center Well

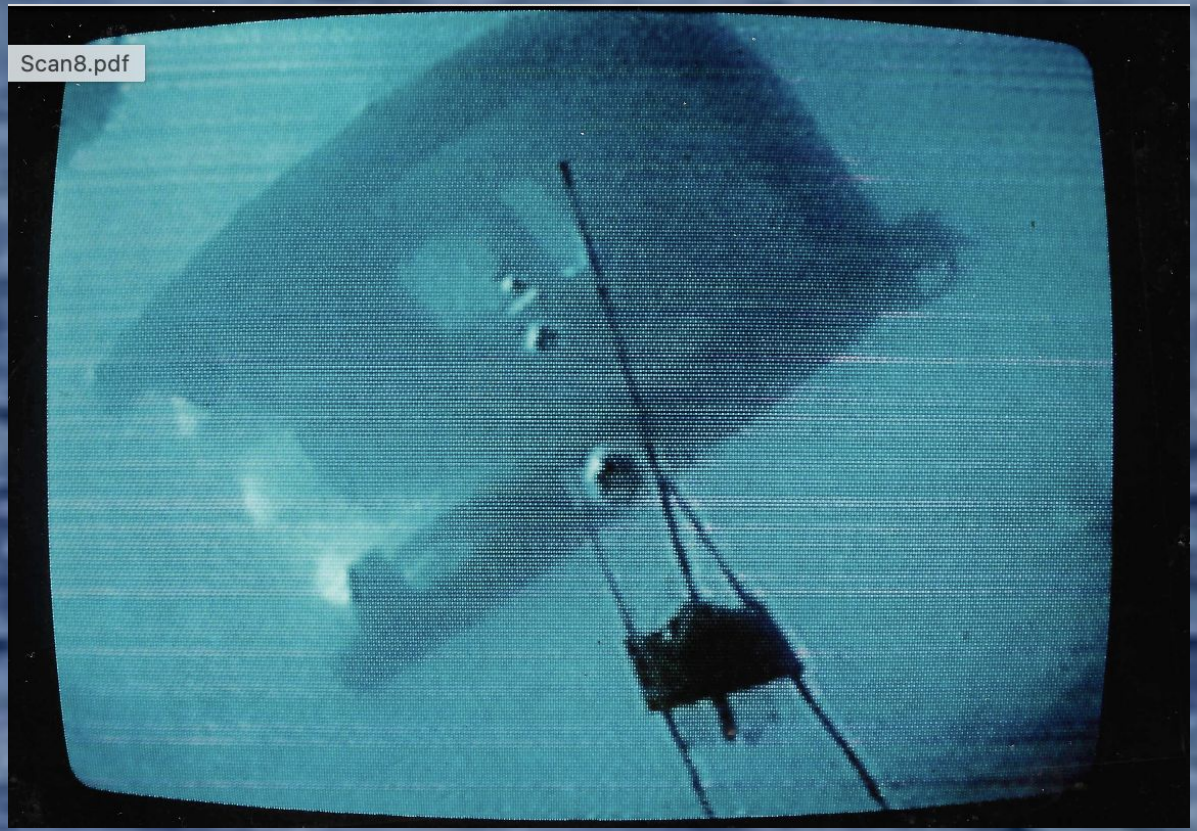
Short Prototype String SPS



Short Prototype String SPS Deployments



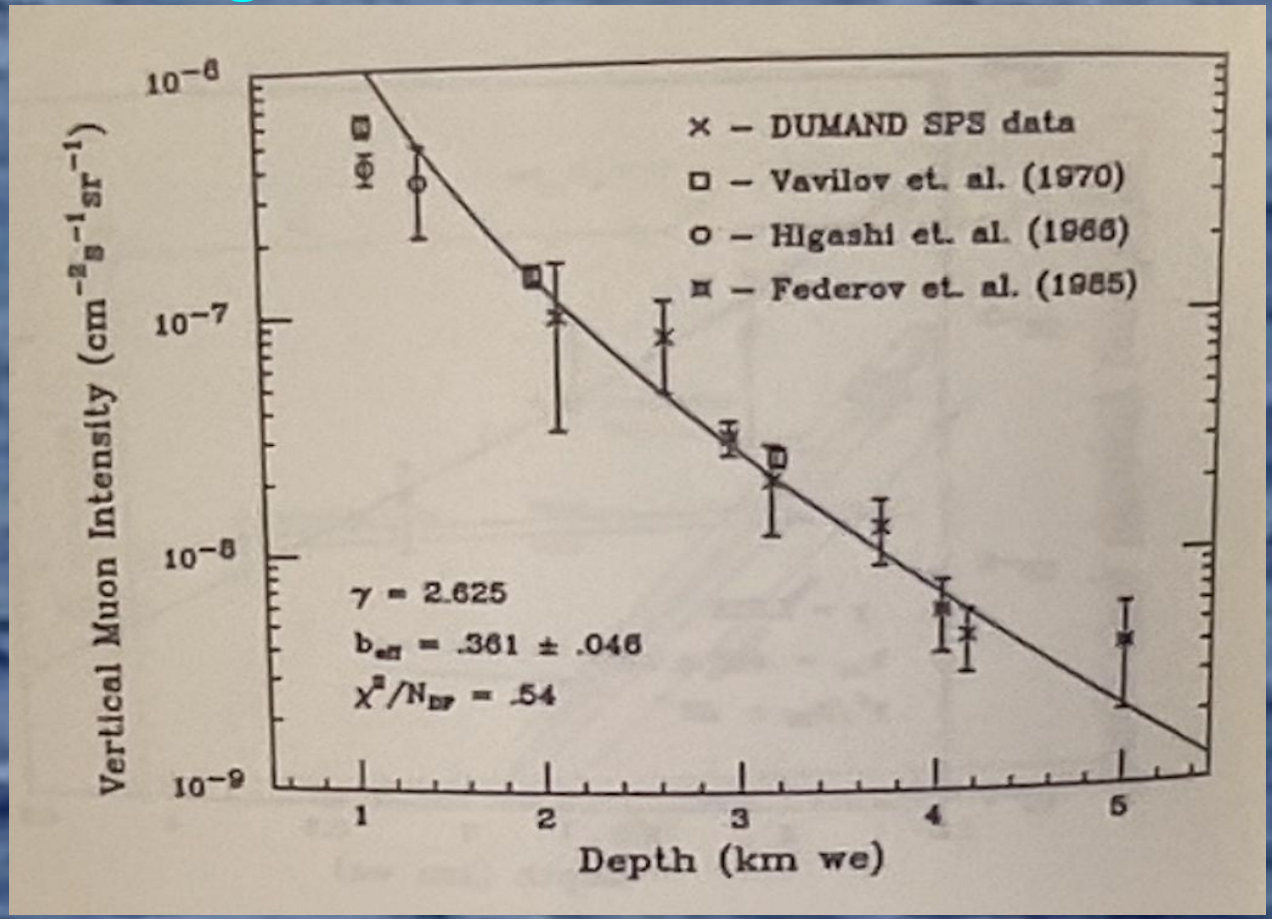
Short Prototype String SPS Deployments



Short Prototype String SPS

Ocean Depth (m)	Overburden (m.w.e.)	Livetime after cuts (sec)	5-Fold Recon	Muon Event Rate (s^{-1})
2035	2090	179	13	$7.3 \pm 2.0 \times 10^{-2}$
2564	2633	7315	414	$5.6 \pm .34 \times 10^{-2}$
3077	3160	488	23	$4.7 \pm .97 \times 10^{-2}$
3610	3707	1704	99	$5.8 \pm .58 \times 10^{-2}$
4048	4157	5826	99	$1.7 \pm .18 \times 10^{-2}$

Short Prototype String SPS



Short Prototype String SPS

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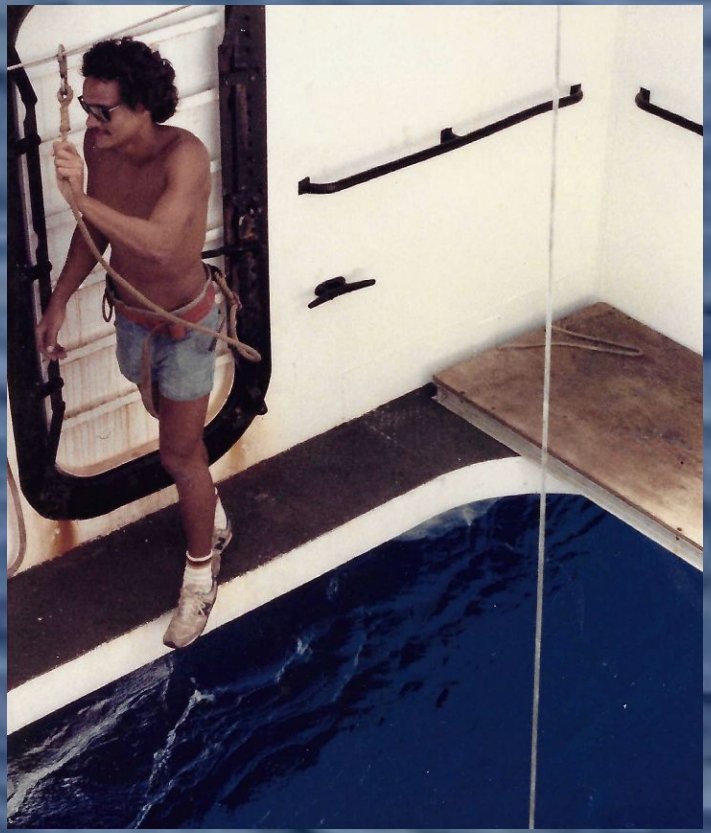

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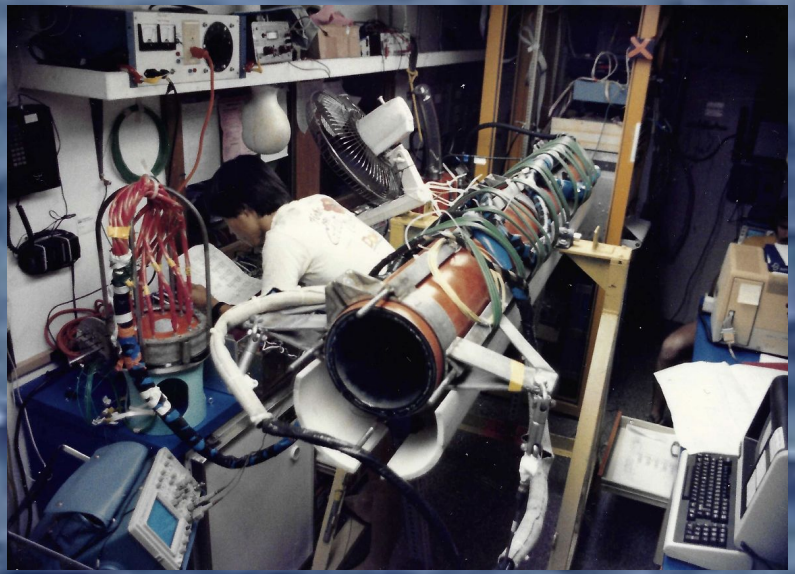
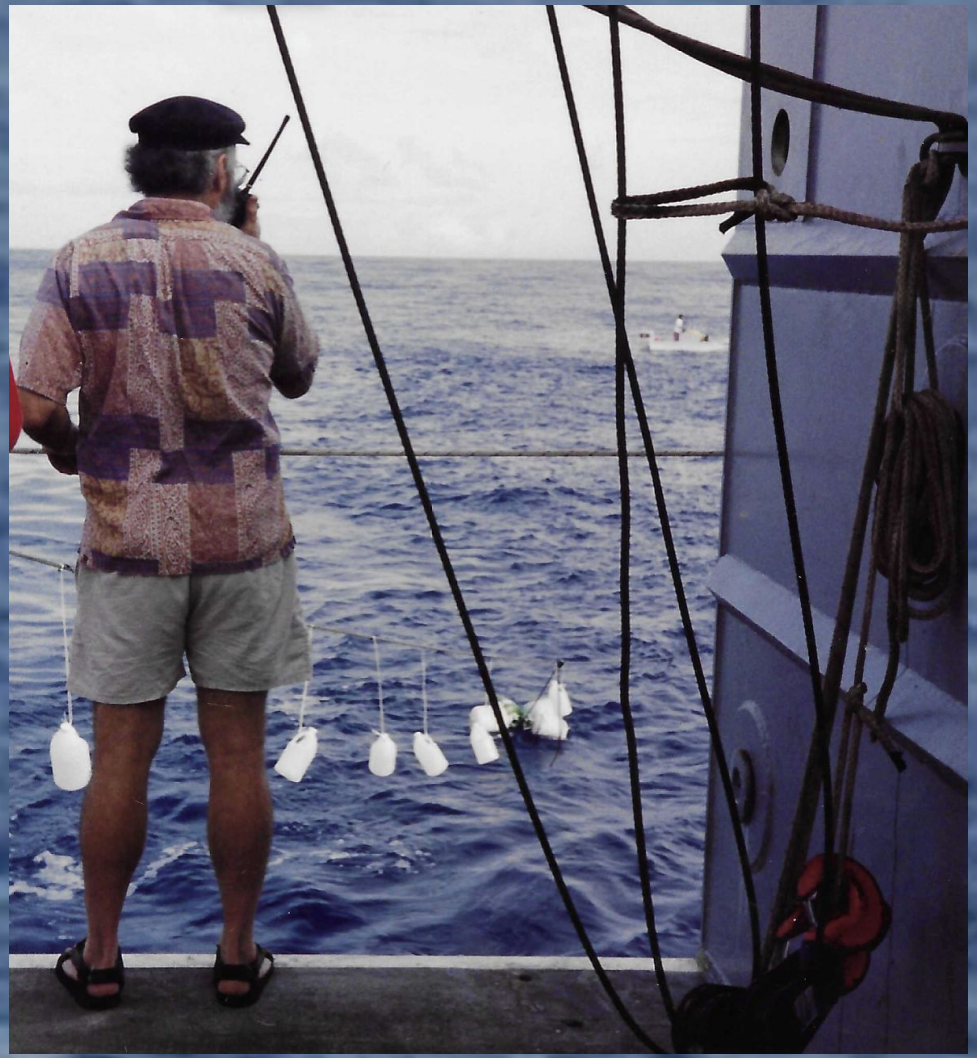


Short Prototype String SPS


O'NEILL



Mahalo Nui to John for all his many huge contributions