Student Mike

MARINE SKILL REPORT SUBMITTED TO THE

UNIVERSITY OF HAWAII MARINE OPTION PROGRAM

Laboratory Experience in
Physics and Oceanography
with the DUMAND Project

DURATION

September 1, 1982 - May 1, 1983

PROJECT MEMBER

Jeremy Uejio

ADVISOR

Mike McMurdo
Researcher
Hawaii DUMAND Center

REPORT DATE

August 11, 1983

8/11/83

INTRODUCTION

The DUMAND project (Deep Underwater Muon And Neutrino Detector) is an international collaboration of physicists, astronomers, oceanographers, and engineers formed to build a gigantic array of light detectors for high energy physics, cosmic ray physics, neutrino astronomy, and the earth sciences. Presently, relatively little is known about the higher energy neutrinos and cosmic rays and their origins and production. Because neutrinos can pass through tons of matter without interacting with it, one needs an extremely sensitive or an extremely large detector to study these events. The DUMAND array is such a detector. It is proposed that the array be composed of 36 strings of about 21 photomultiplier tube detectors and several electronic and accoustical modules spaced 25 meters apart. The strings will be placed 50 meters apart in a 6 x 6 square, 4.7 kilometers beneath the oceans surface.[1] The overall dimensions thus becomes 250m. x 250m. x 500m.--- the largest detector in the world. This "telescope" will be used to detect the neutrinos by detecting the light given off by high energy muons, which are from neutrino interactions, when such muons interact electromagnetically with water molecules. The array essentially uses a large space of ocean as a detector and hence will be able to detect the uncommon interactions of the neutrino. It is hoped that DUMAND will not only enhance present physics and astronomy but also open a "window" onto a new branch of high energy neutrino astrophysics.

In the past year, the Hawaii DUMAND group has been concerned with the following projects:

1) The designing and calibration of the detector modules which also involved the construction of a large water tank used for testing the modules;
2) The designing and testing of the fast electronics package controlling the modules;
3) The designing of a fiber optics system to be used to connect the array of detectors to shore; and
4) The designing of possible biological and geophysical deepwater experiments.[2]

In January of 1982, I began my volunteer work with the DUMAND project. As the year progressed, I found I was gaining valuable laboratory experience; consequently, in August of 1982, I proposed a work-study student project to the Marine Option Program.

The original goals of this student project were as follows:

1) To help with a anti-biofouling experiment and learn various data collecting techniques, gain experience in the scientific method, and learn about electrolysis and biofouling; and,
2) To gain experience working in a physics laboratory by assisting with the construction and testing of the detector modules and the electronics package, and assisting with general laboratory functions.

However, due to unforseen circumstances (as explained in my progress report submitted in January of 1983) the first goal of helping with the anti-biofouling experiment was not achieved.

Thus as an alternative, I proposed the following goals:

1) The building of several geophysical models of the DUMAND project to be used for display;
2) helping with some of the simpler electronics involved in the construction of the fast electronics packages; and
3) assisting with the construction and testing of the detector modules and the test tank.

These goals were fulfilled.

THE WORK

The most important work I did for DUMAND was the construction of three geophysical models: the first, a model of an experimental string of five detectors, the second, a model of the DUMAND array and the third, a 3-dimensional contour map of Keahole Point off the island of Hawaii. The first model was used as a display for an experimental string of five detectors which collected data early last year. The second model was valuable in showing the size of the DUMAND array (250 X 250 X 500 m.) by comparing it to a small ship (50 m.). (see fig. 1) The array model scales the ship to a little over an inch long and the array itself to a little under 18 inches. This model was often used to show the general public and the scientific community the great magnitude of the DUMAND project. The first two models were used in Washington D.C. this past April to help get official scientific

approval for DUMAND. The last model was used to show the spacial characteristics of Keahole Point.

From DUMAND, I learned many laboratory techniques that I would not learn in an ordinary laboratory class. I had hands-on experience with electronics, computers, mechanics, engineering, and, of course, physics. The building of the models gave me experience in engineering and experience in working some of the shop equipment located on the first floor of Watanabe Hall at the University of Hawaii. When I was not making models, I was assisting in the construction and maintanence of a large water tank located on the ground floor of the Marine Science Building at the U.H. This also involved working some heavy shop equipment and operating simple electronics. The water tank was used to first calibrate the detector modules and then test them under various light conditions using a pulser. This was done to simulate the bioluminesence background that would also be detected by the modules.

In addition to building the models and helping with the construction of the detector modules, I also gave general laboratory assistance by taking data, making many delay cables for the electronics package, and helping with other small jobs.

Working with DUMAND has not only been an experience in physics but also in many other sciences as well. I have learned that an experimental physicist must not only know a vast amount of his field of study but also must have a working background in engineering, electronics, mechanics, computer science, and a general knowledge of many other fields.

In closing, I would like to thank the Hawaii DUMAND group for allowing me to complete my skill project. I would like to give special thanks to Dan O'Connor for all that he has taught me.

FOOTNOTES

[1]The International DUMAND Collaboration, *DUMAND Proposal*, Abridged (Honolulu: Hawaii DUMAND Center, 1982), p.10,12.

[2]Dan O'Connor, (personal interview, spring 1983)

FIG. 1:

DIAGRAM OF THE DUMAND ARRAY MODEL

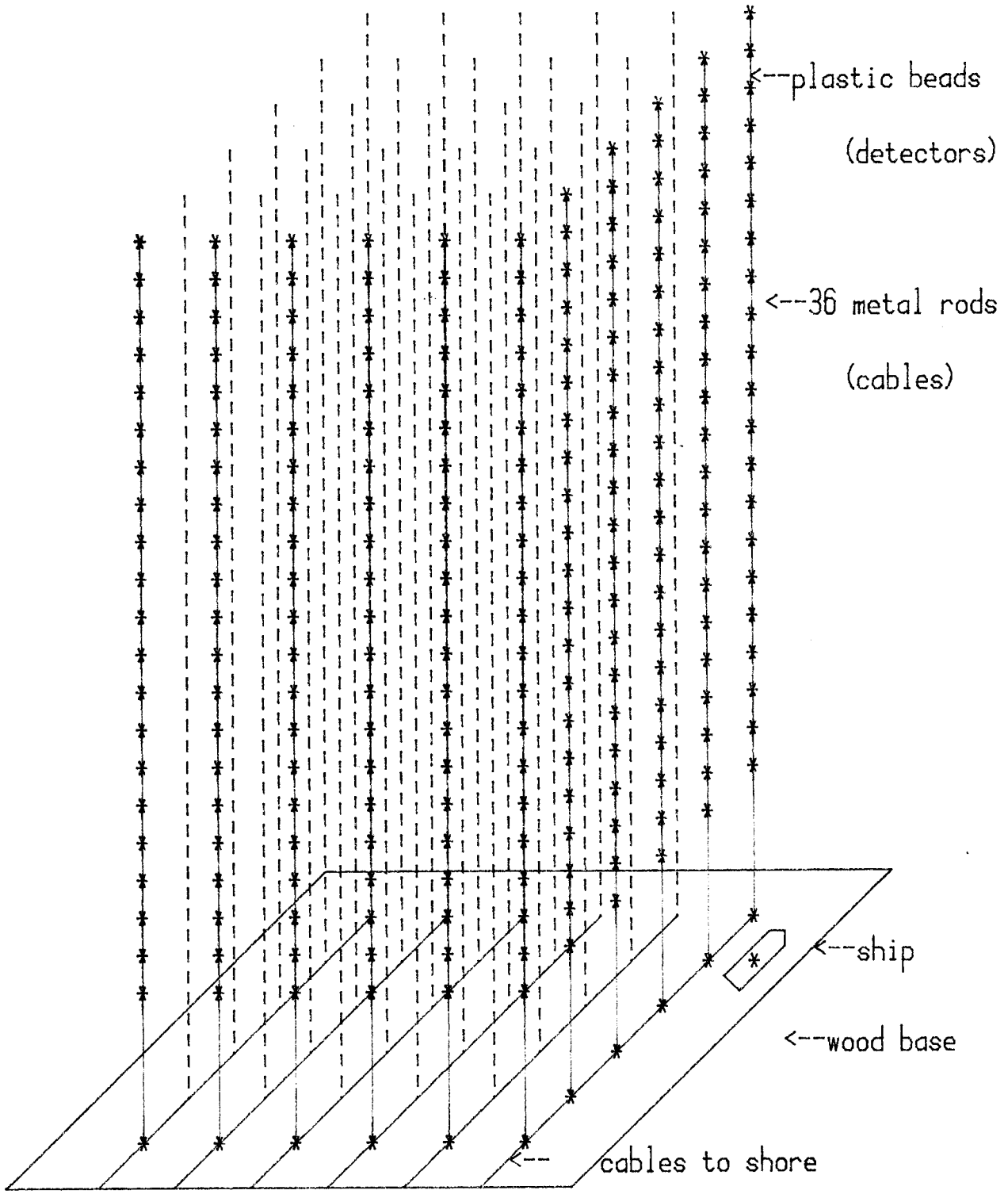
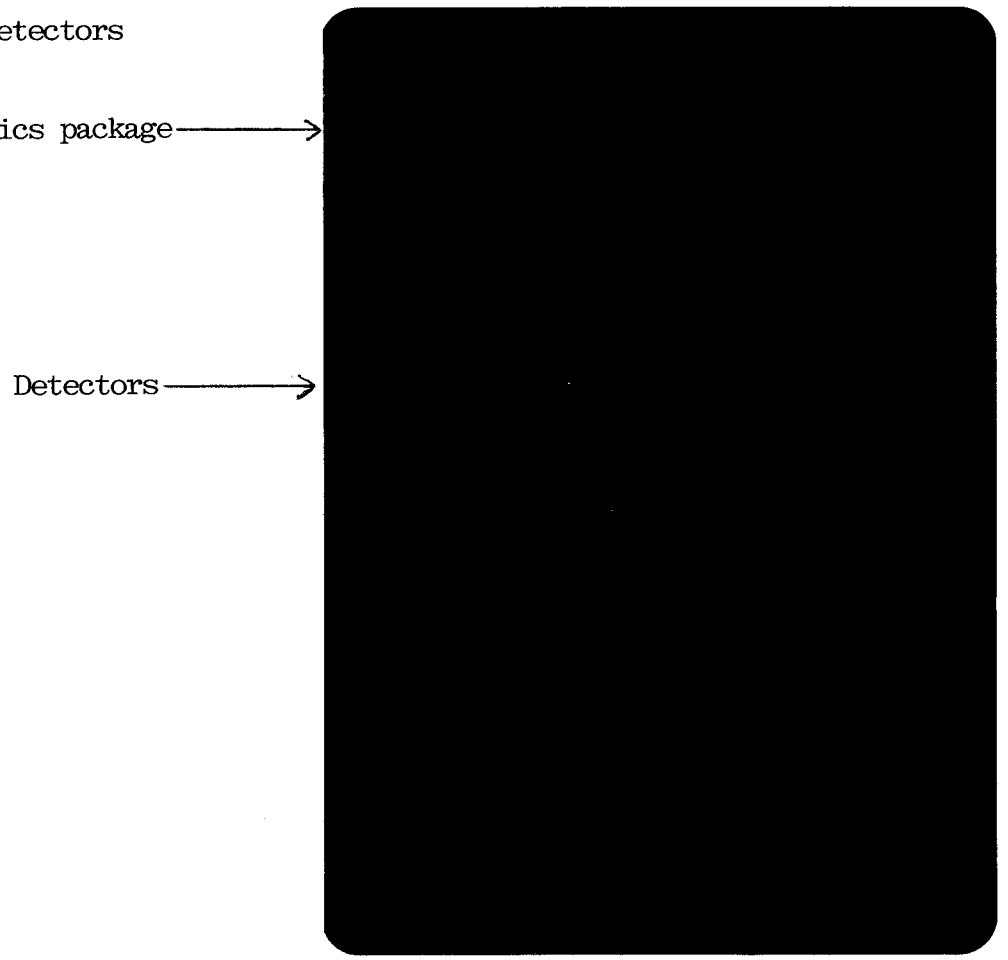
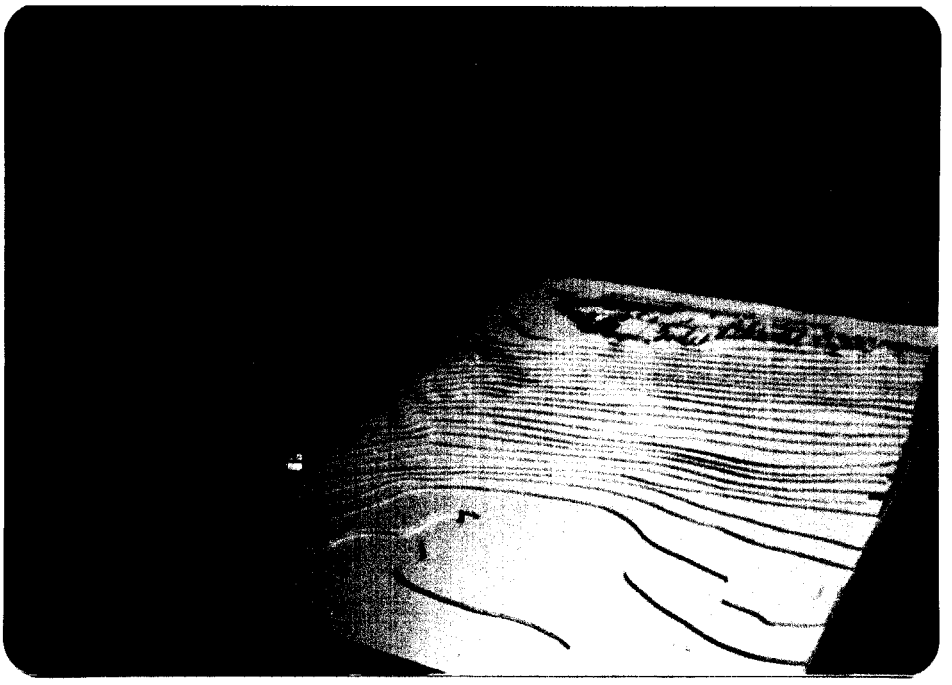


FIG. 2: PHOTOGRAPHS OF THE MODELS

A. String of detectors





B. Array and contour map

The red marker is the DUMAND site.