Update on the Neutron Scatter Camera from the shakedown voyage

SAND2007-6719P

Sponsored by DNDO
Transformational & Applied Research Directorate

Core TEAM

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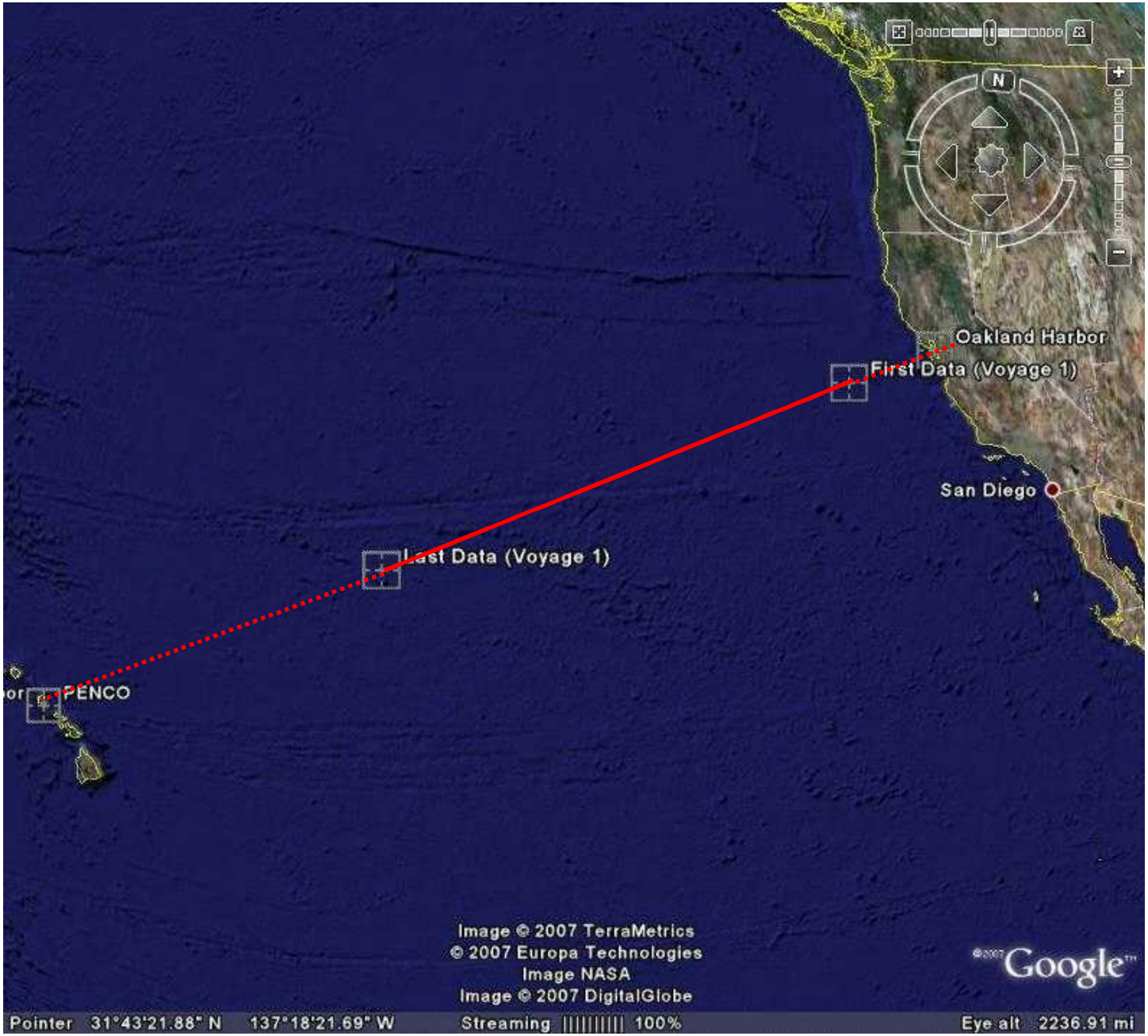
Mechanical Design – Jim Brennan

HazMat Shipping -- Grace Miranda


Oakland Harbor
First Data (Voyage 1)
San Diego
Last Data (Voyage 1)
PENCO
Image © 2007 TerraMetrics
© 2007 Europa Technologies
Image NASA
Image © 2007 DigitalGlobe
Google
Pointer 31°43'21.88" N 137°18'21.69" W
Streaming 100%
Eye alt 2236.91 mi

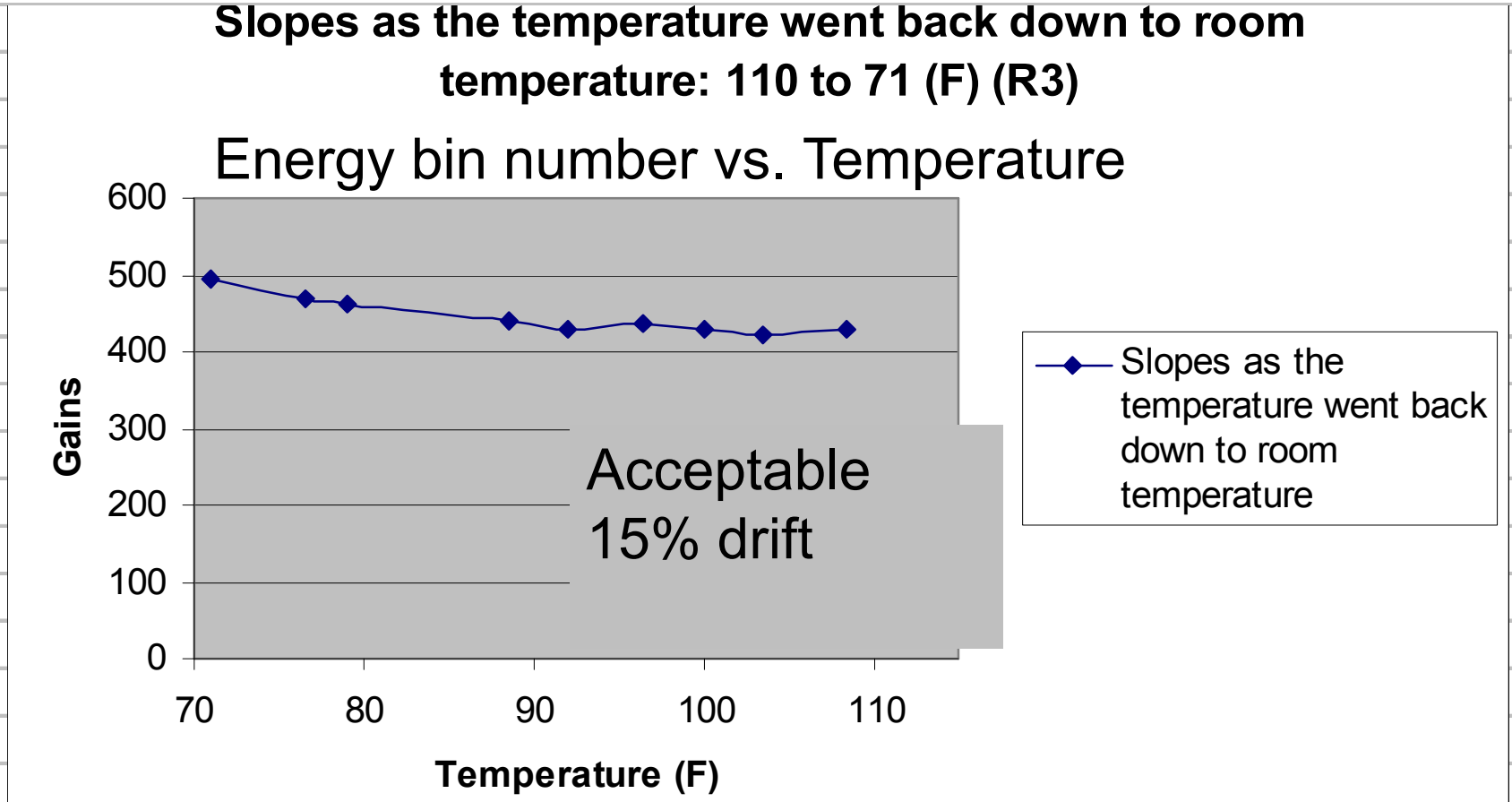
Project Details

- Schedule 1st month (July)
  - Define requirements
  - Await DOT Special Permit
  - Risk Reduction Activities
  - Mechanical Design of camera
  - Develop more software control
  - Build analysis tools

Risk Reduction Activities

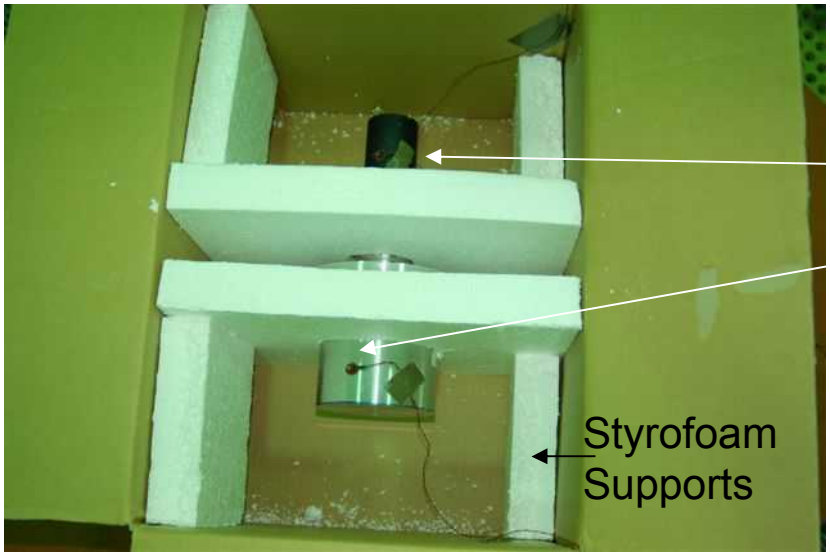
- Test CR-39 plastic for replacing glass window
- Run the additional electronic modules
- Check stability of PMT energy calibration
  - Anarghya Vardhana – Summer student
- Exercise electrical power down and up routines
- Prepare mock setup for the vibration and shock test

PMT Energy Calibration Temperature Stability



Vibration and shock test setup

Mock PMT
Detector package

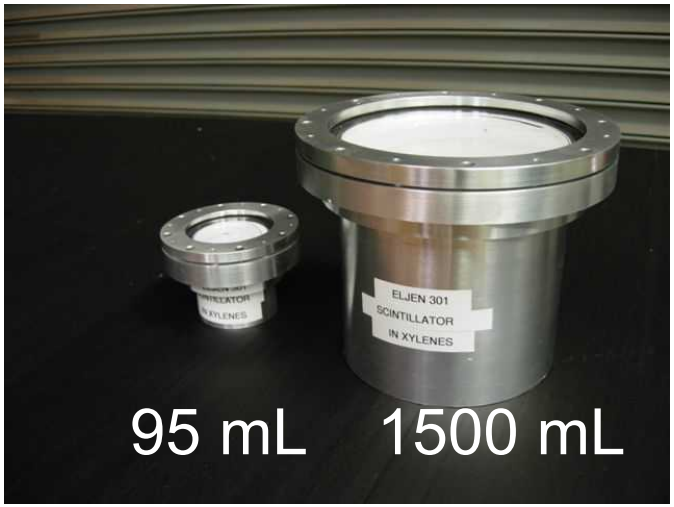


Accelerometers

David Shimizu

Secured to
shake table

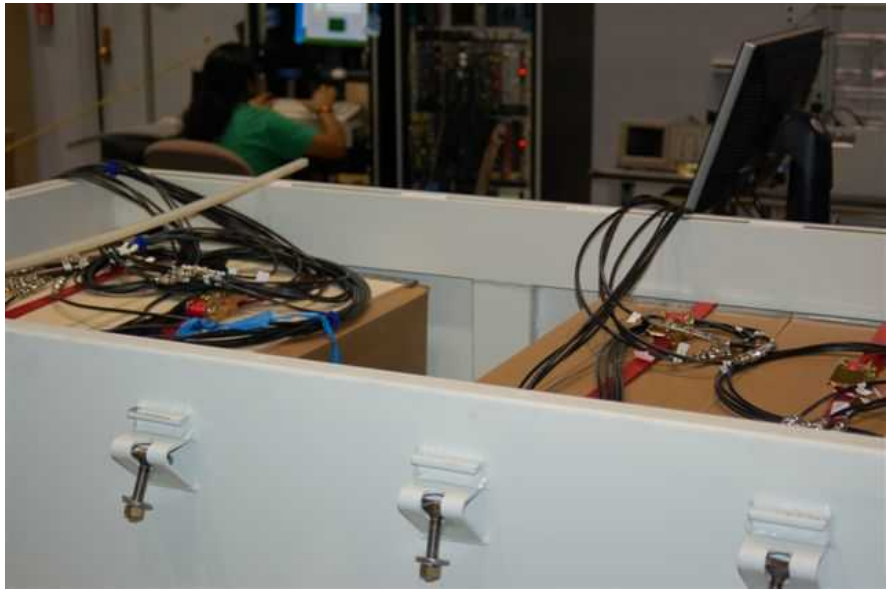
Shock isolation packaging



Rear Plane
PMT/Cells

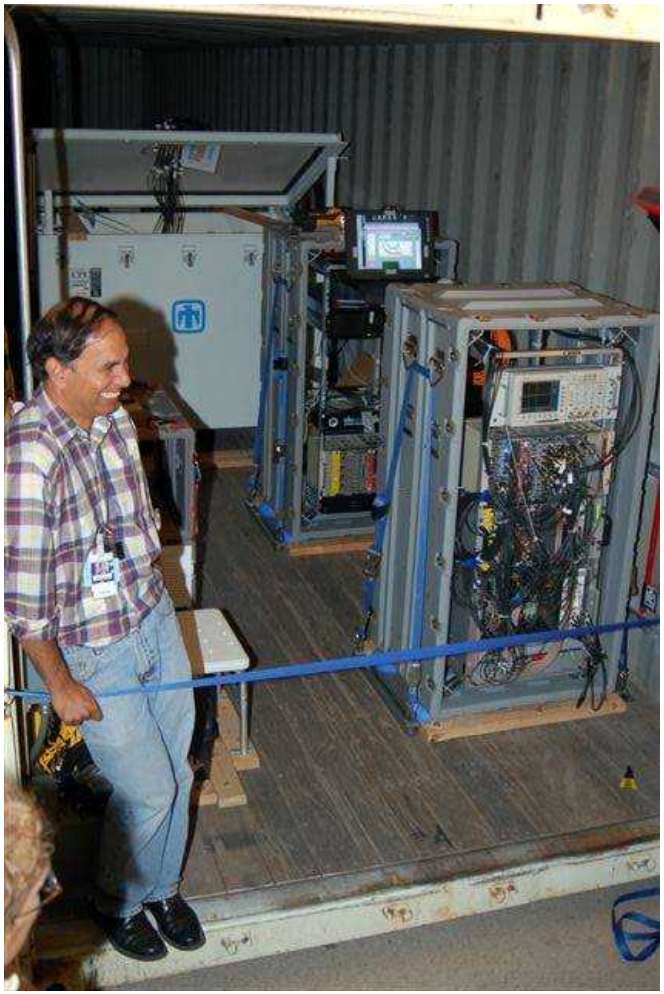
Base
boxes

Packed into DOT-rated Type A STRONG-TIGHT container

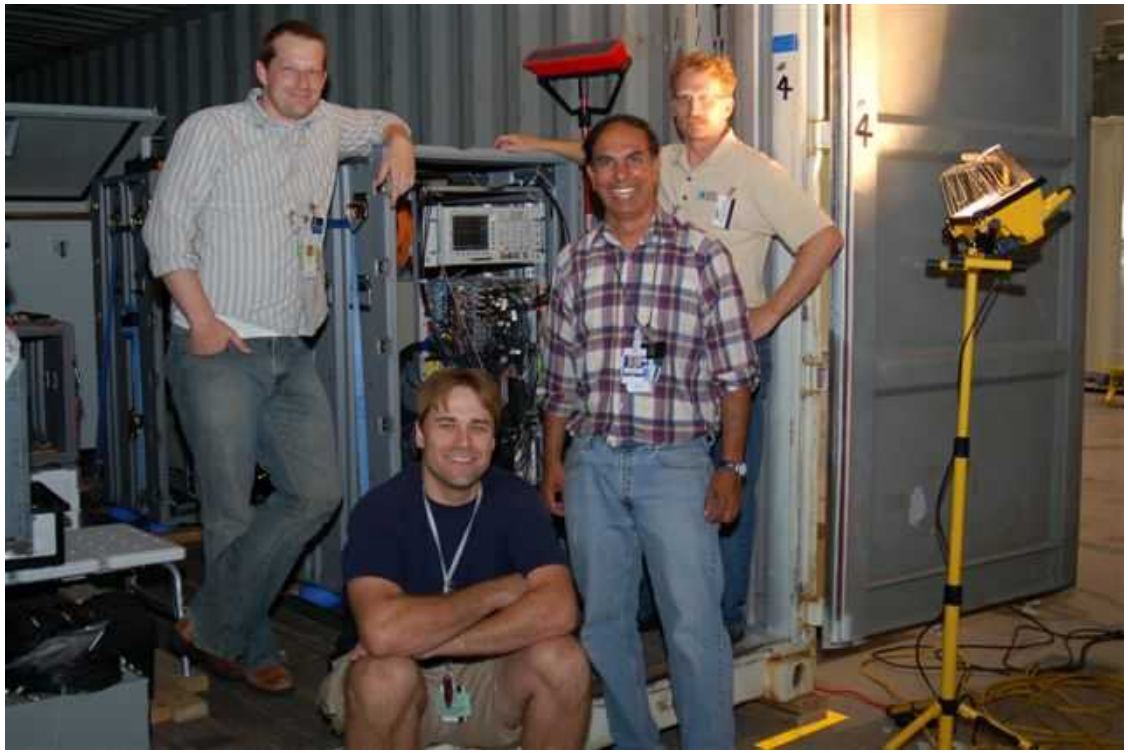


2-weeks before departure

NSC loaded into sea-land container
1 week ahead of B942 departure

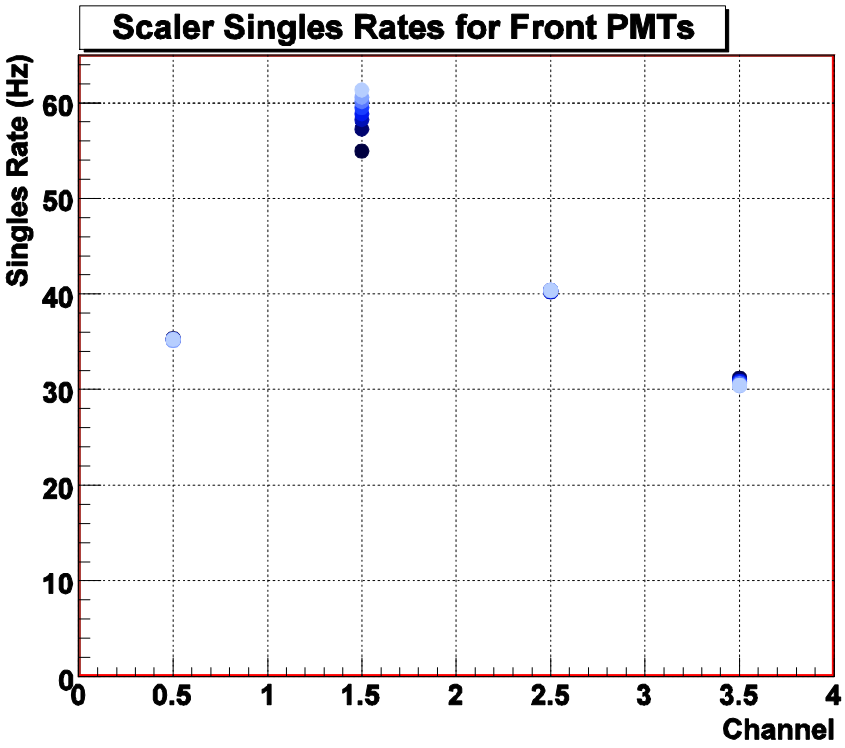


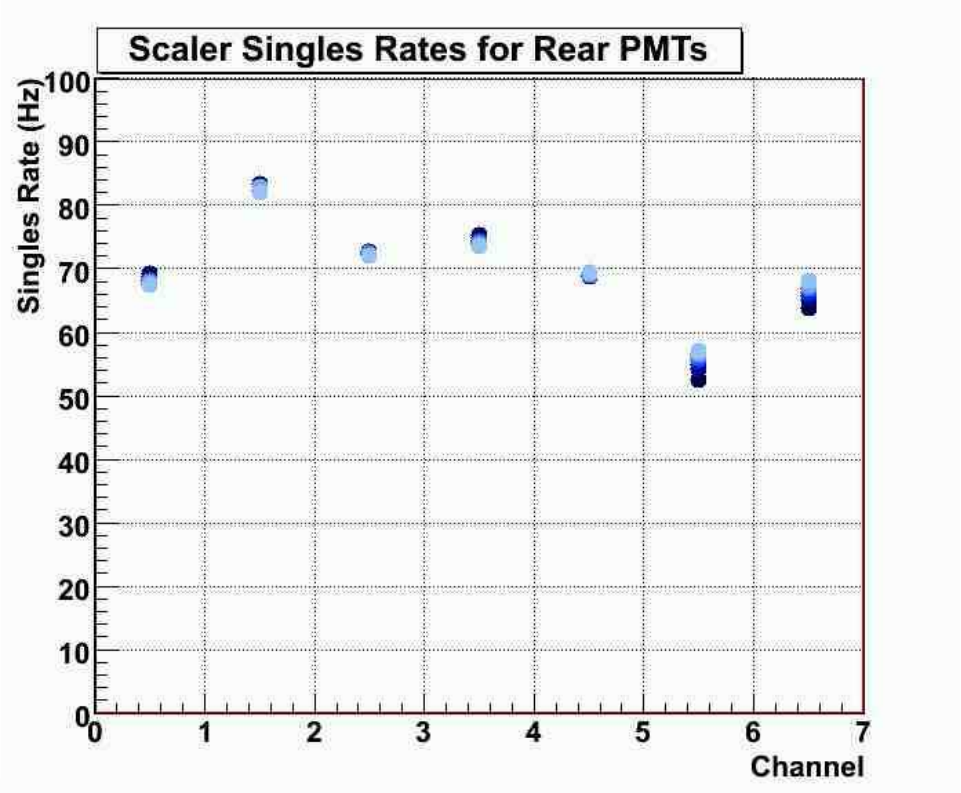
1. Energy calibration checks
2. Neutron source viewing
3. AC electrical power cycling



Stability of the Detector (individual Cell scaler rates)

6 hours per point (dark to light)

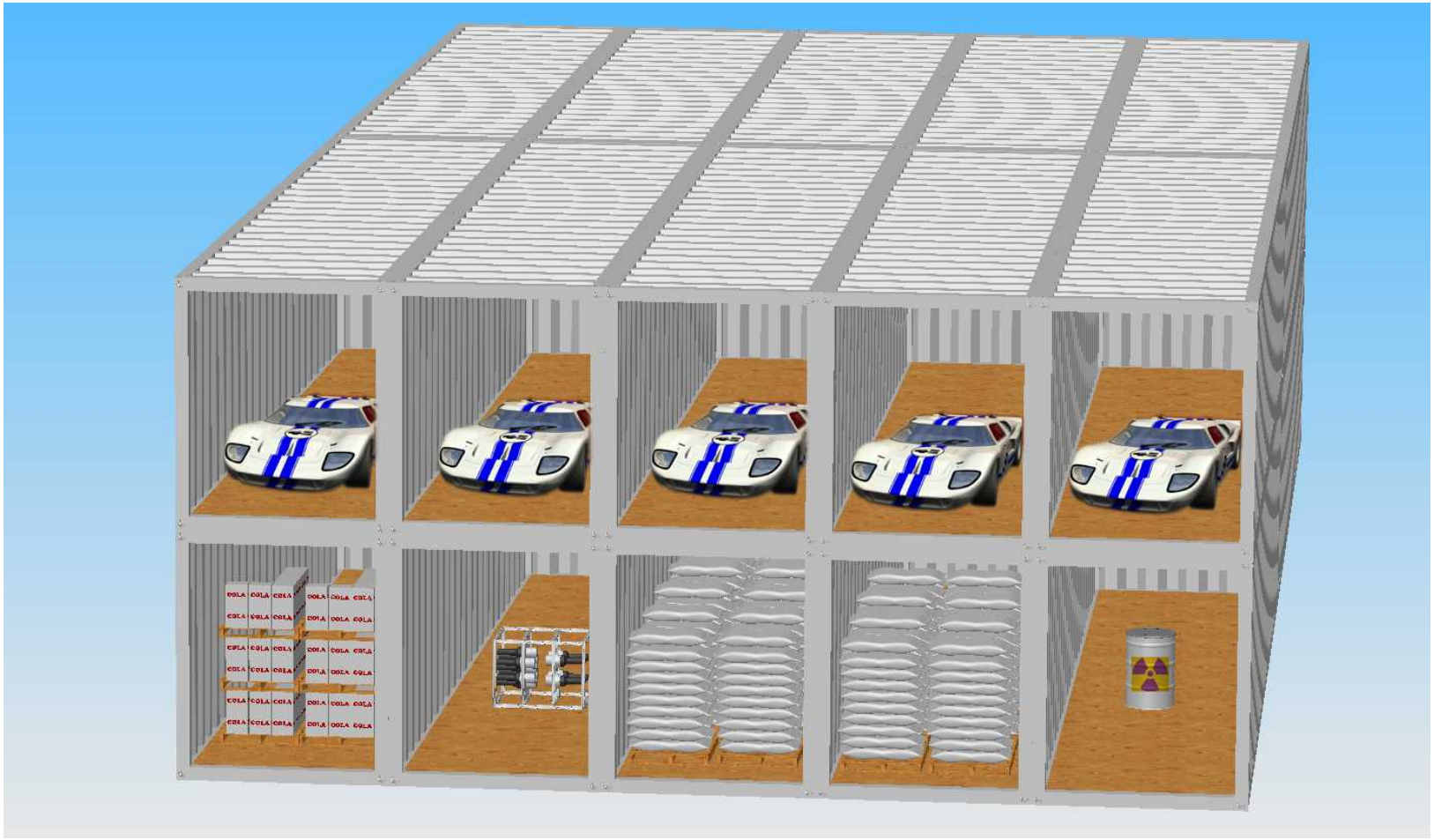




Deployment Status

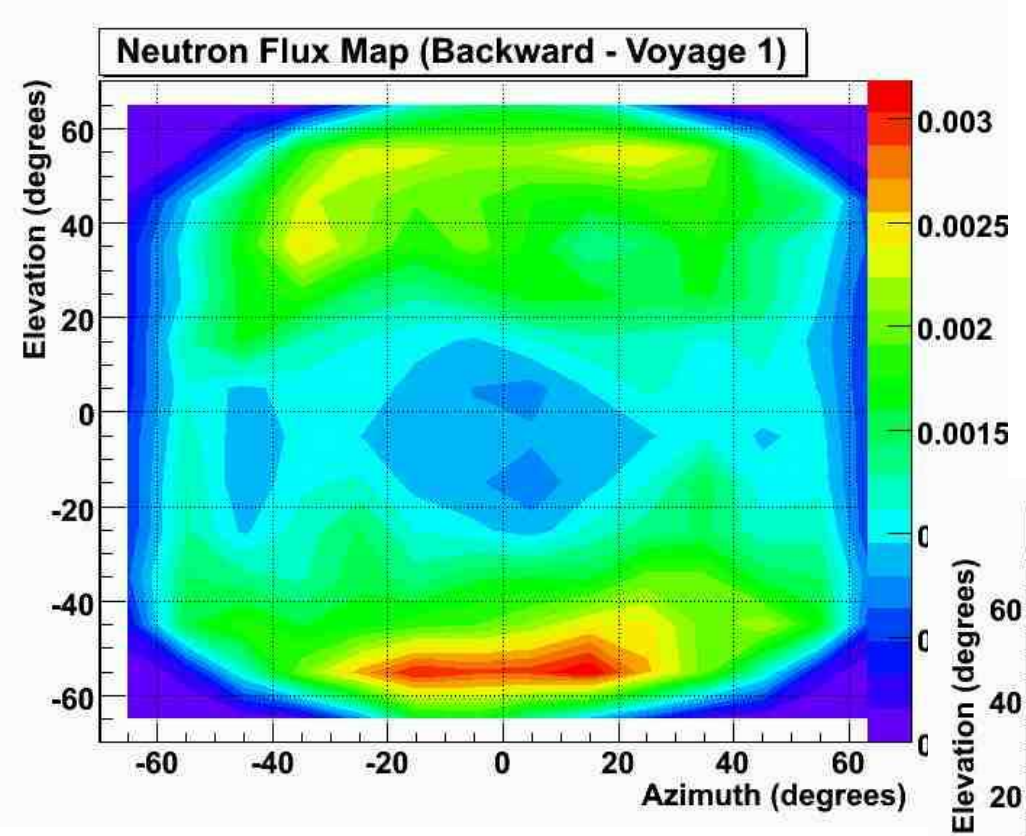
- 1st leg of Voyage 1 complete
  - Data acquisition occurred for 2 days, 2/3 of 1st leg
    - – analysis underway
  - Nim bin defect
  - Diagnosis and repair performed in Honolulu
  - Readied system for 2nd leg.

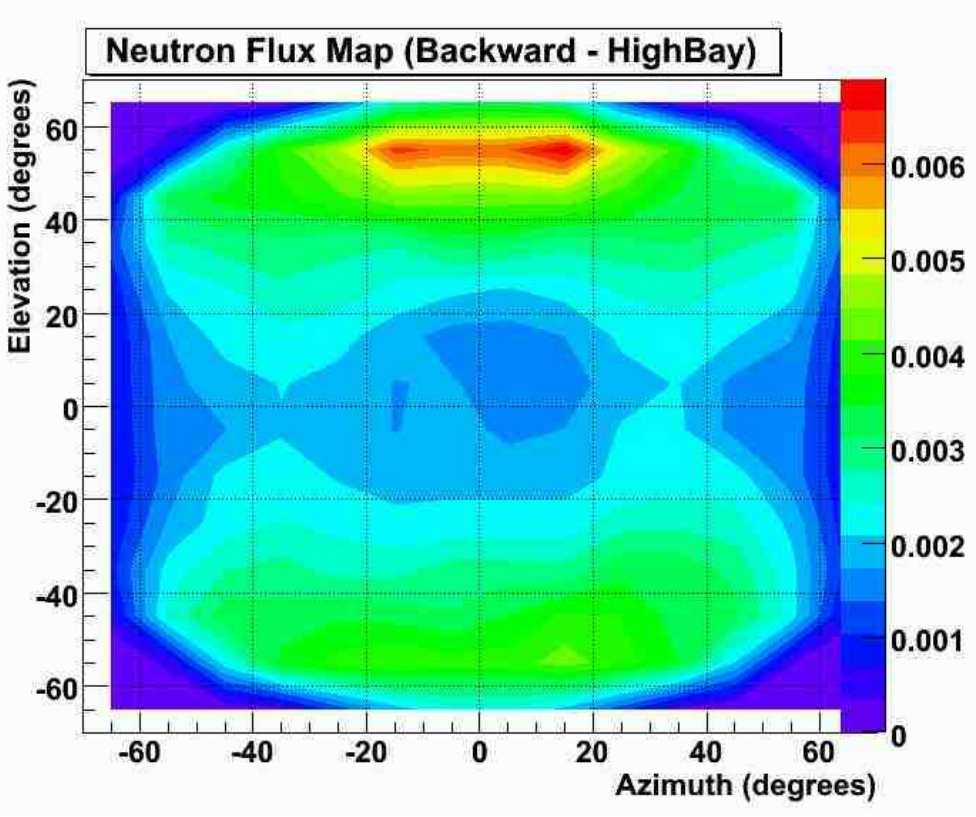
T4 on voyage1

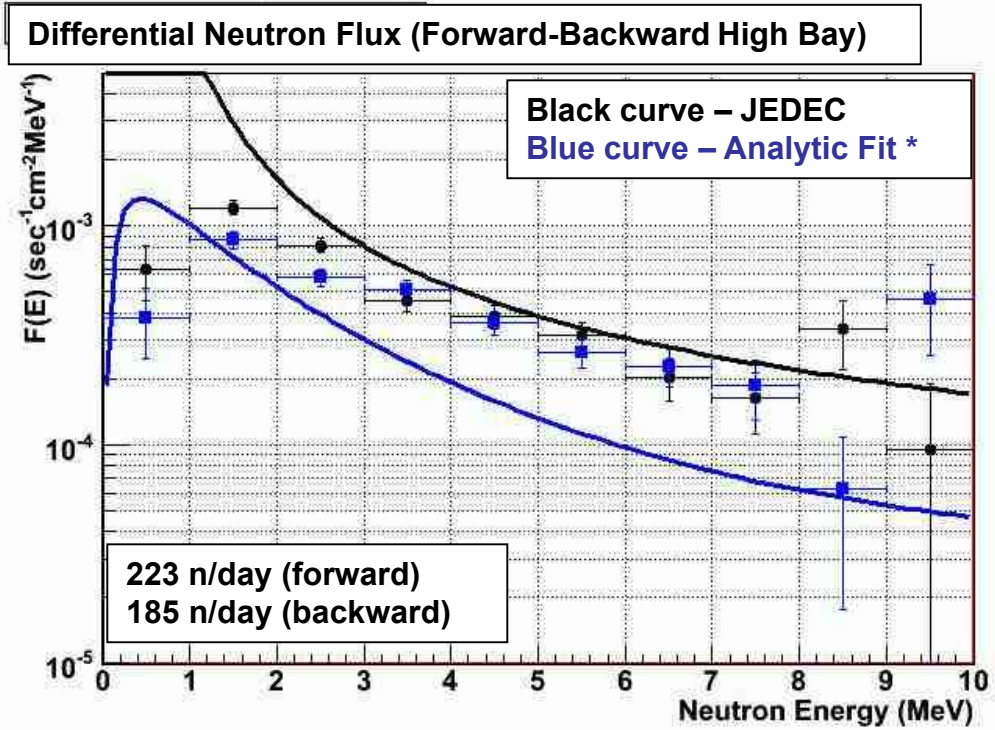


Rice 52 tons

Backward Flux Maps



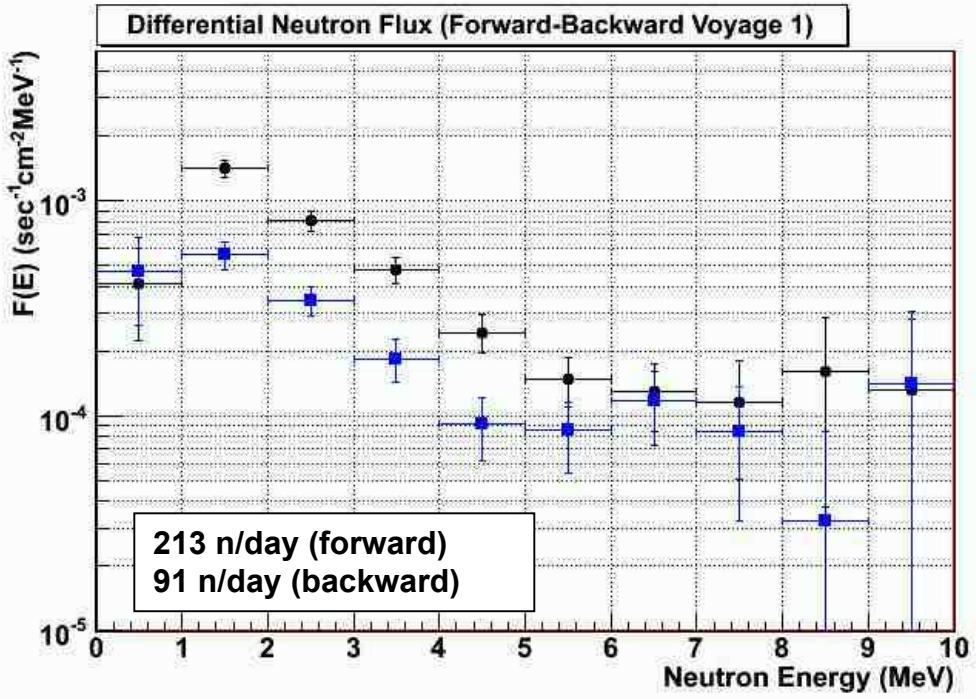




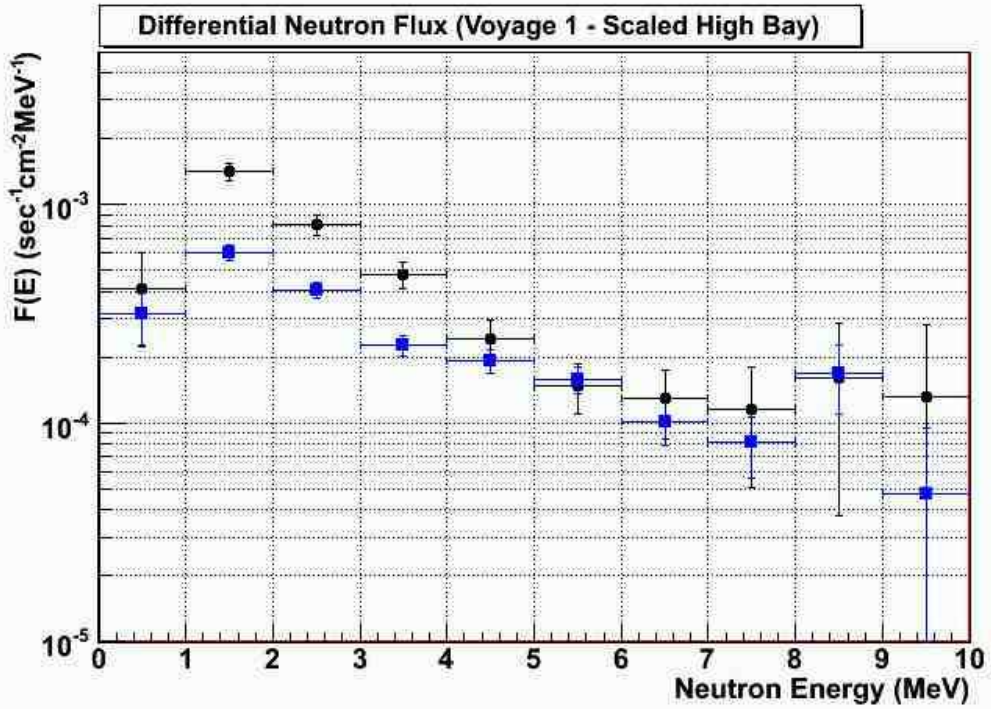
Black – Forward Flux

Blue – Backward Flux

Backward flux at sea was ~50% the Backward flux as measured in Livermore (High Bay)



* Gordon et al., IEEE TNS vol.51, no. 6, 2004

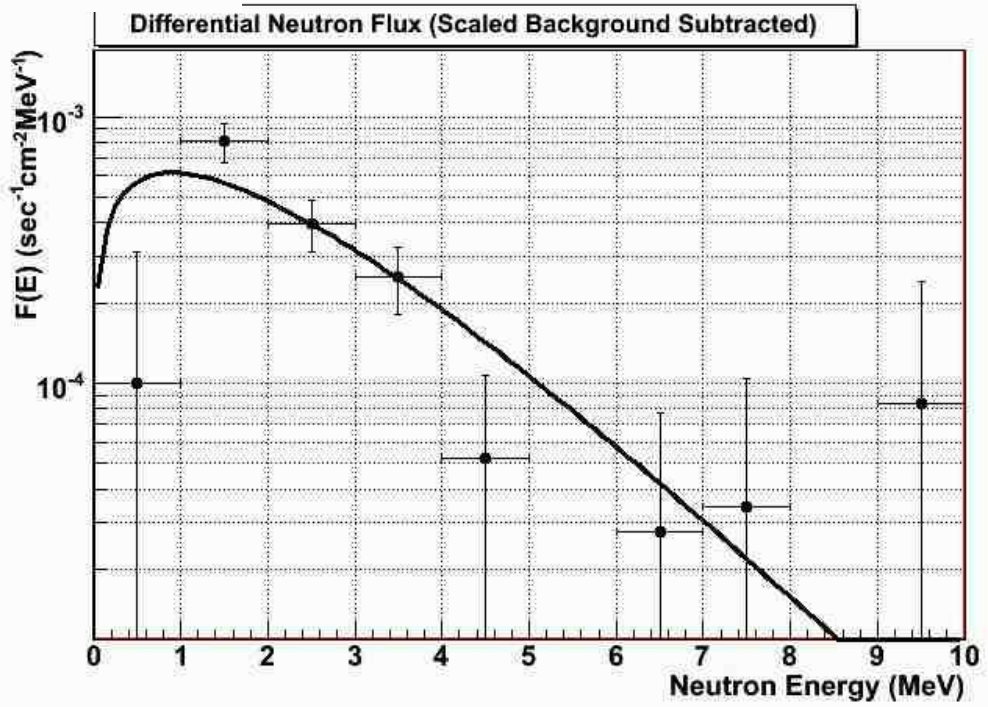


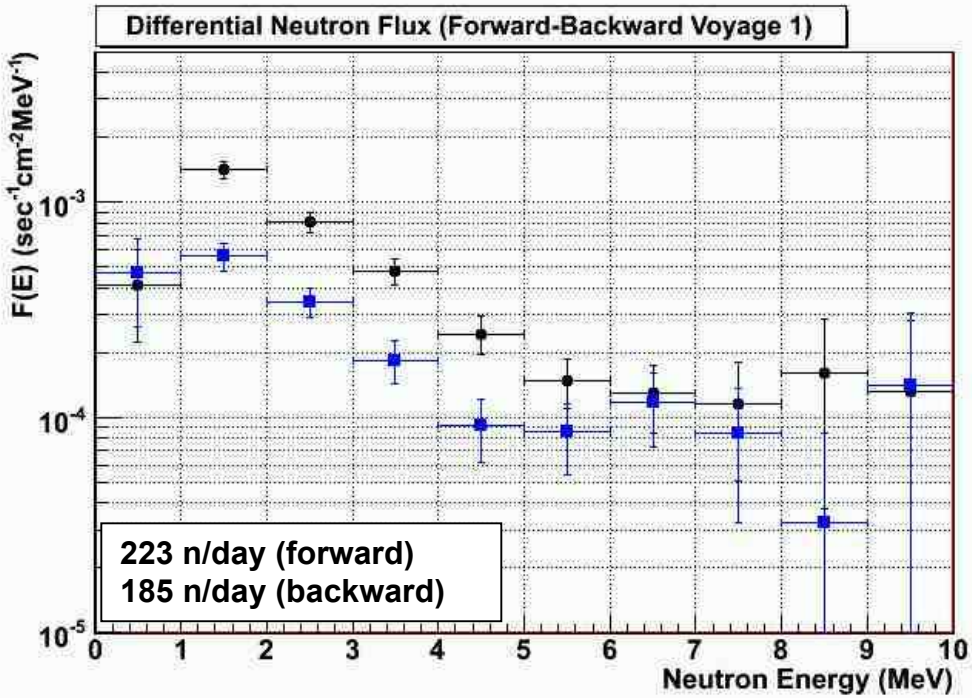
k – Forward Flux at Sea

– Forward Flux High Bay (Scaled)

Excess Forward Flux
Fit with a Watt Spectrum giving an integrated rate of 0.16 Hz

This corresponds to an attenuation factor of 1.2×10^{-3} from the unattenuated flux



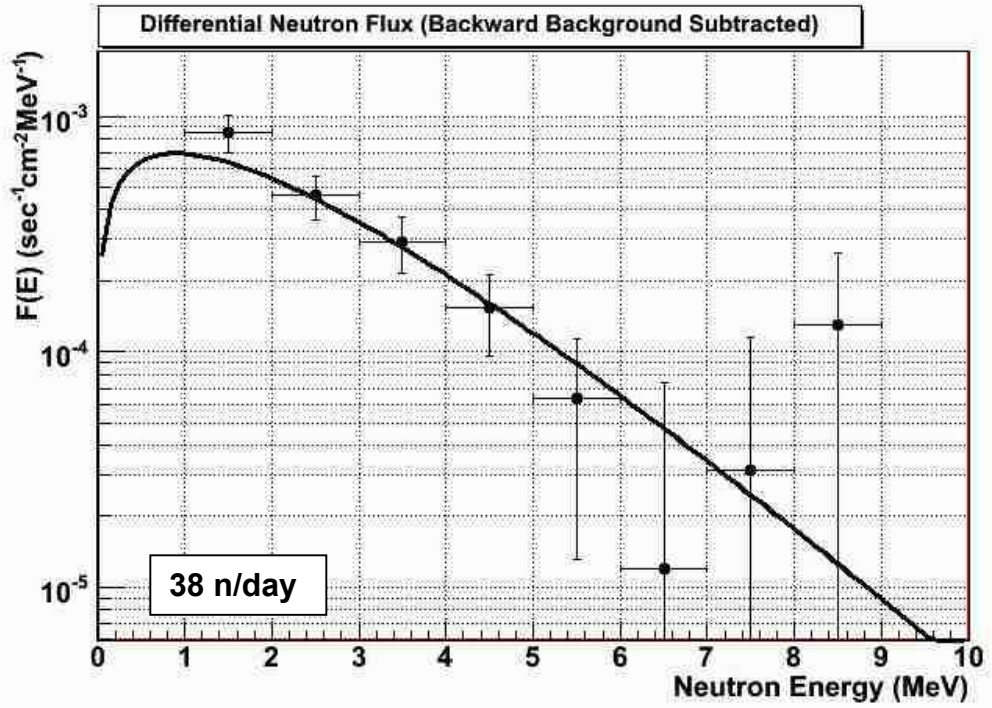


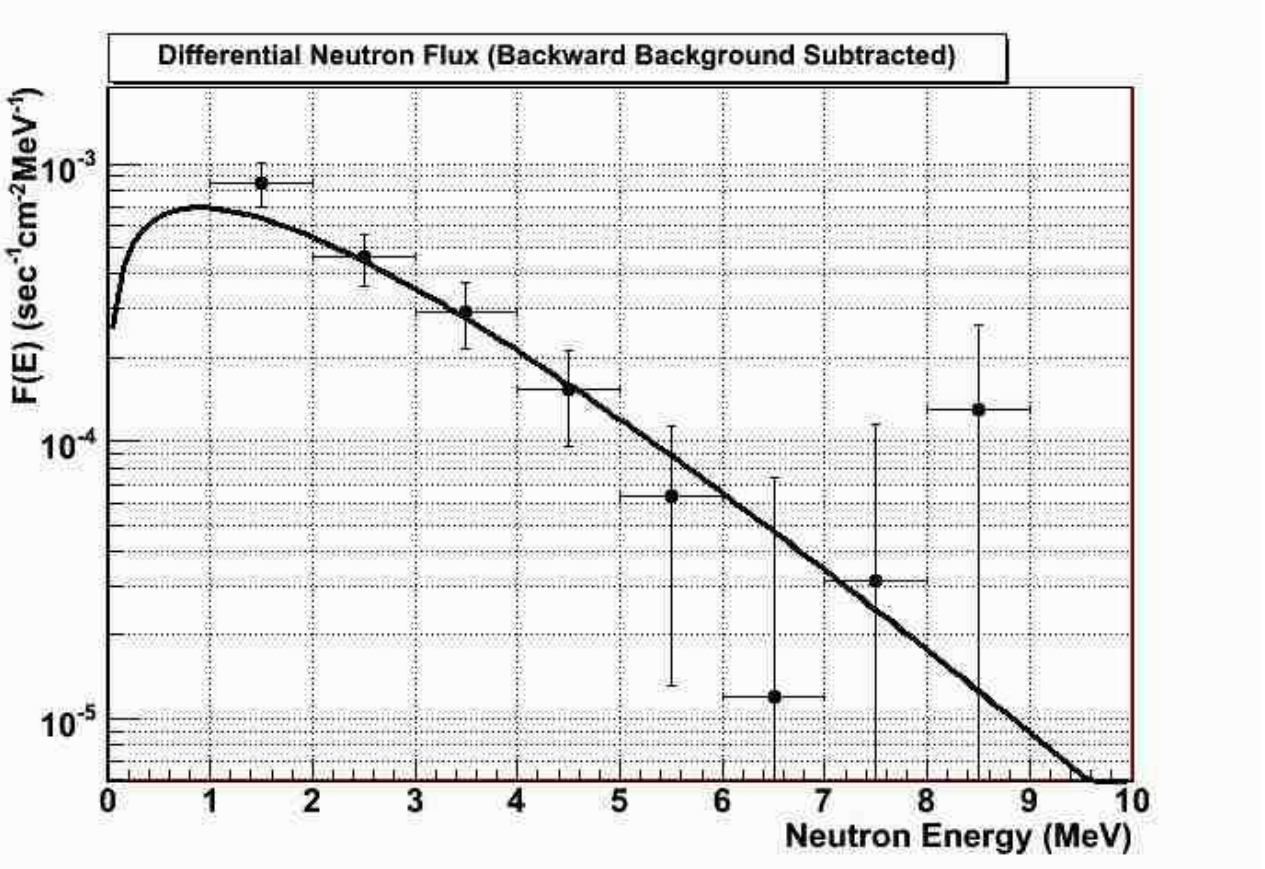
Black – Forward Flux at Sea

Blue – Backward Flux at Sea

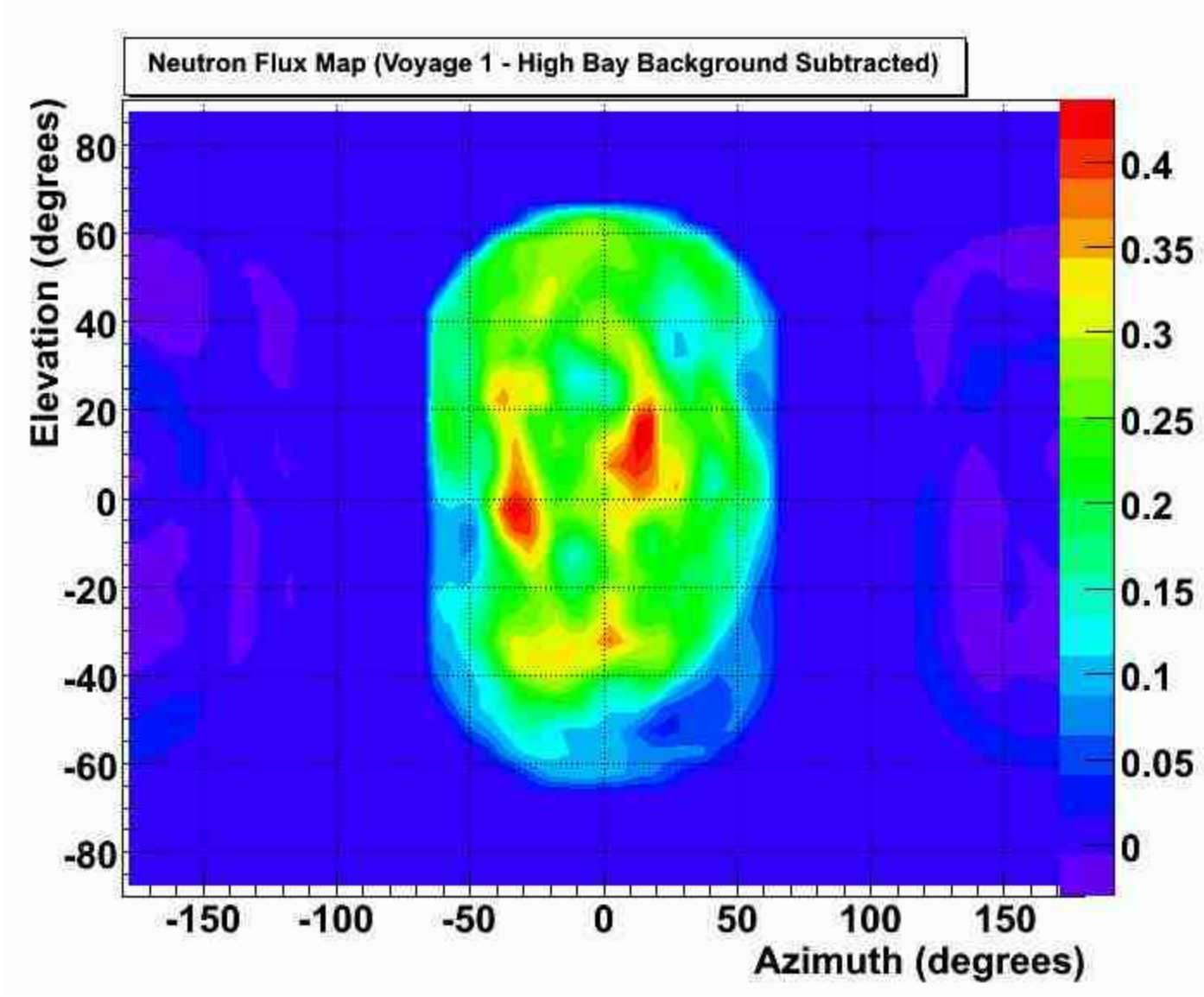
Excess Forward Flux
Fit with a Watt Spectrum giving an integrated rate of 0.18 Hz

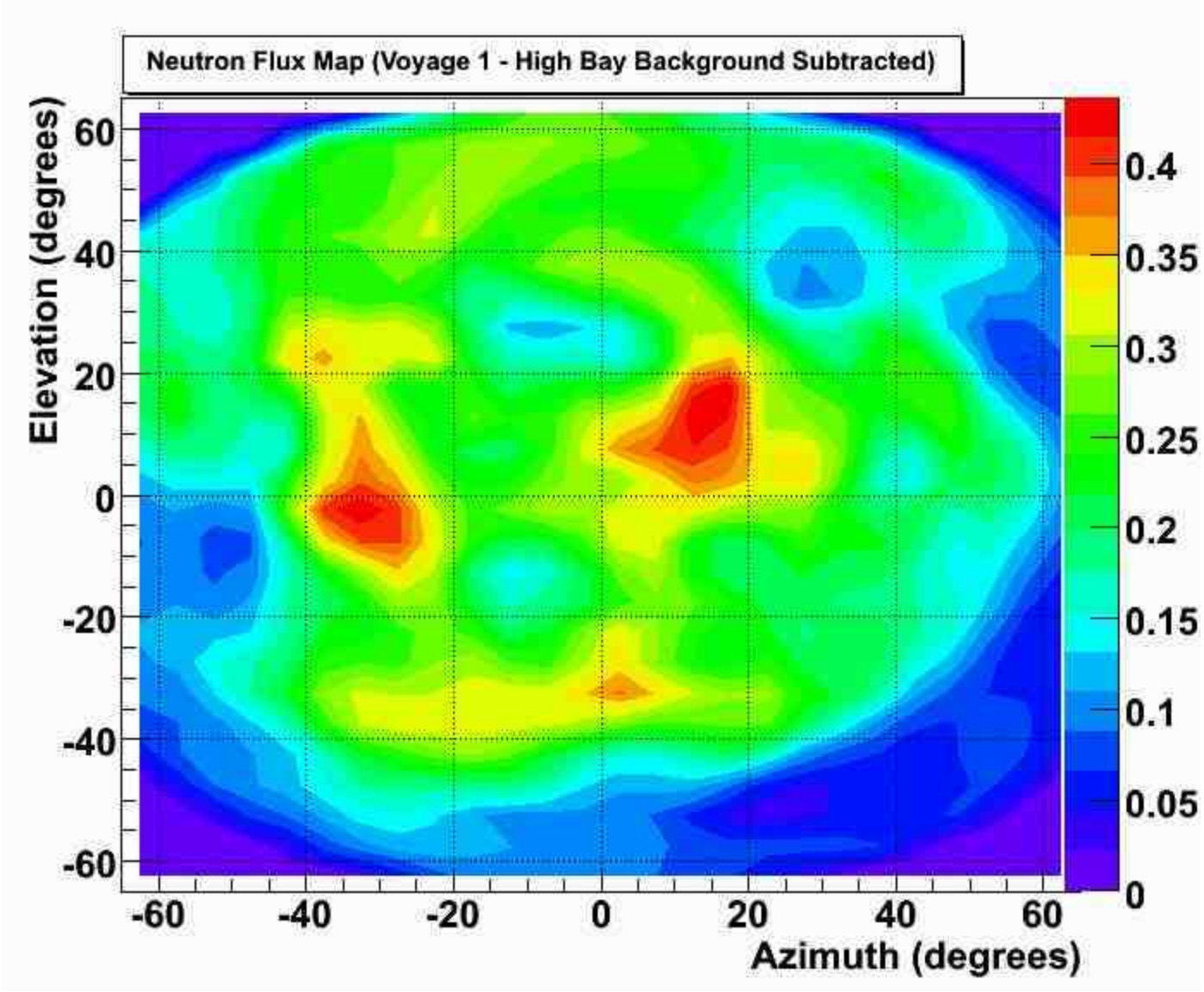
This corresponds to an attenuation factor of 1.3×10^{-3} from the unattenuated flux

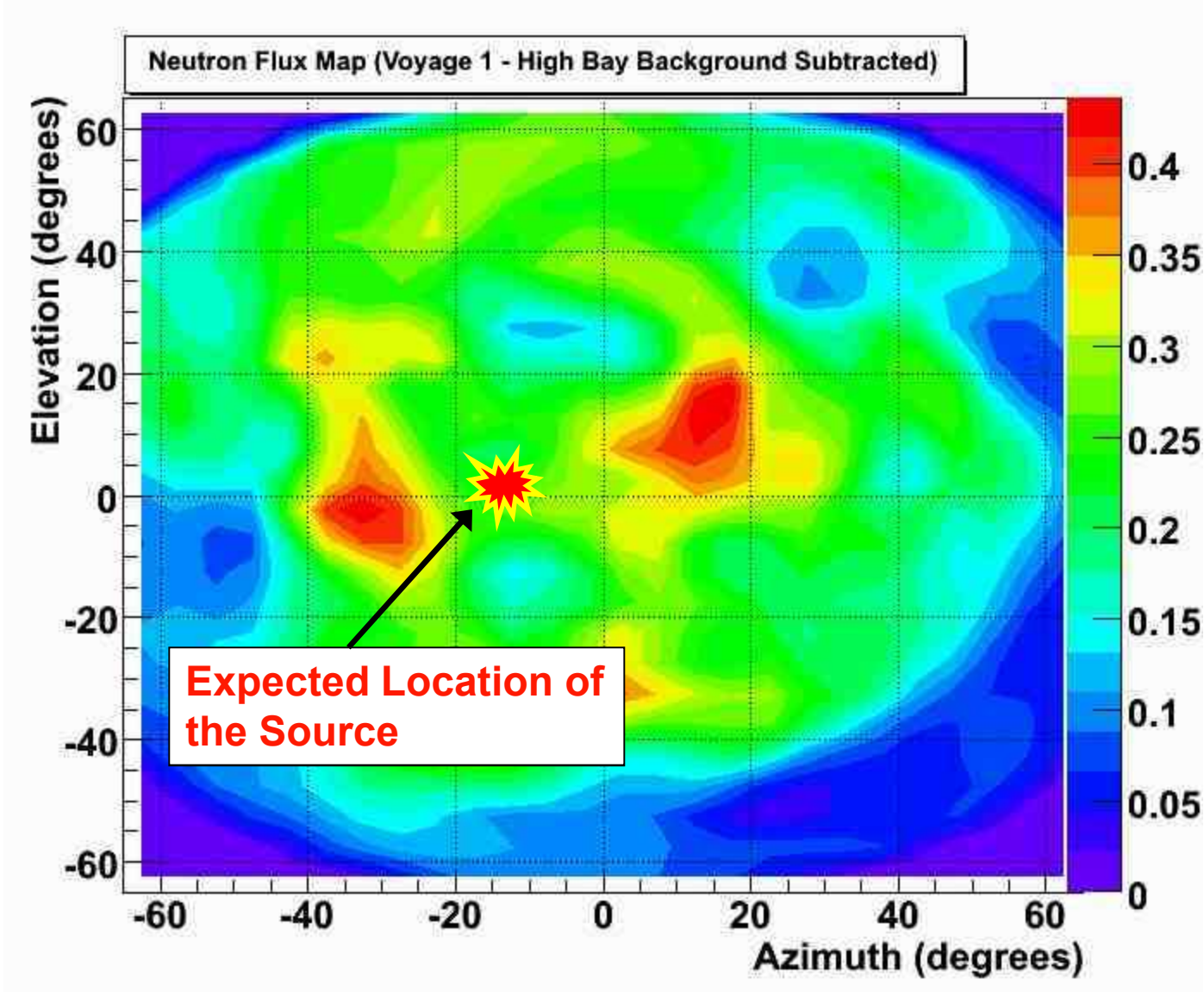


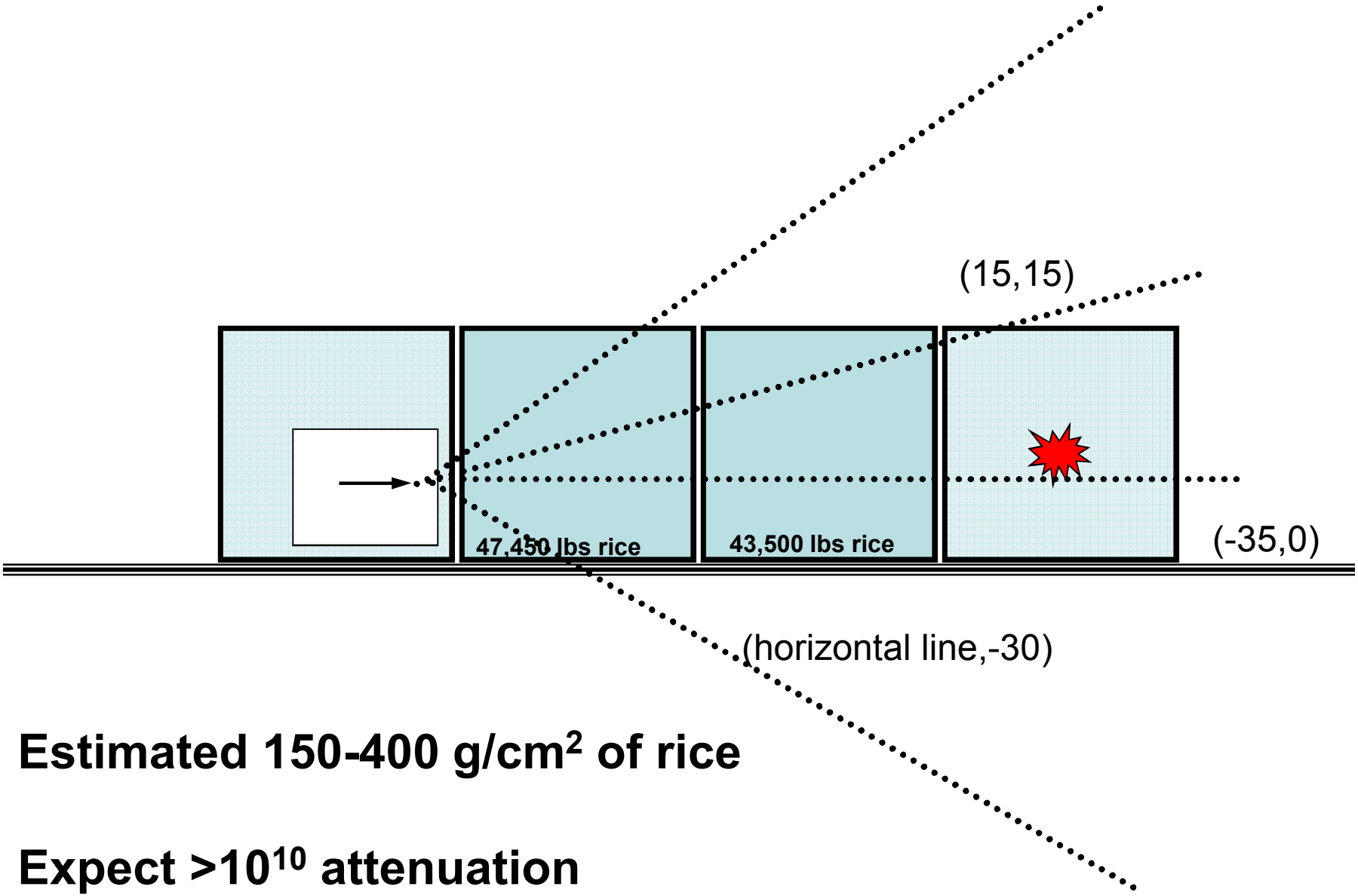


439 neutrons in 2.05 days gives a 9.5 σ detection significance (using the scaled High Bay background).


Neutron Flux Map (Voyage 1 - High Bay Background Subtracted)
Elevation (degrees)
80
60
40
20
0
-20
-40
-60
-80
-150
-100
-50
0
50
100
150
Azimuth (degrees)
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0


Neutron Flux Map (Voyage 1 - High Bay Background Subtracted)
Elevation (degrees)
60
40
20
0
-20
-40
-60
-60
-40
-20
0
20
40
60
Azimuth (degrees)
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0


Neutron Flux Map (Voyage 1 - High Bay Background Subtracted)
Elevation (degrees)
60
40
20
0
-20
-40
-60
-60
-40
-20
0
20
40
60
Azimuth (degrees)
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Expected Location of the Source



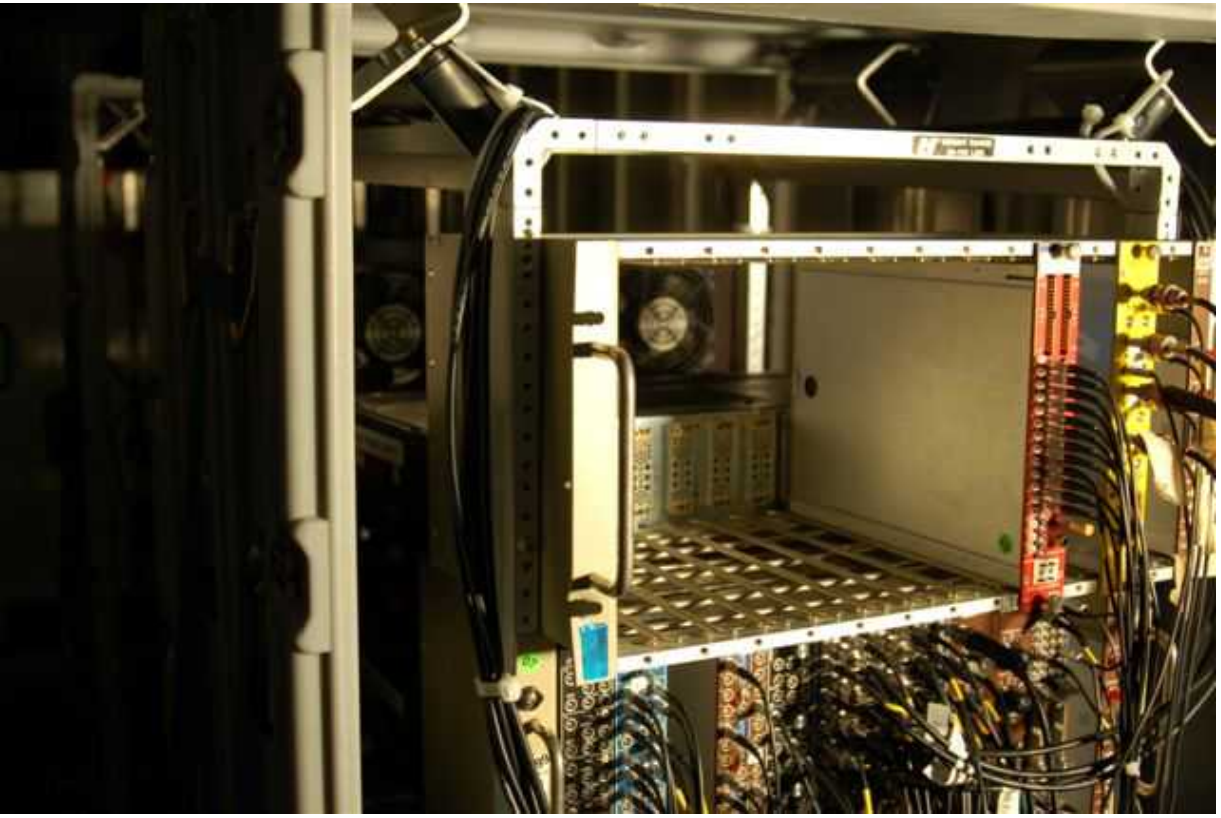
Estimated 150-400 g/cm^2 of rice

Expect >10^{10} attenuation

Deployment Status

- 2nd leg of Voyage 1 complete
  - Data acquisition started but a shock sequence (~ 14 shocks, 2 @28 G's, Sep 26) led to equipment crate to detach from rack
  - No data
    - – failure analysis complete
  - Require stronger bolts+oversize washers
  - Install support shelf for each crate
  - Strap crate to shelf
  - Repair and updates complete.
  - System will be ready for Voyage 2 , Lurline Oct 18.

Crate came loose!



Summary

- Neutron Imaging works- we detected the source (blob) through 52 tons of rice
- Detector survived both legs intact and still operates (detector hardening worked)
- Additional mechanical hardening needed for NIM crates (done)
- Updated shutdown sequence upon power down to protect computer/disks