Water Phase Energy Calibration in SNO+

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Outline

SNO+ Goals & Detector

Expected Signal

^{16}N Source

Monte Carlo Simulations

Updating the Source Geometry

Conclusion

Physics Goals

Water Phase

- Invisible Nucleon Decay

Pure Scintillator Phase

- Solar Neutrinos

Tellurium Loaded Scintillator

- Neutrinoless Double Beta Decay

All Phases

- Supernova Neutrinos
- Geo/Reactor Antineutrinos

SNO+ Detector

Acrylic Vessel
- 12m diameter

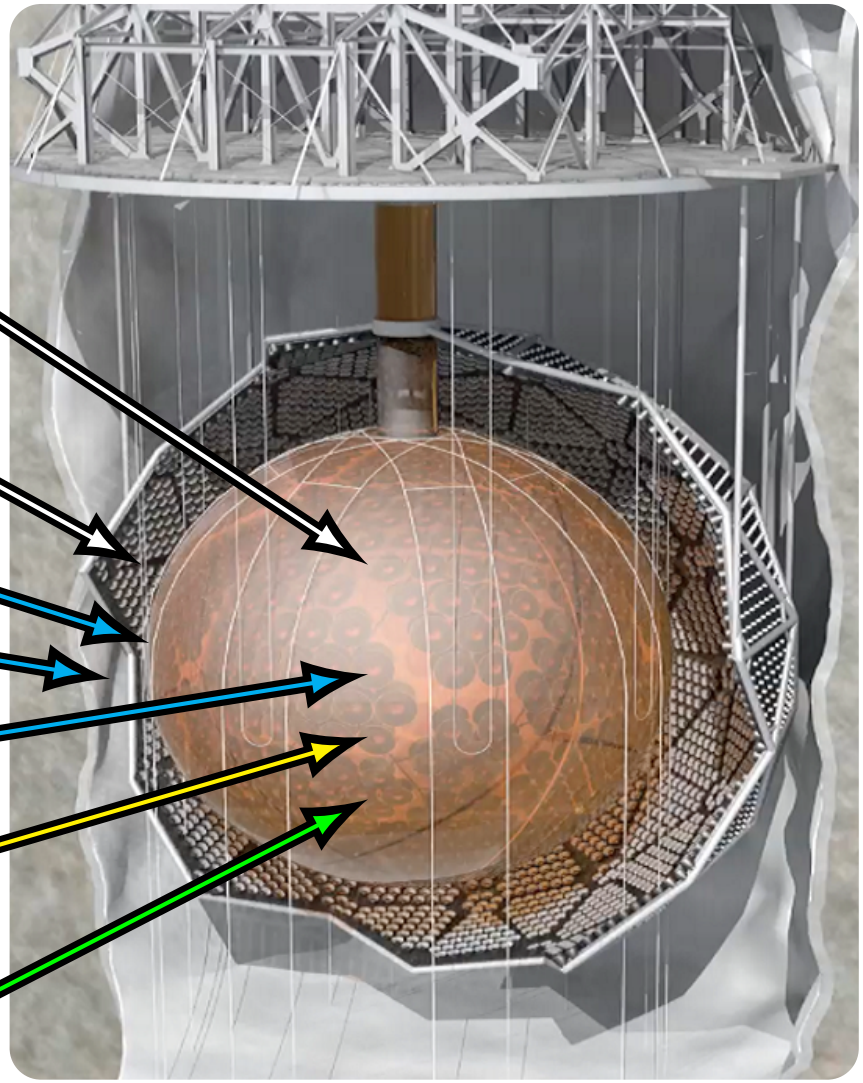
Phototube Support
- 9500 PMTs
- 54% coverage

Water Shielding
- 1700 tonnes inner
- 5300 tonnes outer

Phase I - Light Water
- 900 tonnes

Phase II - Scintillator
- 780 tonnes

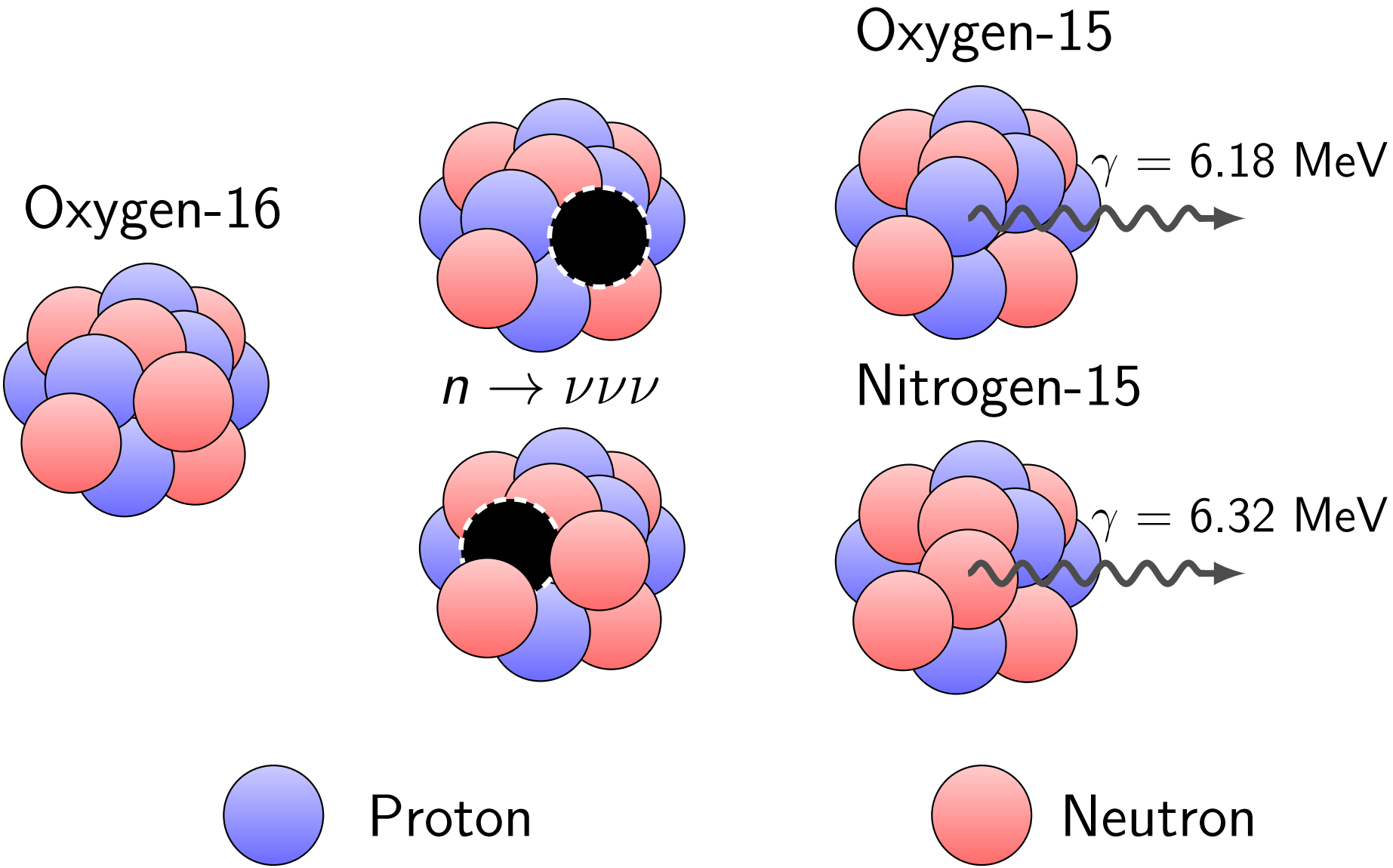
Phase III - Te Loaded
- 3900 kilograms



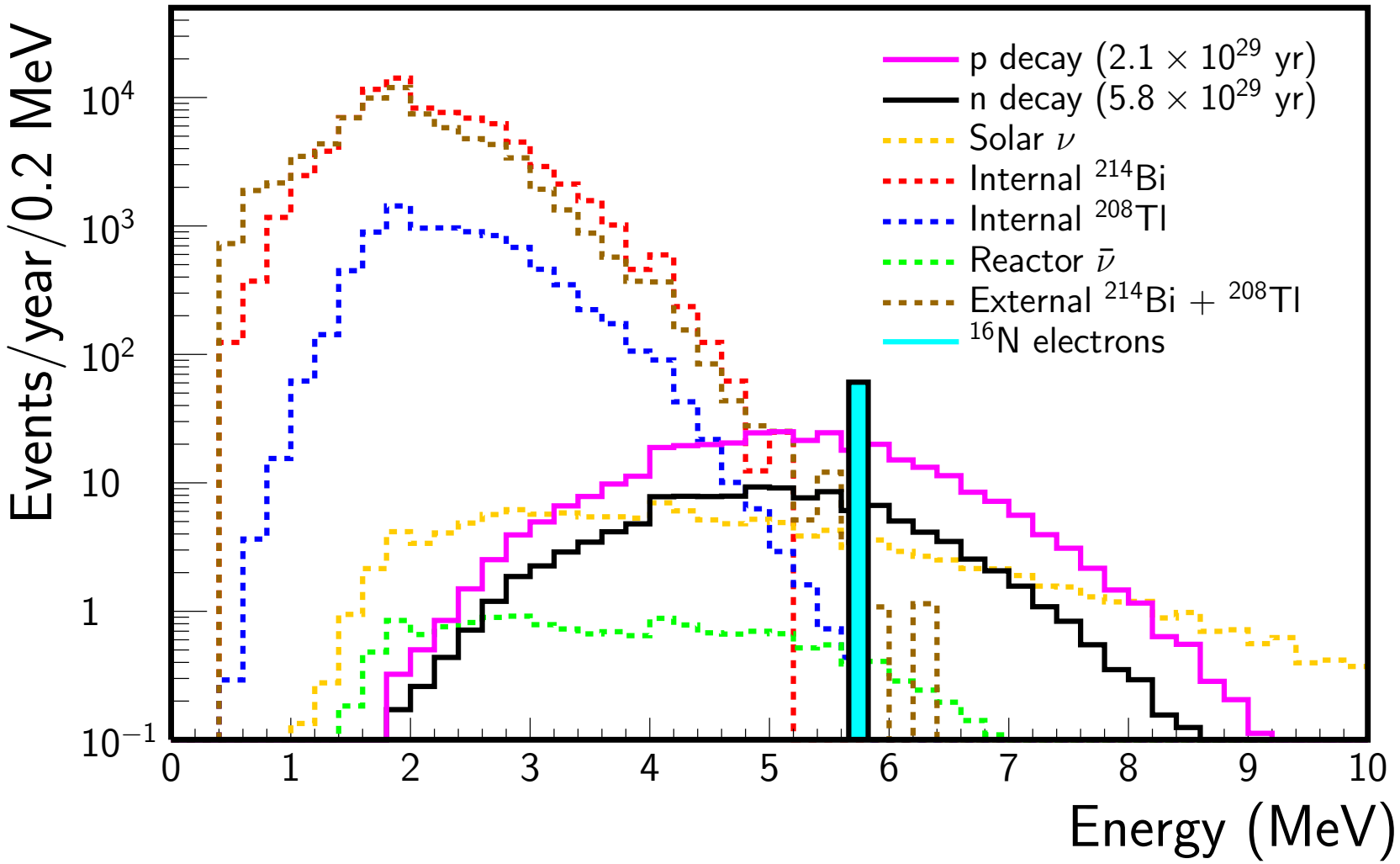
Current Status

Rope net holds detector down in scintillator phase

Invisible Nucleon Decay



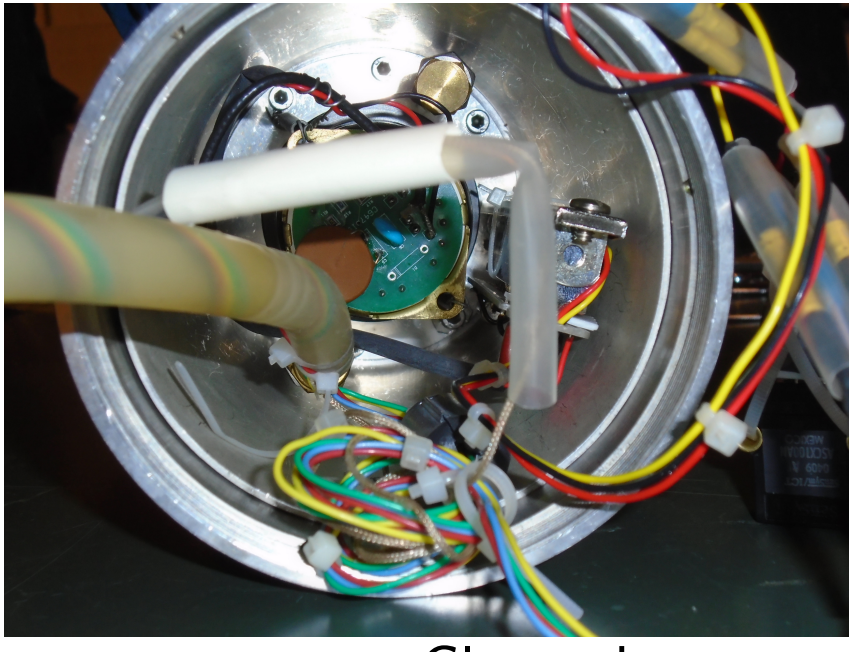
Expected Signal - Monte Carlo Study



Understand Energy Scale with ^{16}N Calibration Source

[1]I. Coulter, SNO+ Collaboration

^{16}N Source



Cleaned, measured and reassembled

Run Plan

- Starting 25 May 2015 for Water Phase
- 104 unique positions
- Initially only scan in Z
- High stats central run
- Scans change in steps of 50cm
- 30 minute runs @500Hz
- External runs can be done for Scintillator Phase

Z Scan

- Z: -550.0cm↔550.0cm

X scan

- X: -550.0cm↔550.0cm

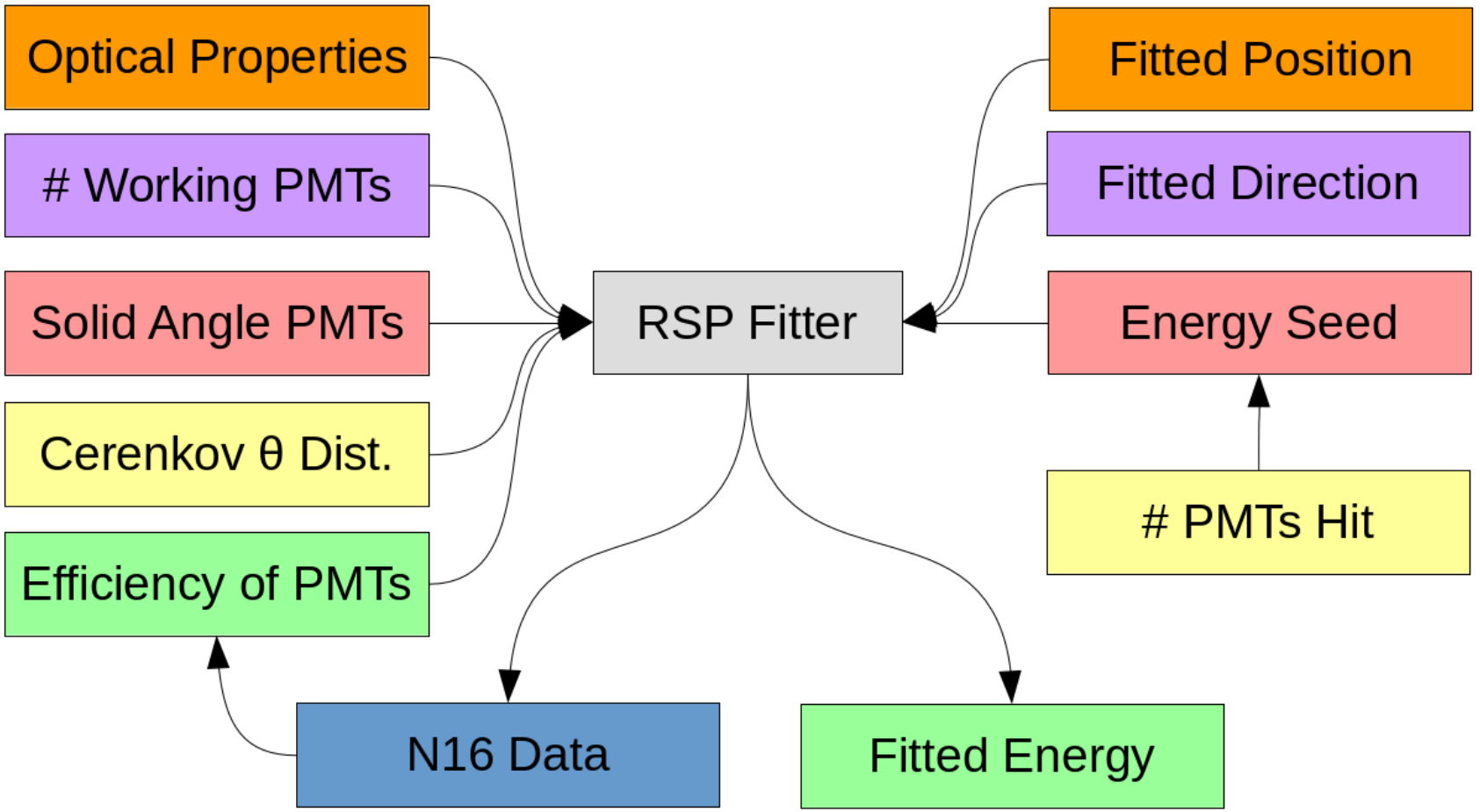
Y Scan

- Y: -550.0cm↔550.0cm

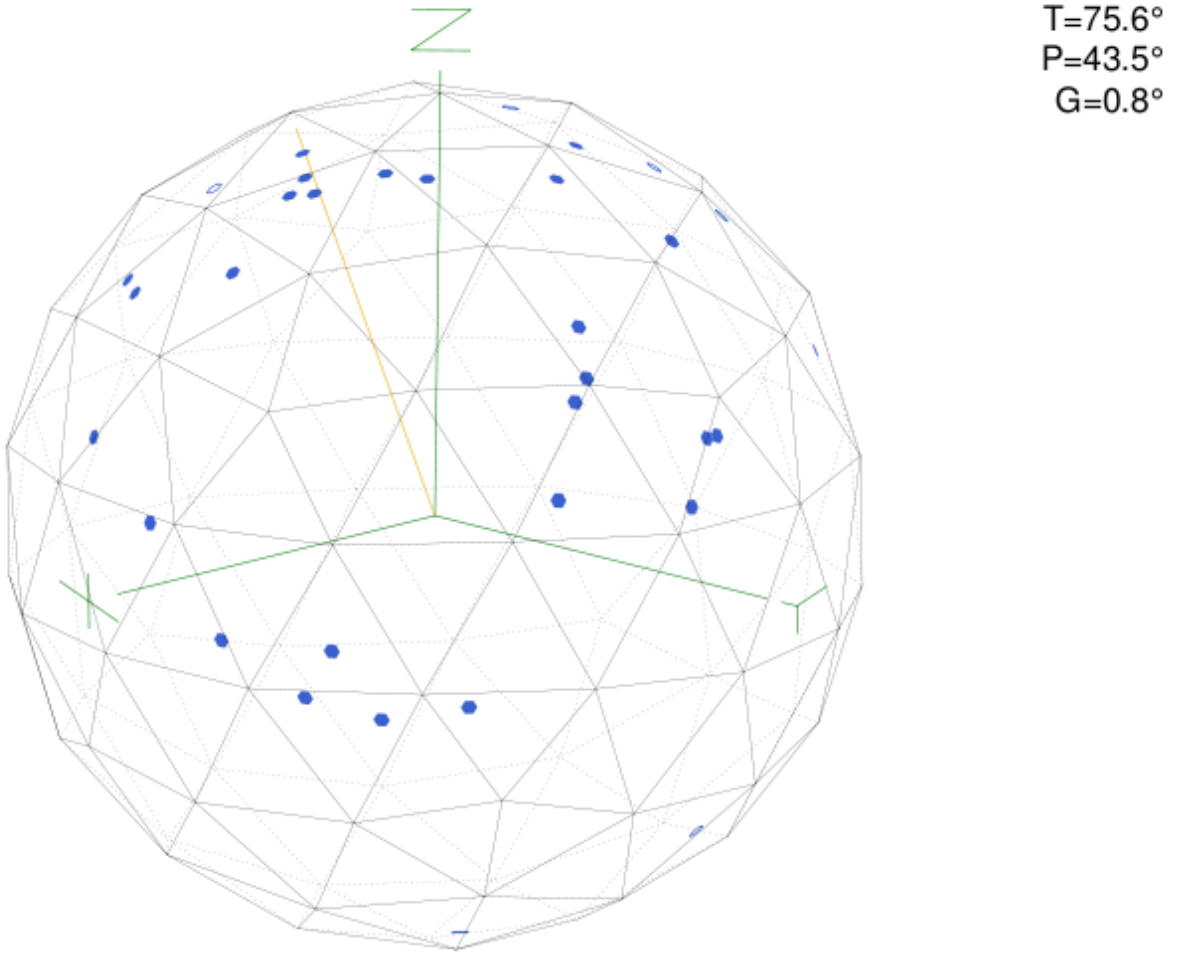
3.0m 'Corners'
2.3m 'Corners'
External Scan

- X: -586.11cm
- Y: -252.41cm
- Z: -500.0cm↔500cm

Response Process Fitter

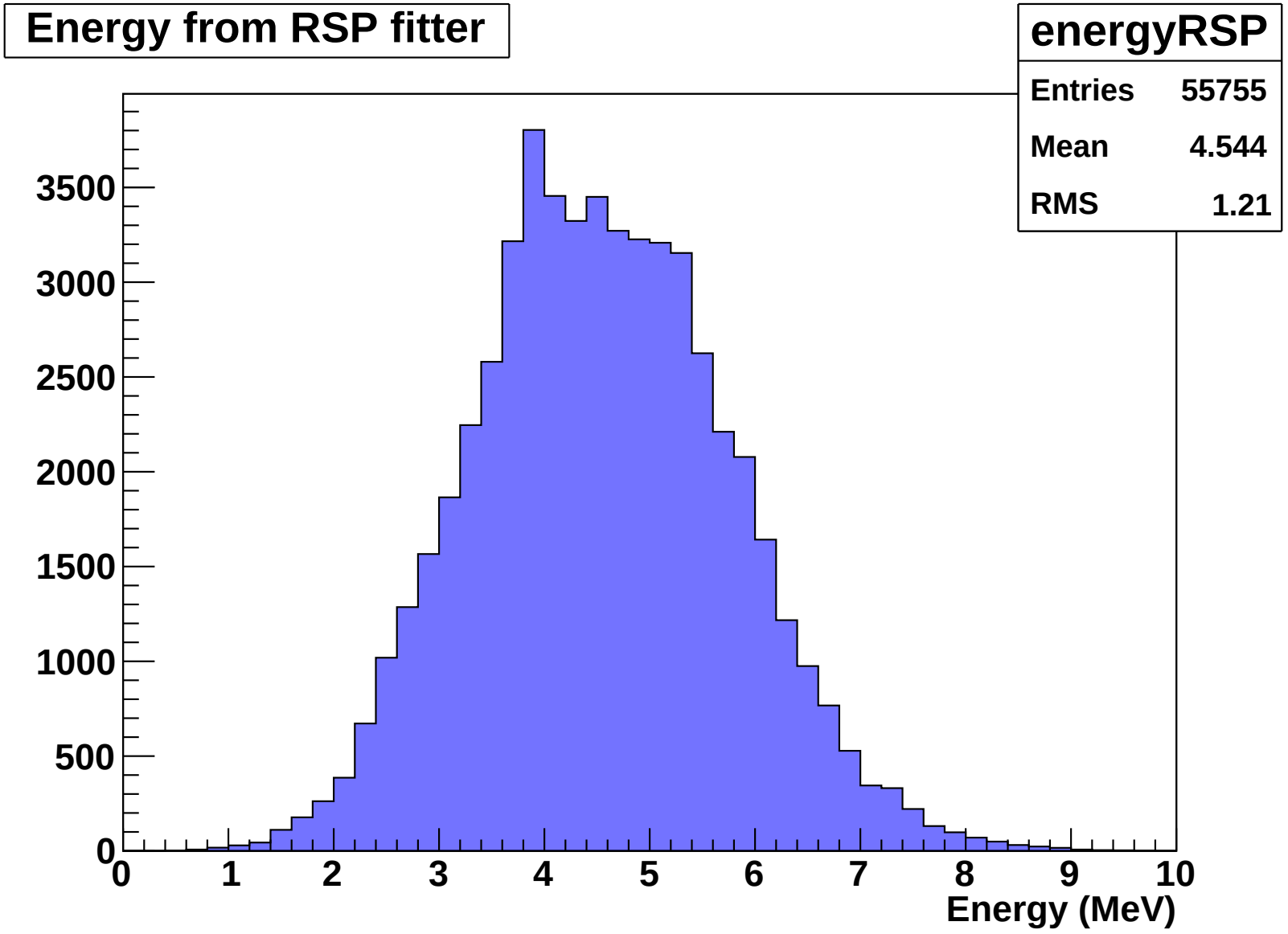


First Look at ^{16}N Data



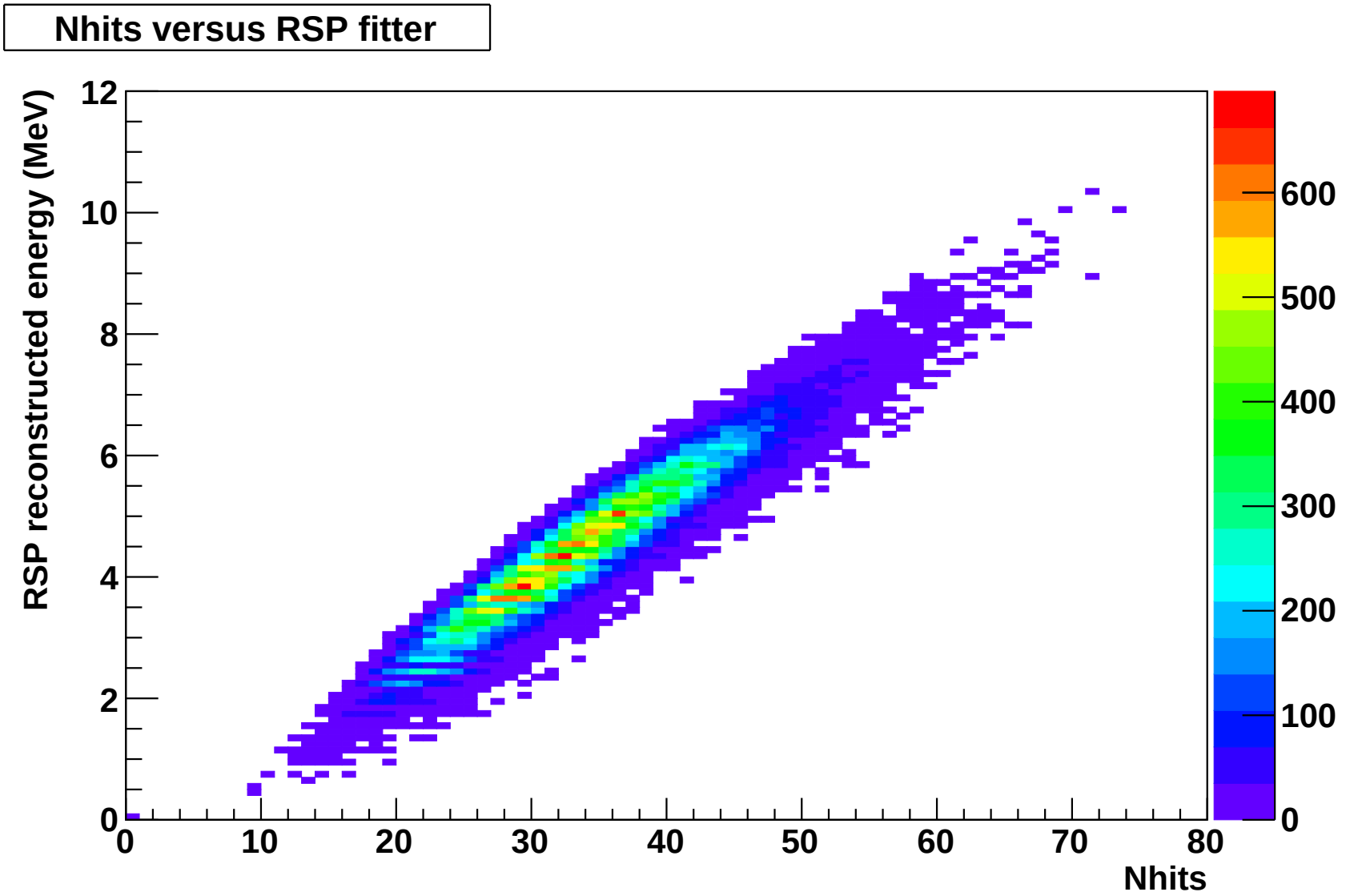
Single Event from a Central Run from ^{16}N Source

Central ^{16}N Monte Carlo



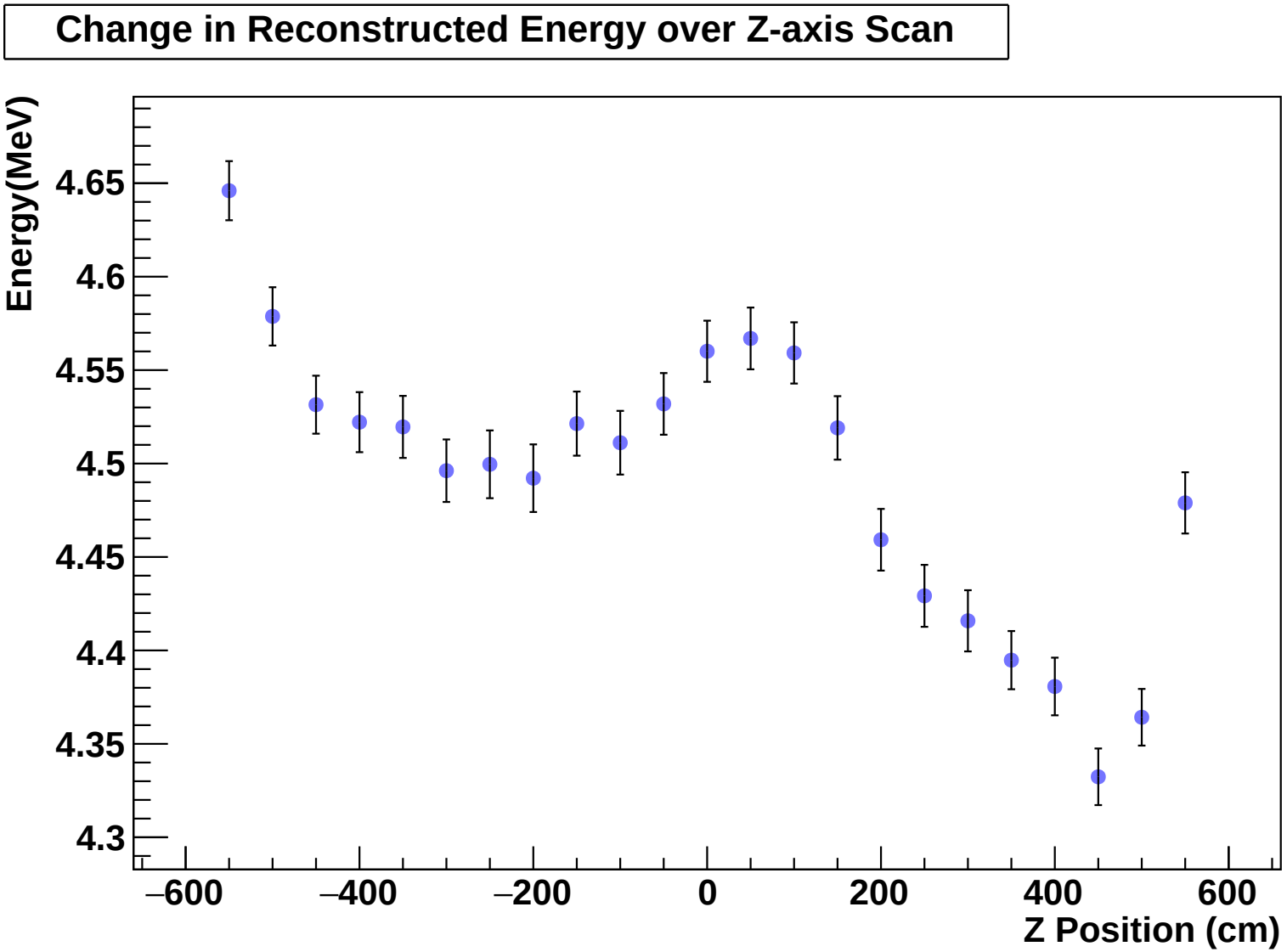
Measured Cerenkov photons from Gamma produced electrons

Central ^{16}N Monte Carlo



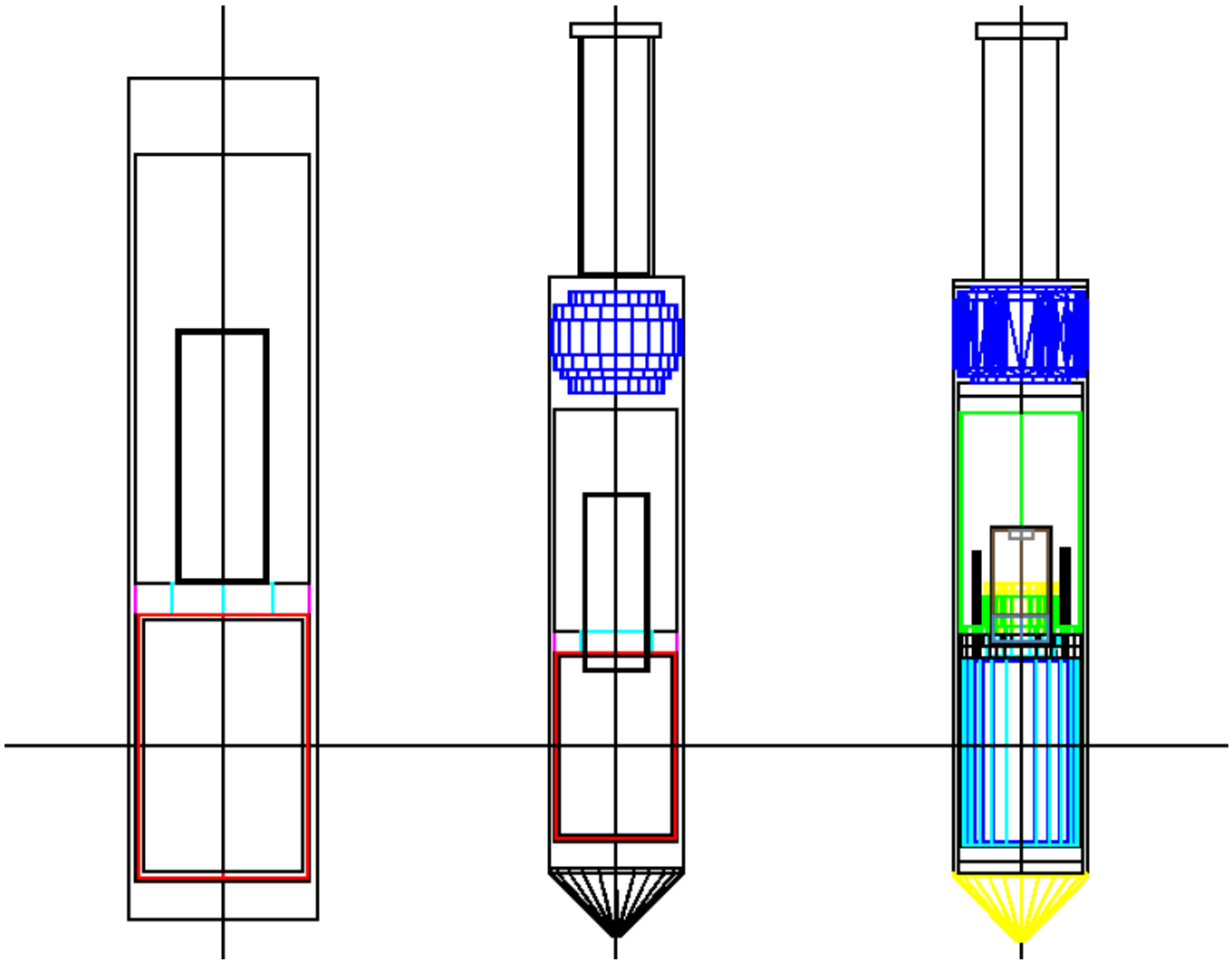
Correlation between number of PMTs hit versus Energy

Monte Carlo - Full Z Scan

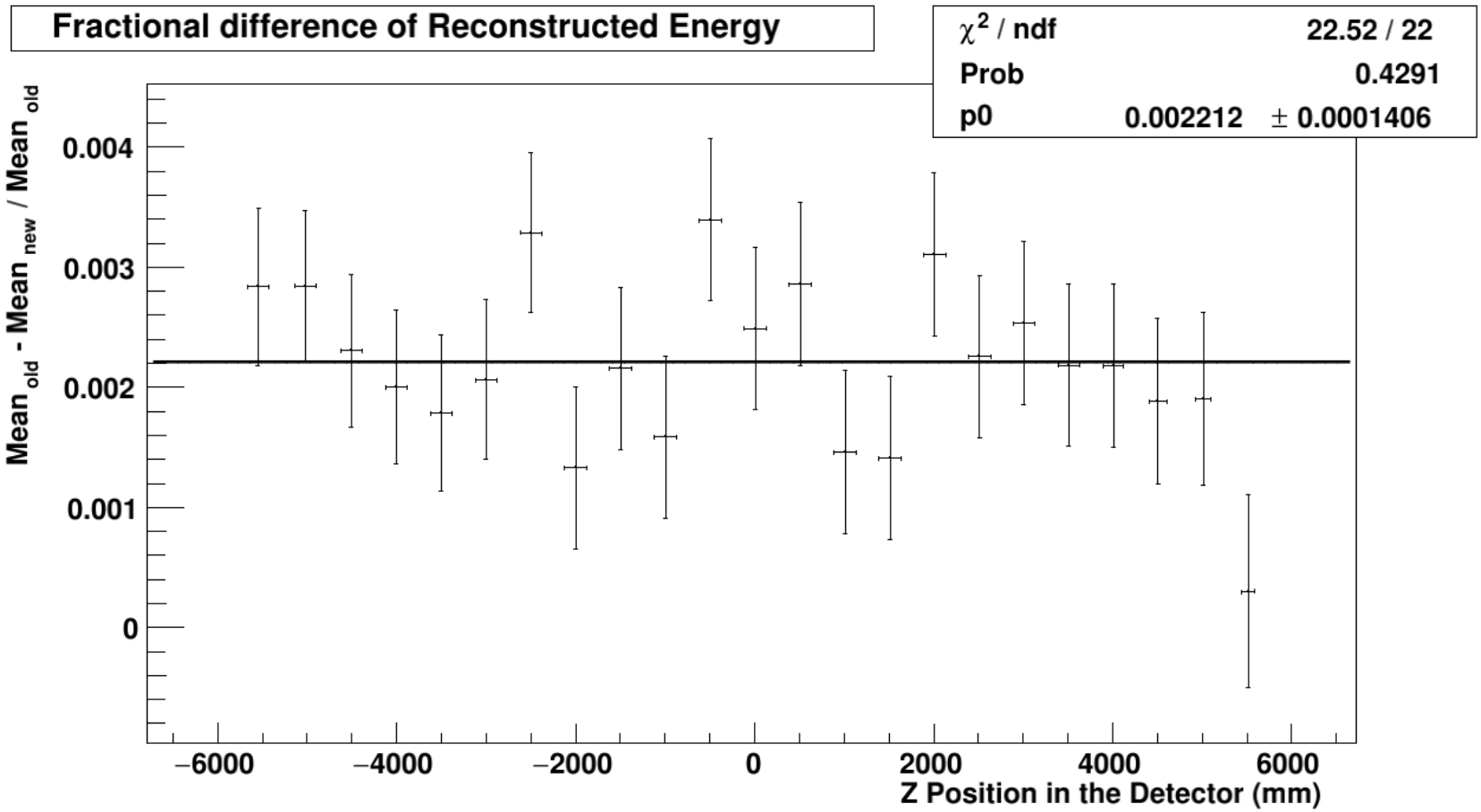


Need input from Calibration constants to improve fit

Updating the Source Geometry



Updating Source Geometry - Continued



Not a significant change and makes code run ≈1.8% quicker

Conclusion

^{16}N calibrations runs started 25 May 2017!!!

Energy Fitter needs ^{16}N for efficiency model

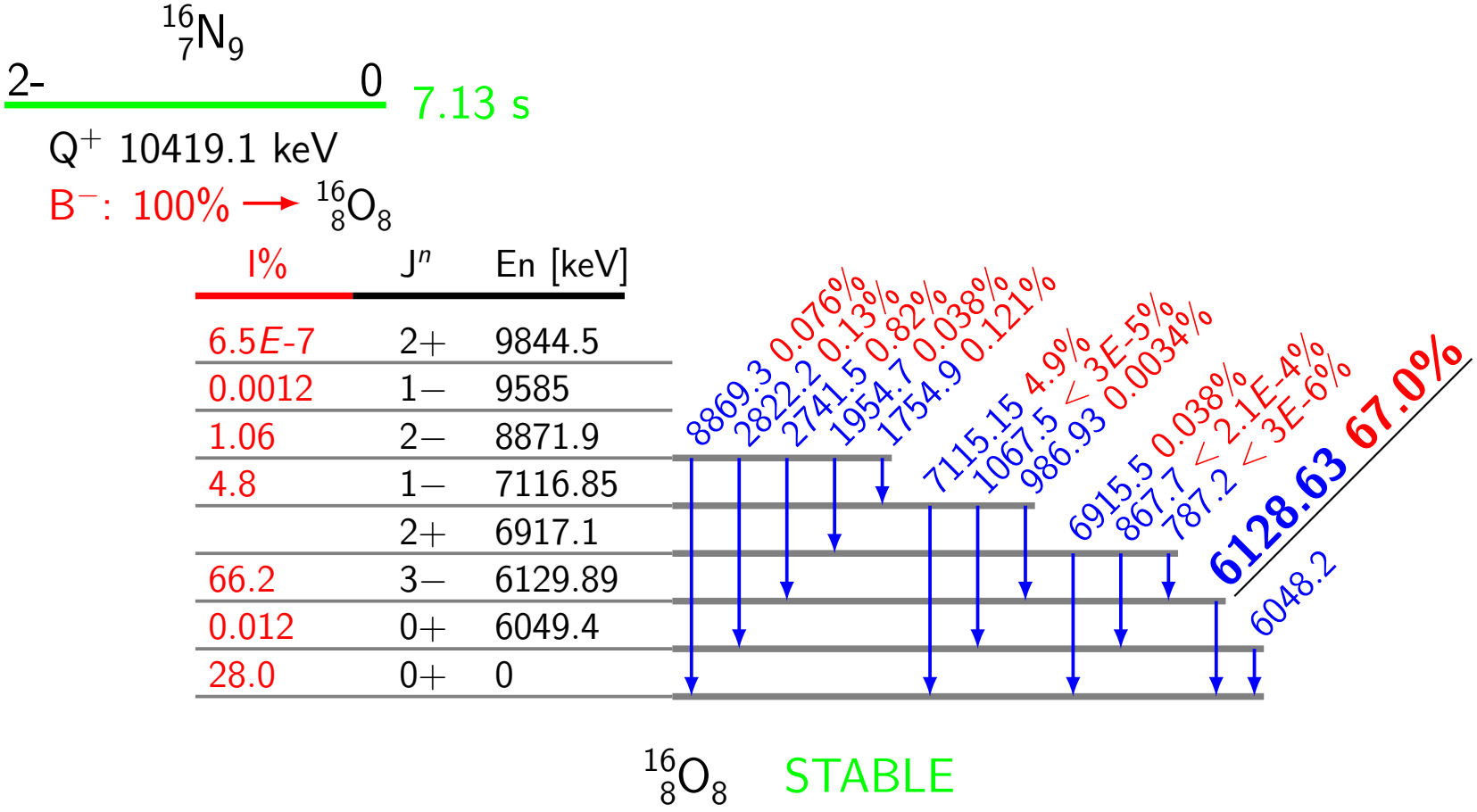
Energy bias will improve with new timing calibrating runs

Correct geometry updated for Monte Carlo

Questions?

Backup Slides

^{16}N Decay Scheme



[2] J.H. Kelley, *et. al.*, Nuclear PhysicsA A564, 1 (1993)