Preliminary results of:

Comparative study of S1000 and S1500

to determine the energy of extensive air showers measured by the Surface Detector at the Pierre Auger Observatory

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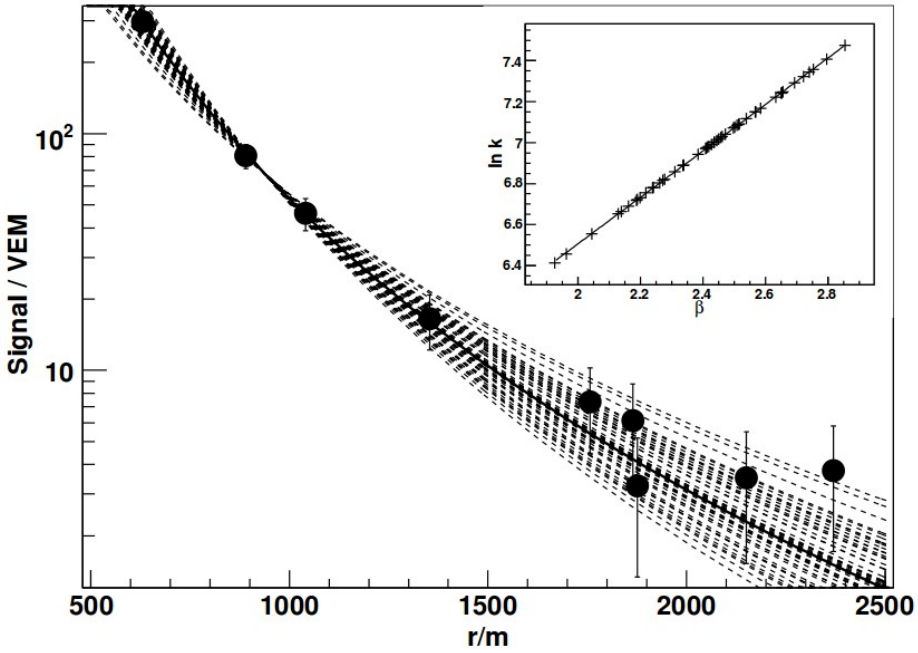
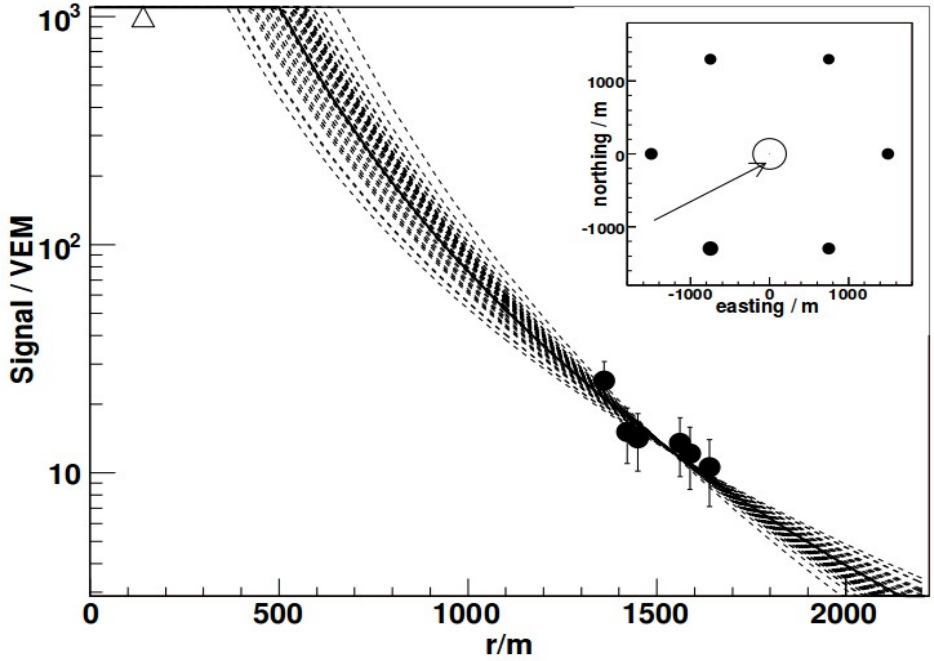
Background

NEWTON, KNAPP, WATSON 2006





Events with no saturated tanks are best constrained at 1000 m from the core. By design, S1000 is least sensitive to different parameterizations of the LDF.

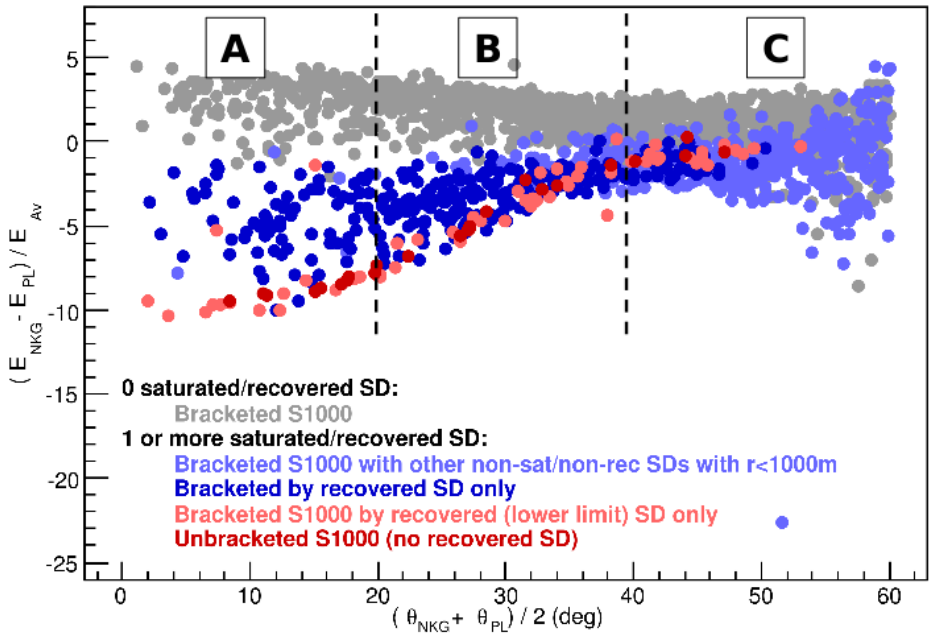
Events with one or more saturated tanks are not necessarily best constrained at 1000 m from the core when considering different LDF parameterizations (ropt increases to ~1500 m).

Background

MALDERA & NAVARRA 2008

Analyzed S1600 as an energy estimator in the context of:
(a) Avoided constant intensity cut method
(b) Reduced uncertainty in energy reconstructions for events with one or more saturated tanks.

$E_{Av} \geq 20$ EeV



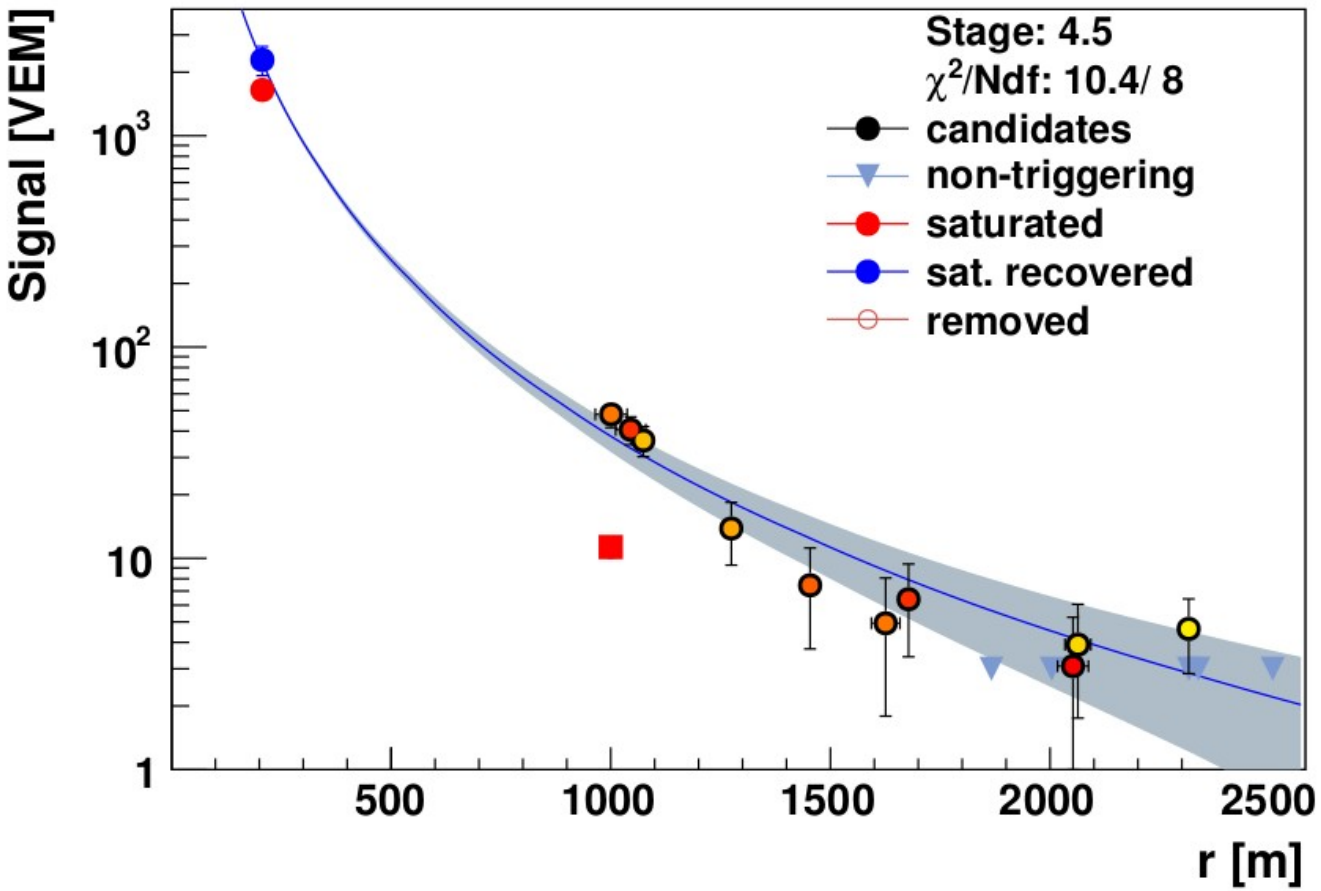
SCHMIDT, MAYOTTE, & SARAZIN

- E_{SD} deviates significantly using NKG and Power Law reconstructions LDFs.
- Poor bracketing of the LDF at 1000 m from the core results in most significant deviations. This occurs more frequently at lower zenith angles.

Implications

- Larger uncertainty in energy.
- Biasing of energy calibration by saturated events.
- Possible bias in energy spectrum, etc.

Study Parameters

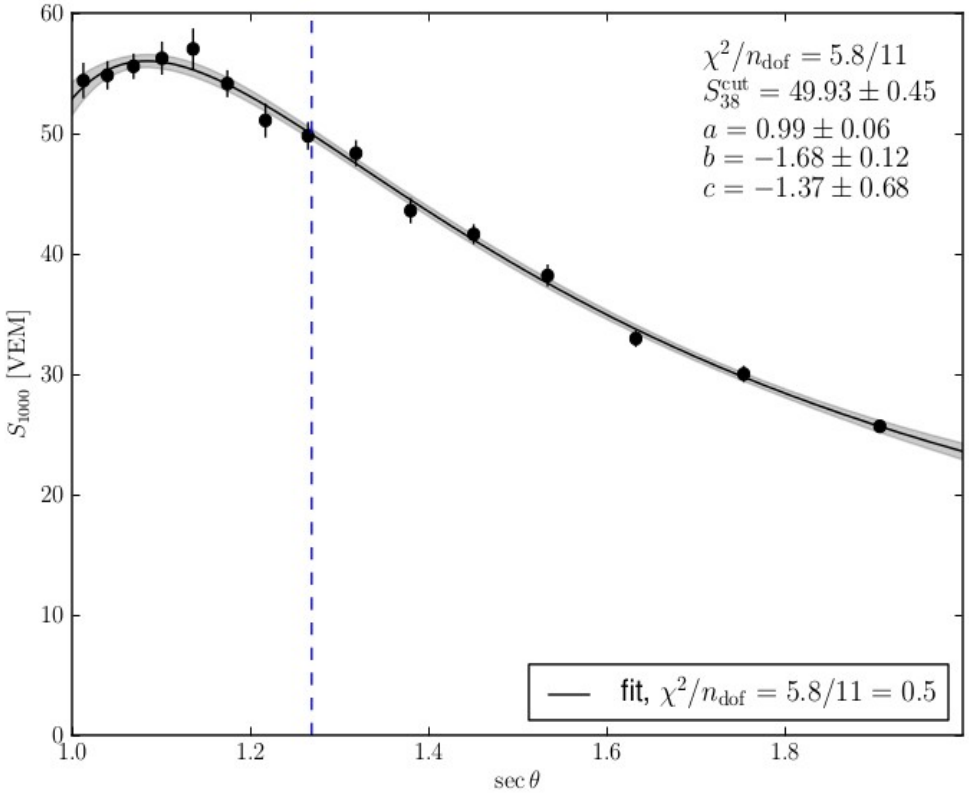


LDFs: NKG
DATA SET: 2004 – 2012
OFFLINE VERSION: 2.9.1
PHYSICAL TRIGGER: 6T5

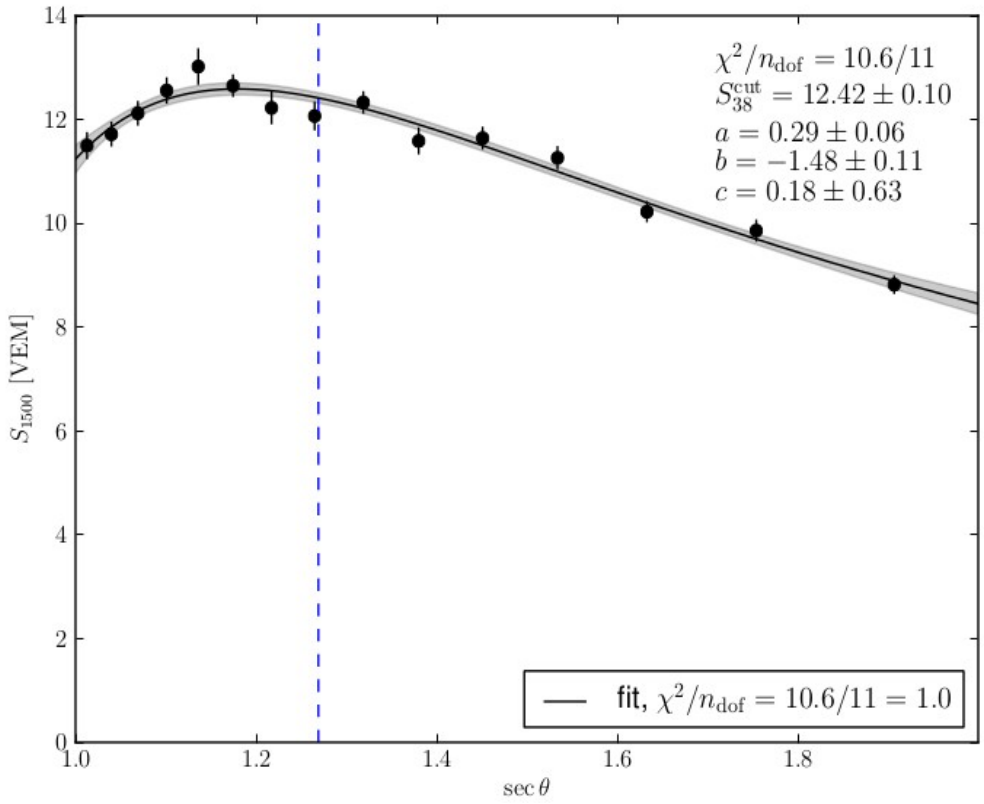
- Separate CIC(θ) derived for NKG S1000 and S1500
- Separate Energy Calibrations performed for NKG S1000 and S1500

CIC Derivation

S_{1000}

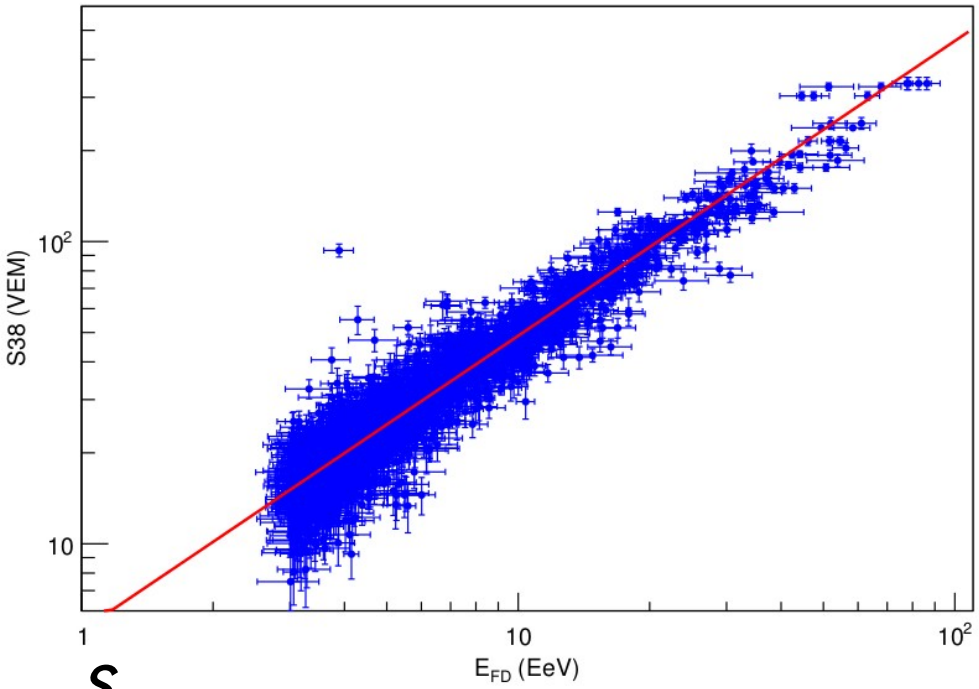


S_{1500}



Obtained CIC derivation program from Alexander Schulz at KIT.

Energy Calibration

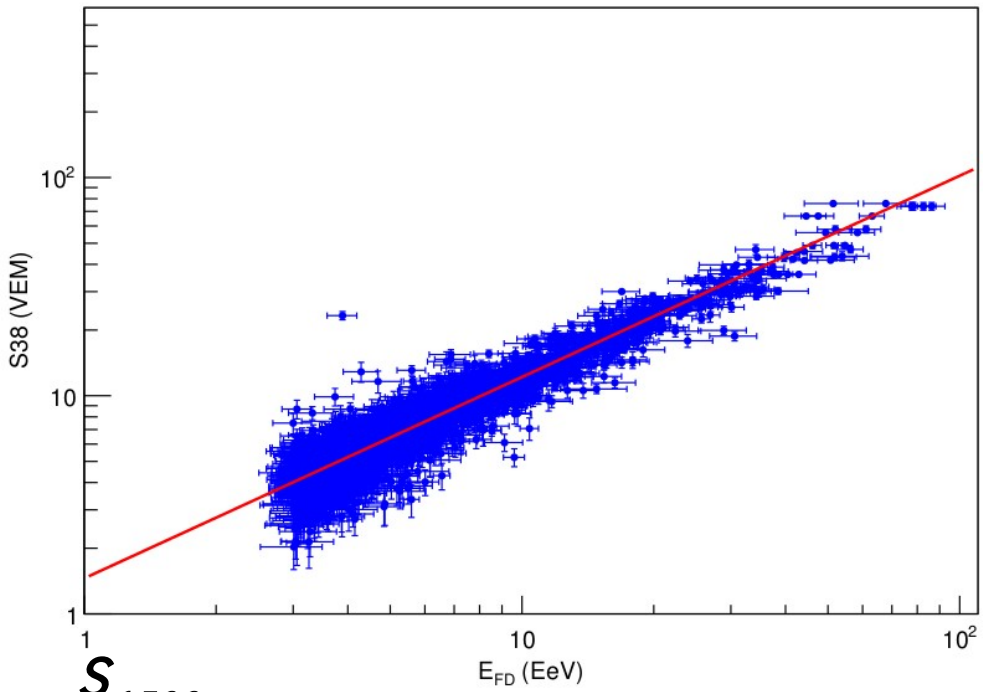


S_{1000}

Events (after cuts): 2164

A = 0.185 +/- 0.003

B = 1.025 +/- 0.004



S_{1500}

Events (after cuts): 2337

A = 0.187 +/- 0.002

B = 1.014 +/- 0.004

ICRC 2013

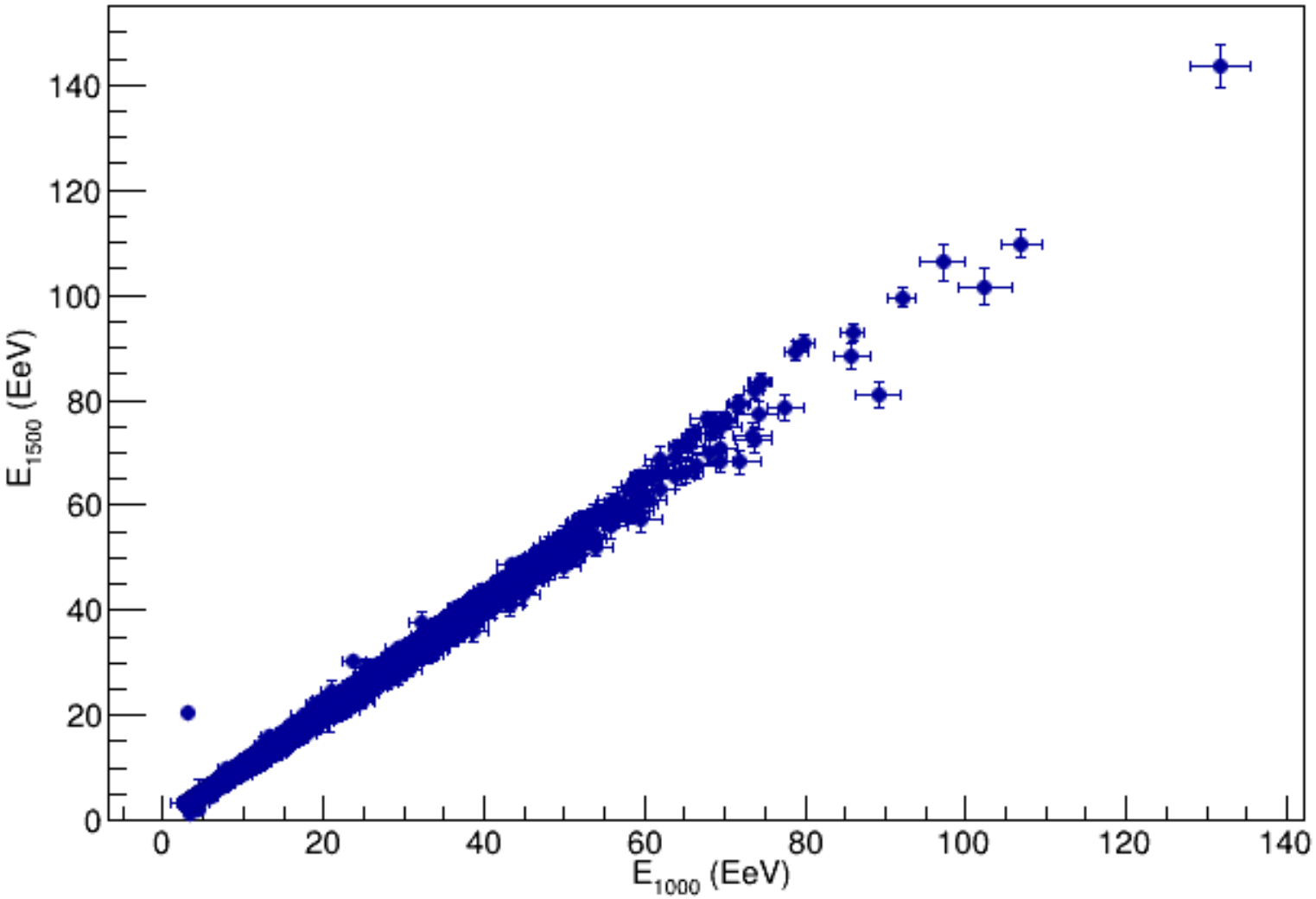
Events (after cuts): 1475

A = 0.190 +/- 0.005

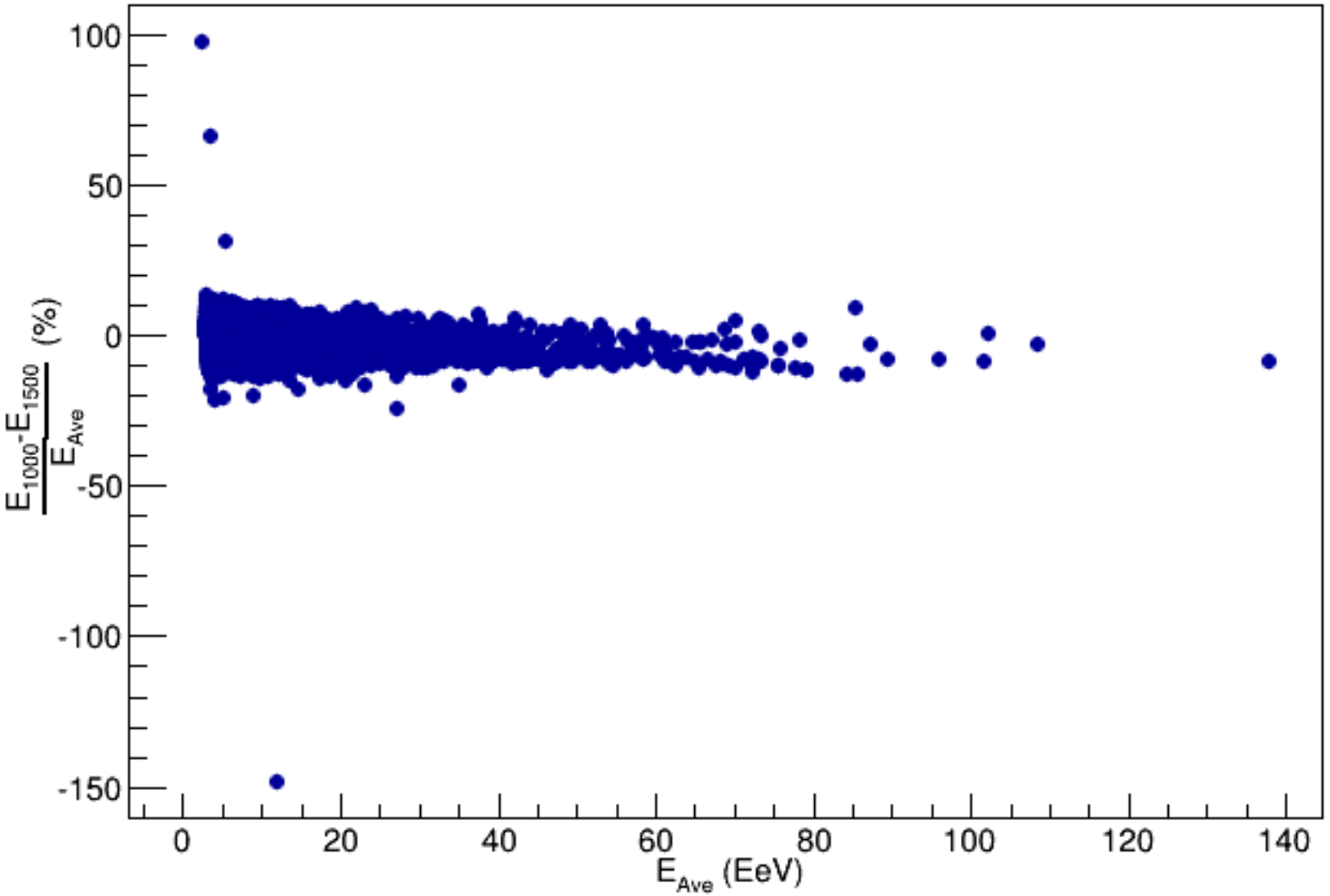
B = 1.025 +/- 0.007

Obtained energy calibration derivation program from Alexander Schulz at KIT.

Energy Comparison



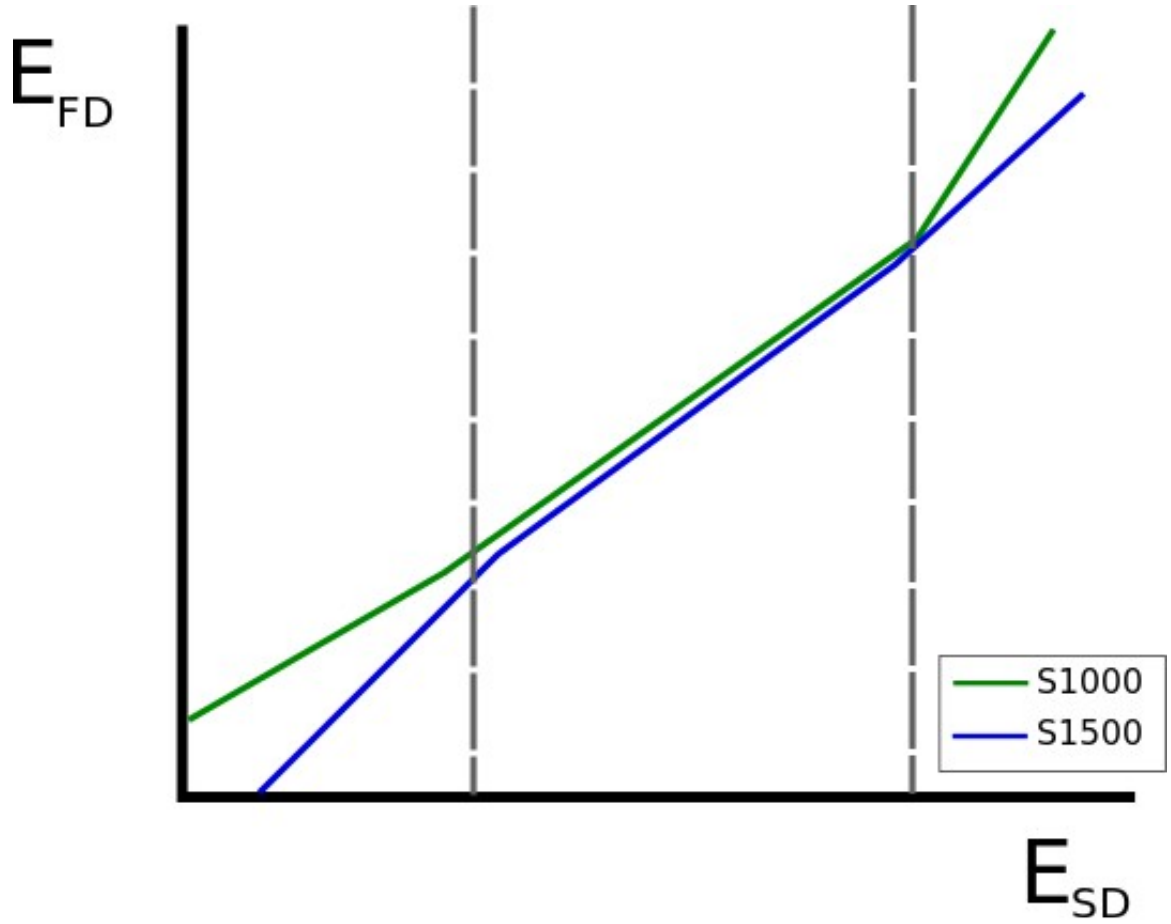
Percent Difference in Energy



Summary

■ If an event has one or more saturated tanks, S1000 may not be properly bracketed.
■ S1500 may be more stable than S1000 for high energy reconstructions due to bracketing of LDF.
■However, S1500 has a higher uncertainty in signal and associated reconstructed energy than S1000.

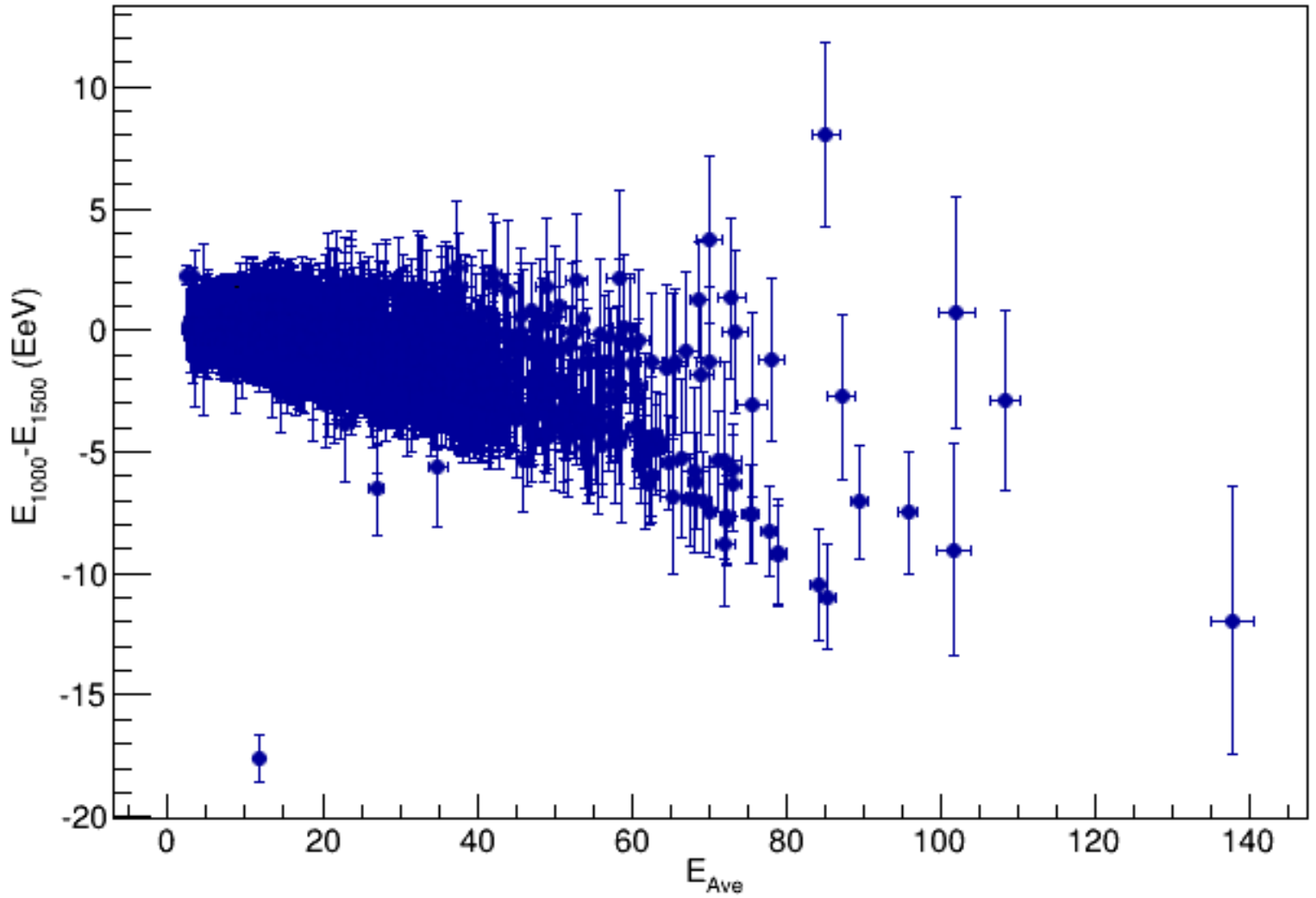
Trade-off between stability and uncertainty



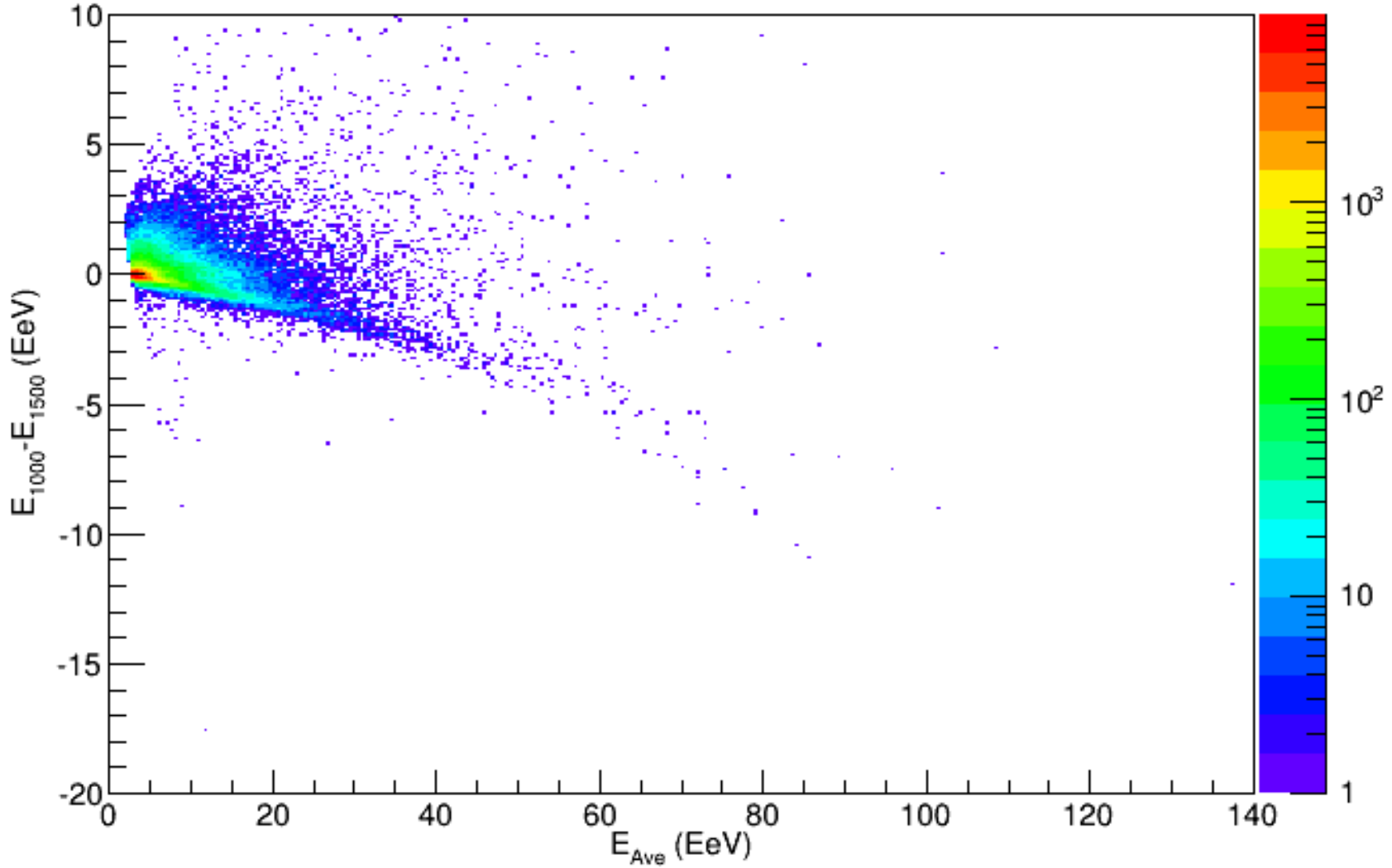
REFINEMENT OF STUDY
- Investigate bracketing cases
-Develop:
1. Region where S1000 and S1500 perform well
2. Region where S1000 performs best
3. Region where S1500 performs best

Backup Slides

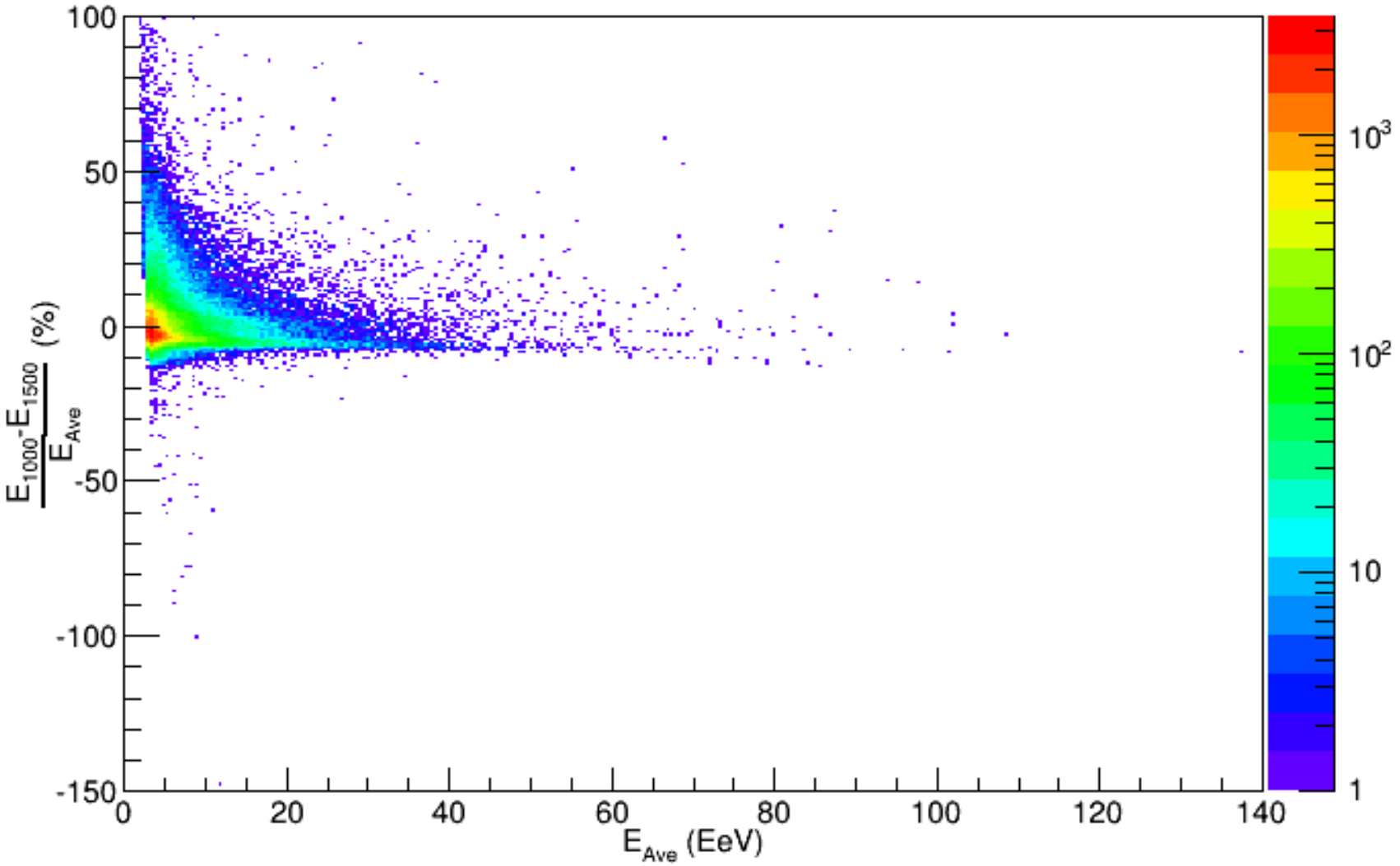
Energy Difference



2D Energy Difference Histogram



2D Percent Energy Difference Histogram



2D Percent Energy Difference Histogram