Snake Array

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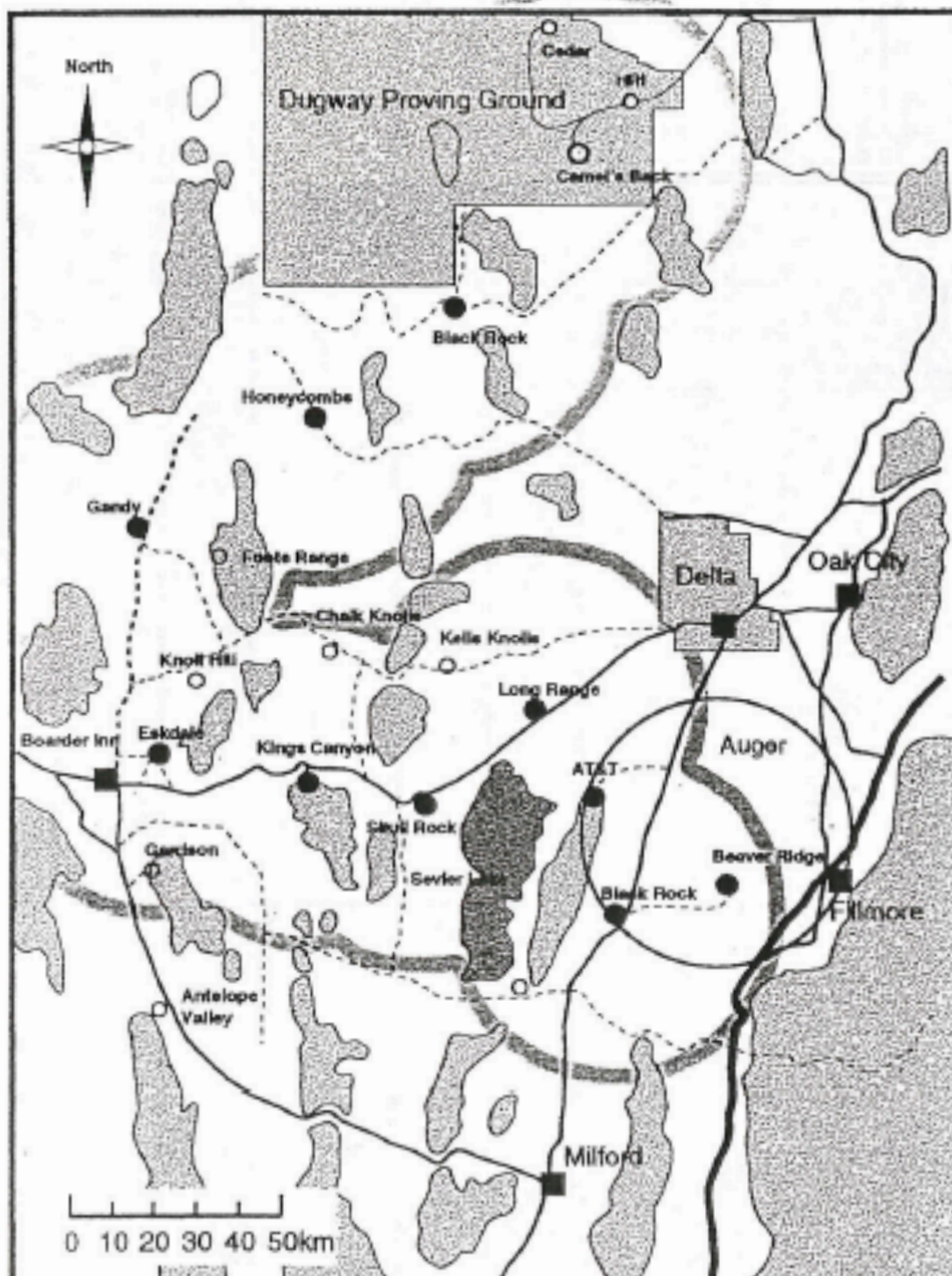
Stereo Xmax resolution

X_{max} resolution vs. thrown energy

hxbias	
Entries	2061
Mean	19.08
Mean y	-0.629
RMS	0.23
RMS y	21.62

Y-axis: $X_{max} - X_{max,MC}$ (g cm^{-2}), error bar = RMS

X-axis: $\log_{10}(E_{MC}/\text{eV})$
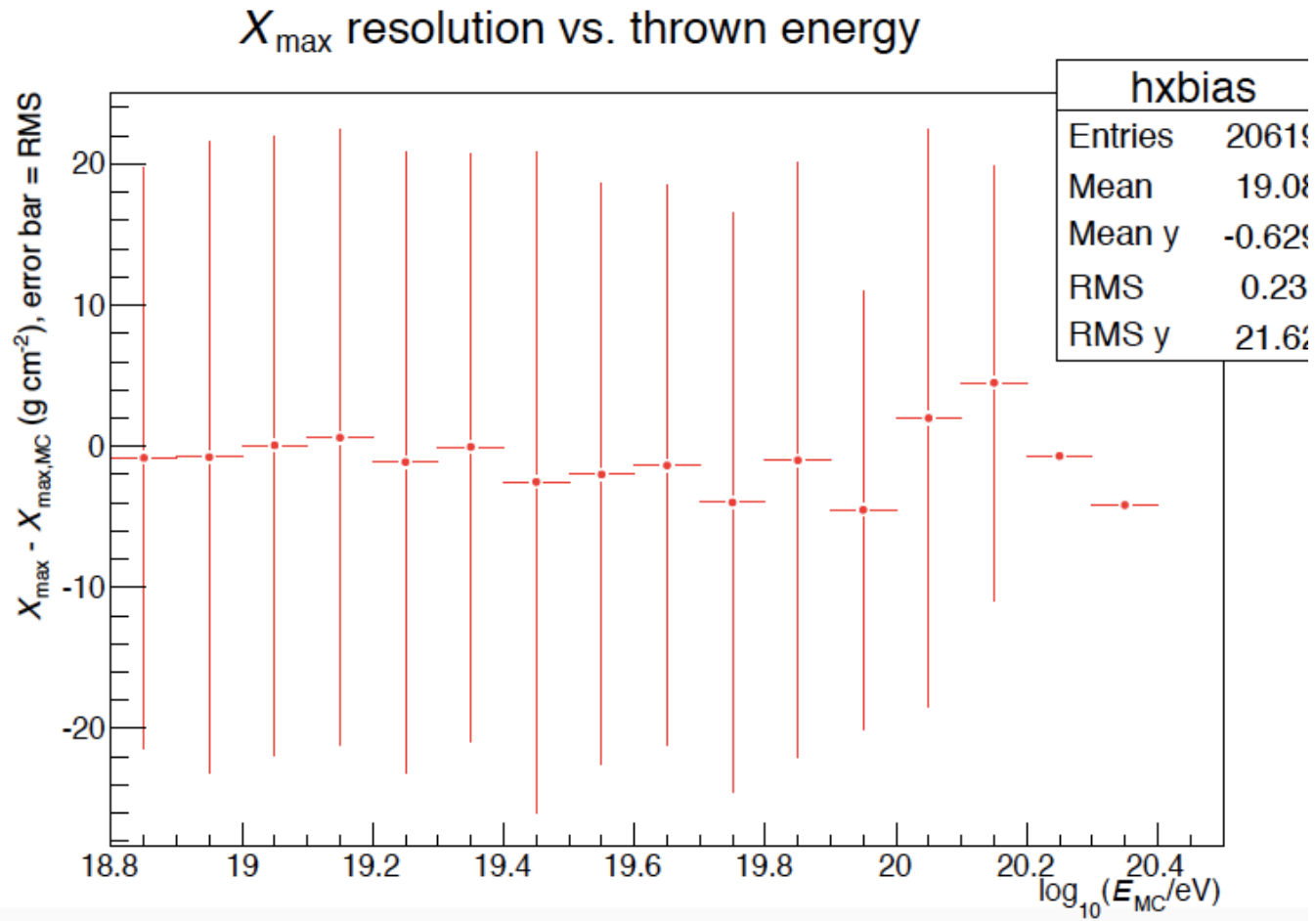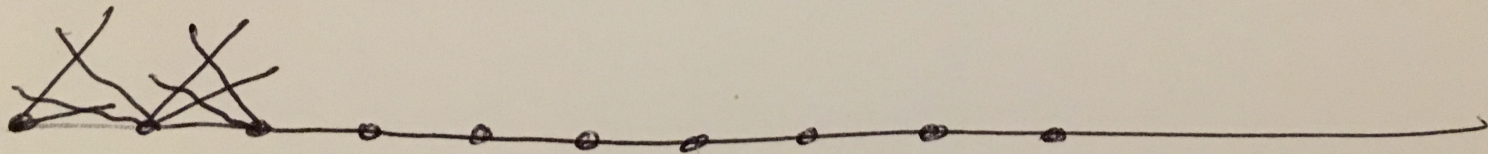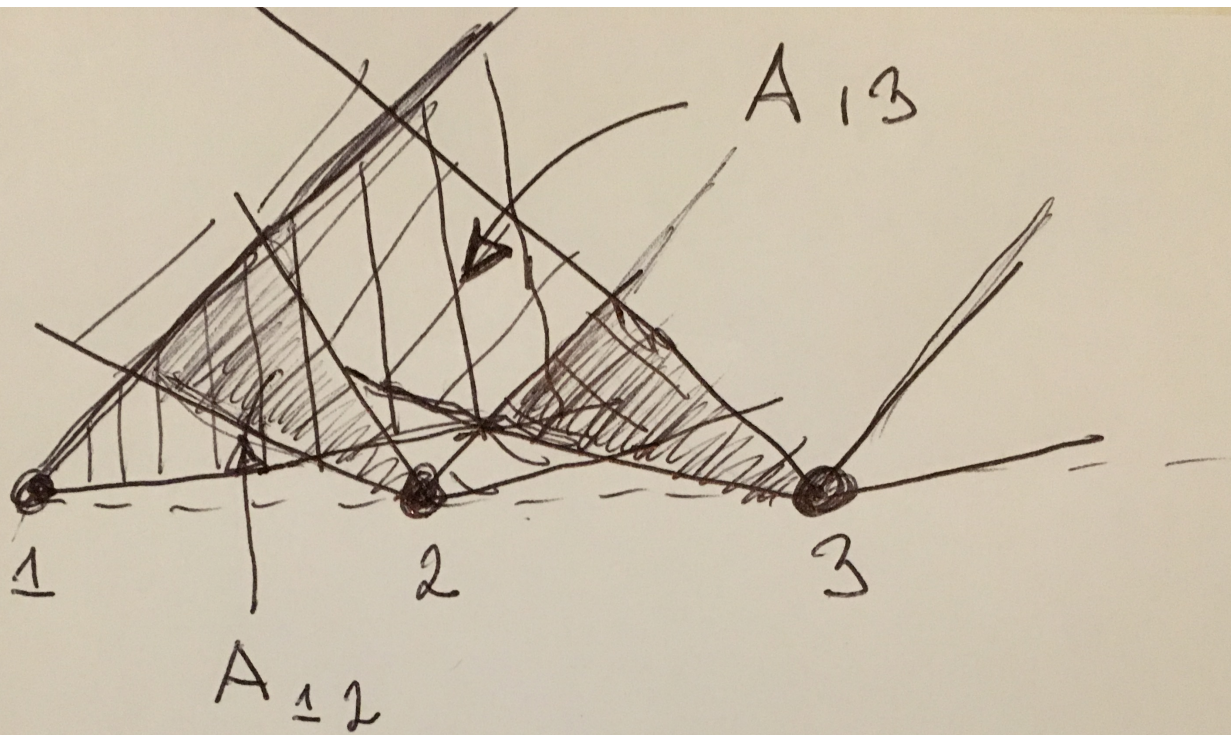
Before TA there was the Snake Array

- Discussions between Gene Loh, M. Teshima and myself (help from L. Wiencke,S. Yoshida)

- Maximize FD Stereo, no SD.

- Optimization -> minimize redundacy – only 2 detector stereo -> linear array of detectors.

- Site survey was done and > 10 sites found

- ~ 30-40 km apart.

Telescope Array Station arrangement, Utah USA

North

Dugway Proving Ground

Cedar

Hill

Camel's Back

Black Rock

Honeycombs

Gandy

Foote Range

Delta

Oak City

Chalk Knolls

Kells Knolls

Knoll Hill

Long Range

Boarder Inn

Eskdale

Kings Canyon

AT&T

Auger

Garrison

Skull Rock

Sevier Lake

Beaver Ridge

Black Rock

Fillmore

Antelope Valley

Milford

0 10 20 30 40 50km

Refine "Snake" based on TA stereo

- Use current stereo reconstruction and data cuts. Use TA mirror/pmt layout

- Guaranteed Xmax and Energy resolution.

- Aperture verified – cross calibrated with hybrid results.
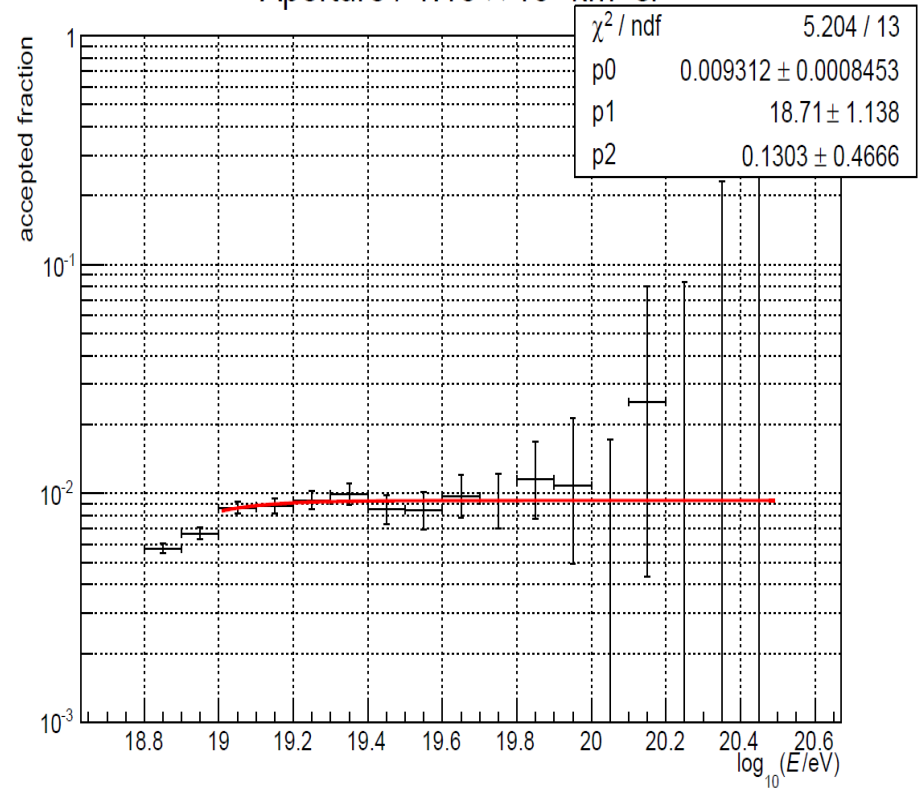
- Linear array minimizes "non-productive" aperture.

A_{13}

A_{12}

1 2 3

35km spacing, head-on
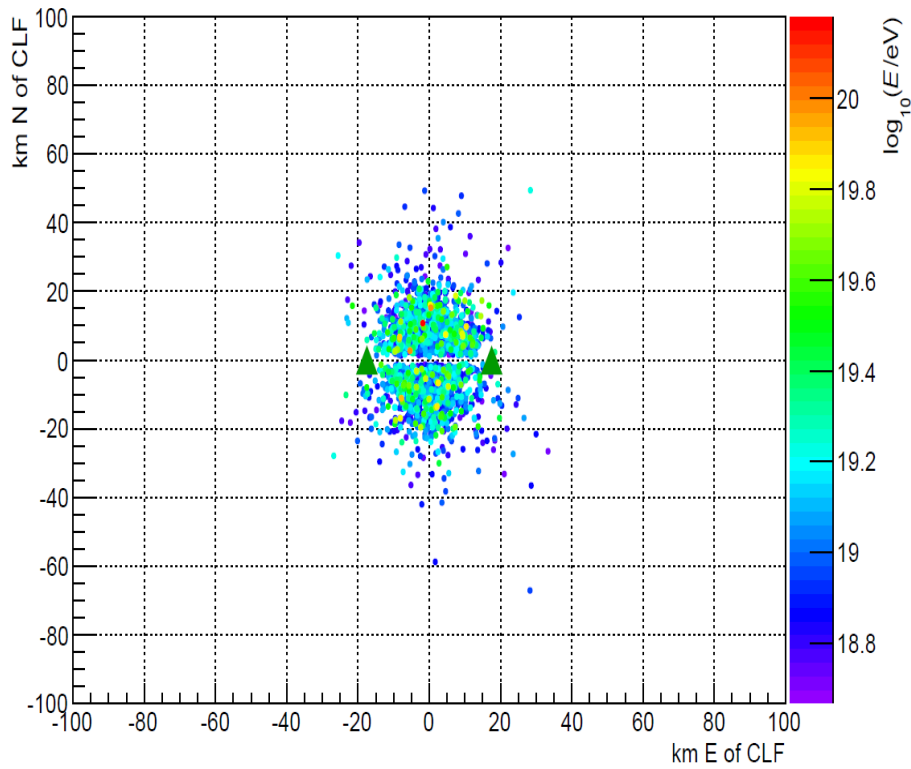
Core positions of accepted events

Aperture / 1.18×10^5 km^2 sr

χ^2 / ndf	5.204 / 13
p0	0.009312 ± 0.0008453
p1	18.71 ± 1.138
p2	0.1303 ± 0.4666

10

70km spacing, head-on

Core positions of accepted events

Aperture / 1.18×10^5 km^2 sr

χ^2 / ndf	78.45 / 13
p0	5466 ± 518.3
p1	19.01 ± 0.004194
p2	$7.835\text{e}+05 \pm 6.534\text{e}+04$

35km, 20° combined rotation

Core positions of accepted events

Aperture / 1.18×10^5 km^2 sr

χ^2 / ndf	5.871 / 13
p0	0.009038 ± 0.0005166
p1	18.97 ± 0.652
p2	0.03306 ± 0.2724

35km, 40° combined rotation

Core positions of accepted events

Aperture / 1.18×10^5 km^2 sr

χ^2 / ndf	7.916 / 13
p0	0.02604 ± 0.06345
p1	17.97 ± 1.045
p2	2.962 ± 11.37
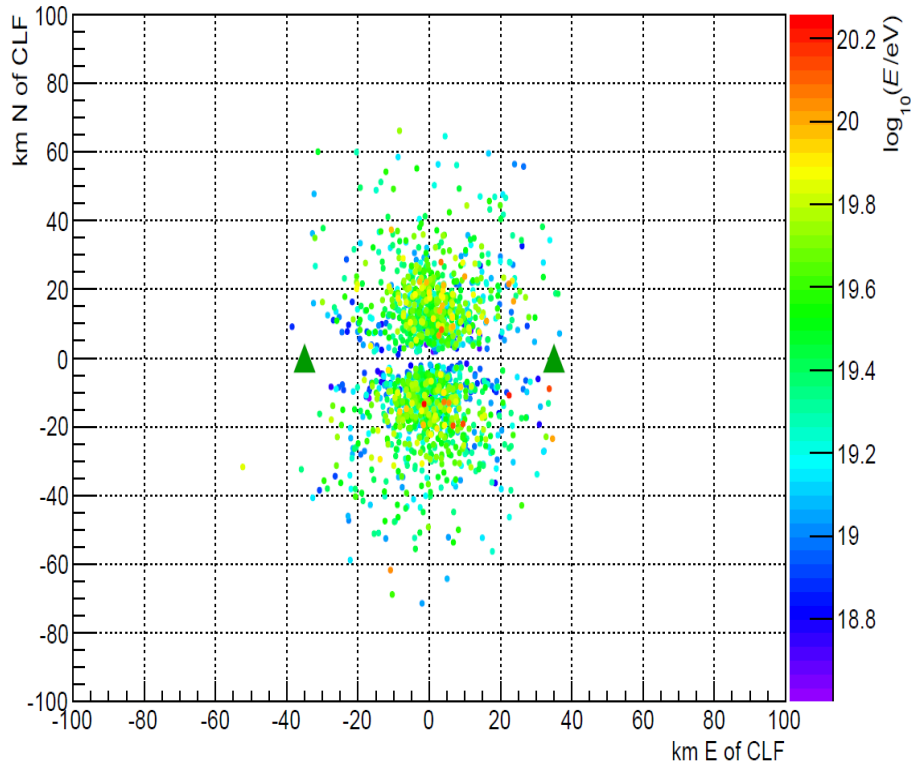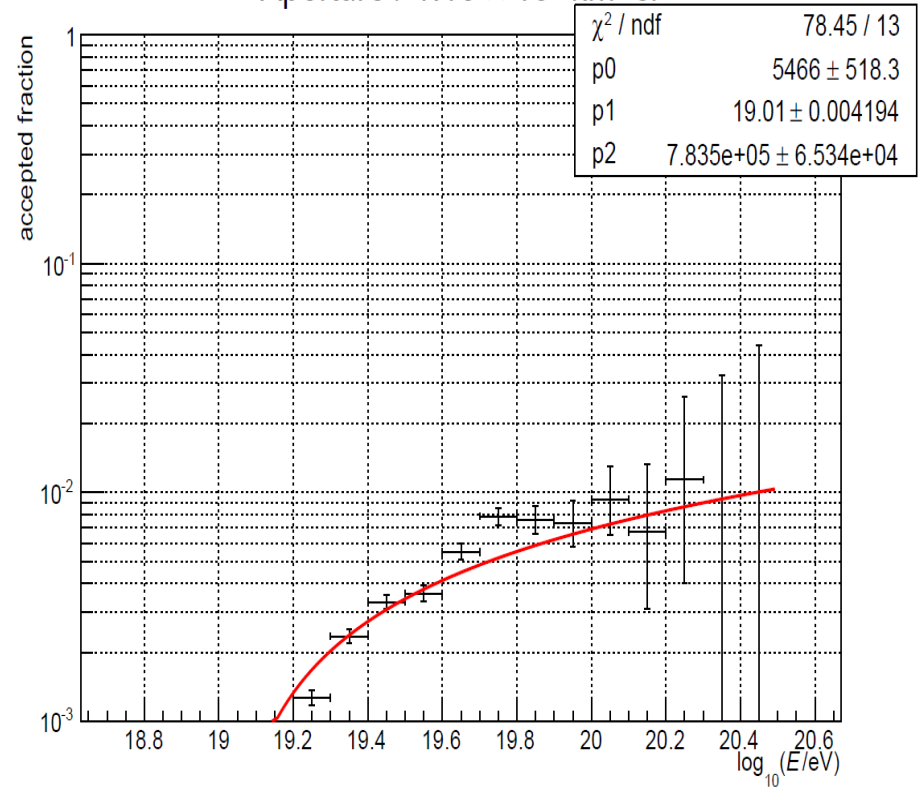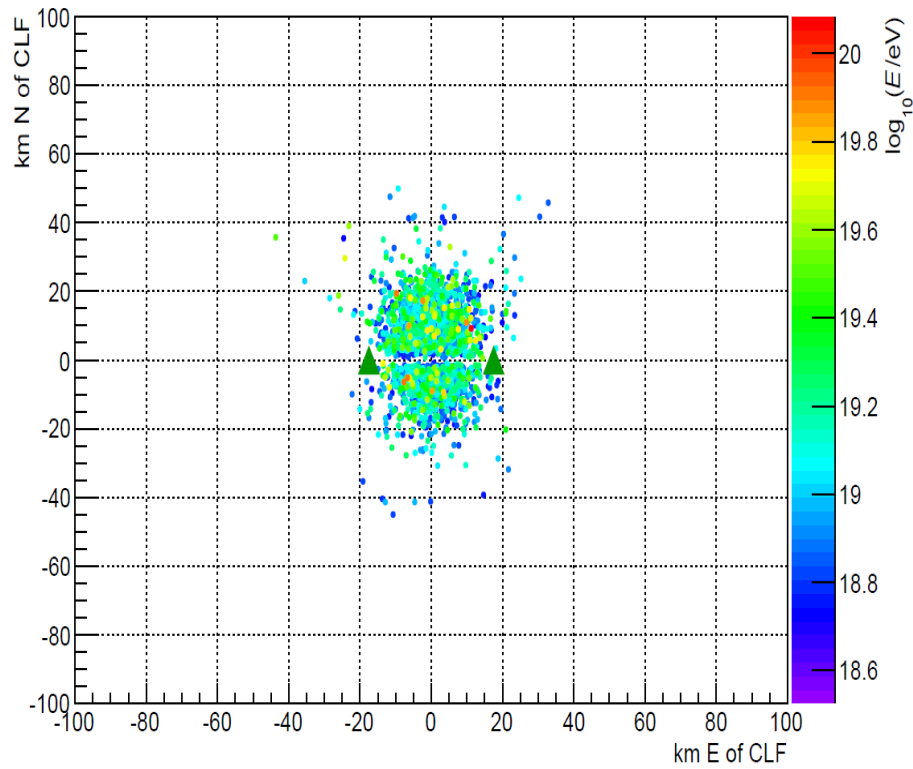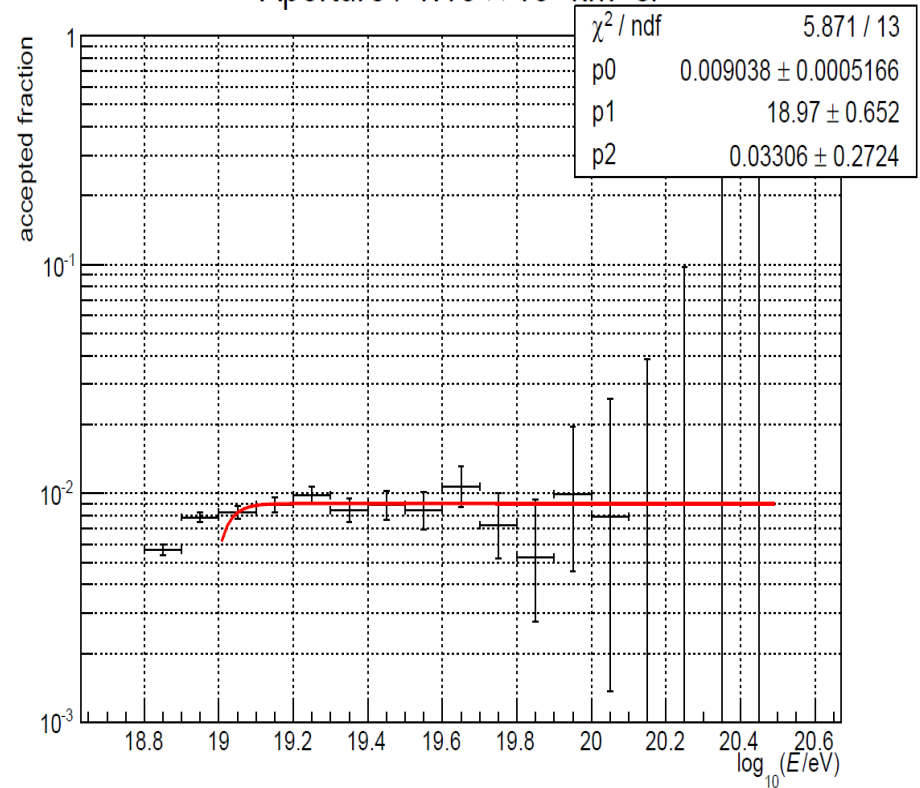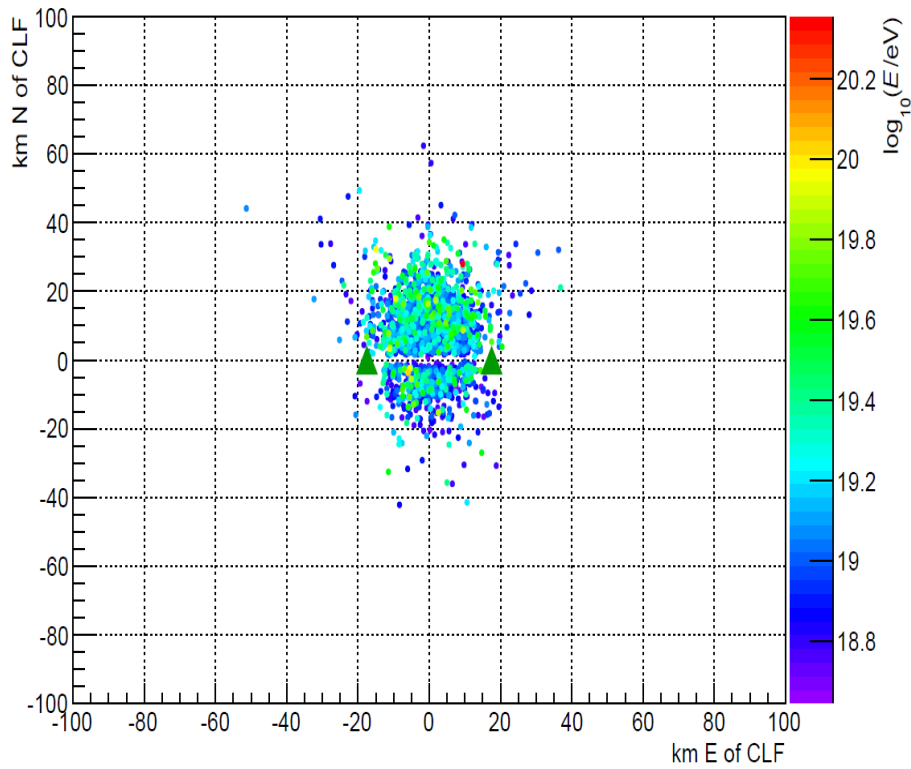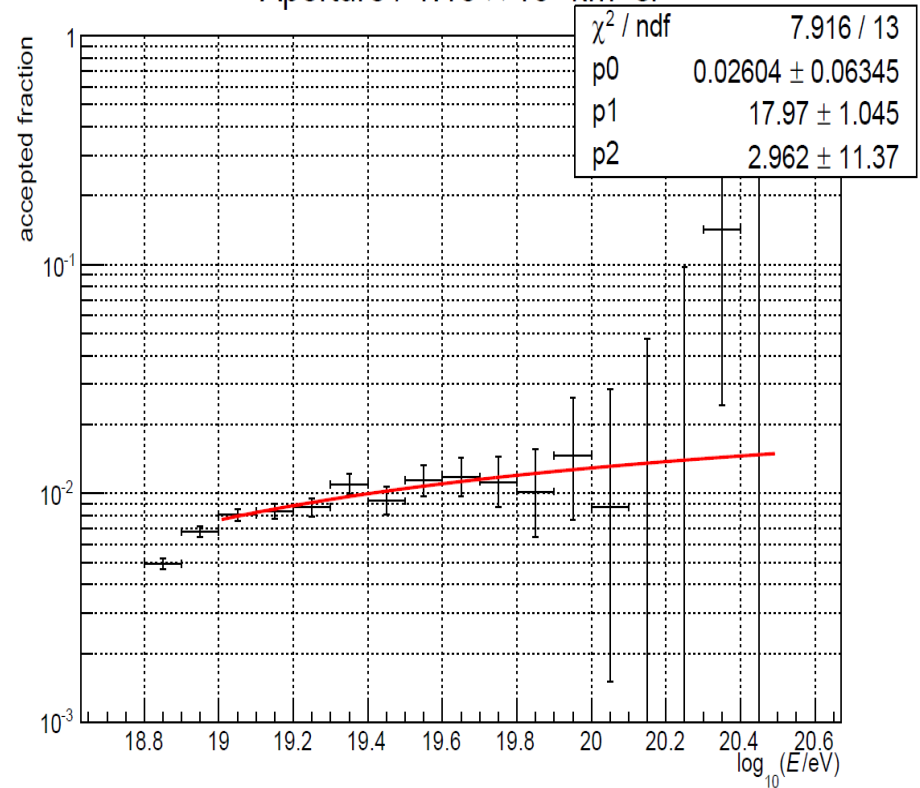
Estimated reconstructed and quality cut aperture

- Pair of stations 35 km spacing, 40 degree angle -1.5x10^3 km2str @ 5x10^{19} eV

- Additional aperture for 70 km, 40 degree angle pair ~ 0.7x10^3 km2str

- Total A12 + (A13) aperture 2.2x10^3 km2str

- Total for 10 sites ~ 2.2x10^4 km2str

- Assuming 15% on time – effective aperture is 3.3x10^3 km2str.

- Extrapolating from TA stereo data, expect ~1000 well-reconstructed events > 3x10^{19} eV in 10 yr run

Total Snake Cost

- Could build Snake for ~ 45-50M$

- Would provide "well-reconstructed, good resolution Xmax data" = Auger SD aperture.

- Based on TA stereo data, expect ~ 1000 well reconstructed events above 3 x 10^19 eV in ~ 10 years.