

CRTNT Experiment Status



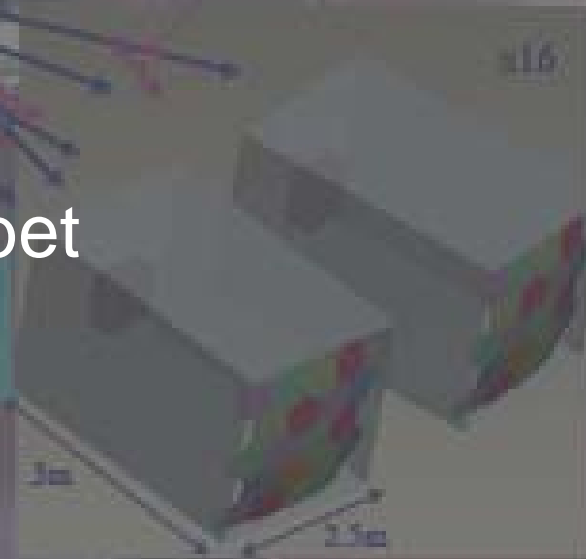
超高能
电子中微子

Zhen Cao

Institute of High Energy Physics, China

RICAP07, Roma, Italy, July, 2007

- ❖ Introduction
- ❖ Two prototype telescopes
- ❖ Test run on ARGO-YBJ site, Tibet
- ❖ Full scale experiment: 2008
- ❖ Updates in Physics
- ❖ Summary



Introduction

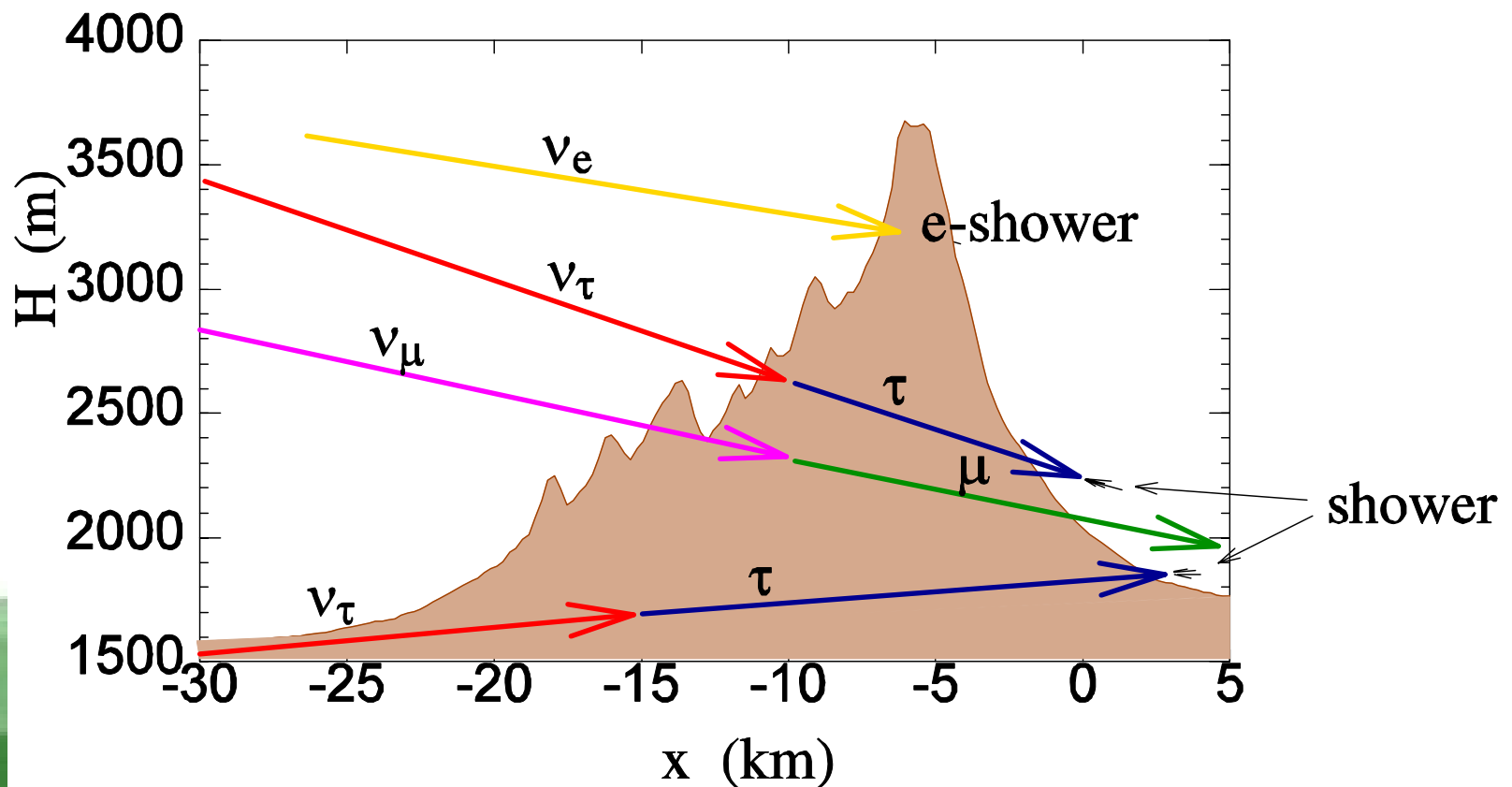


CRTNT

❖ CRTNT : Cosmic Ray Tau Neutrino Telescope

- Detect shower from τ , which comes from Earth-skimming ν_τ

$$10\text{km} = 2.6 \times 10^6 \text{ g/cm}^2$$



CRTNT feasibility study

Z. Cao, M.A. Huang, P. Sokolsky, Y. Hu,
J. Phys. G, **31**, 571-582, (2005)

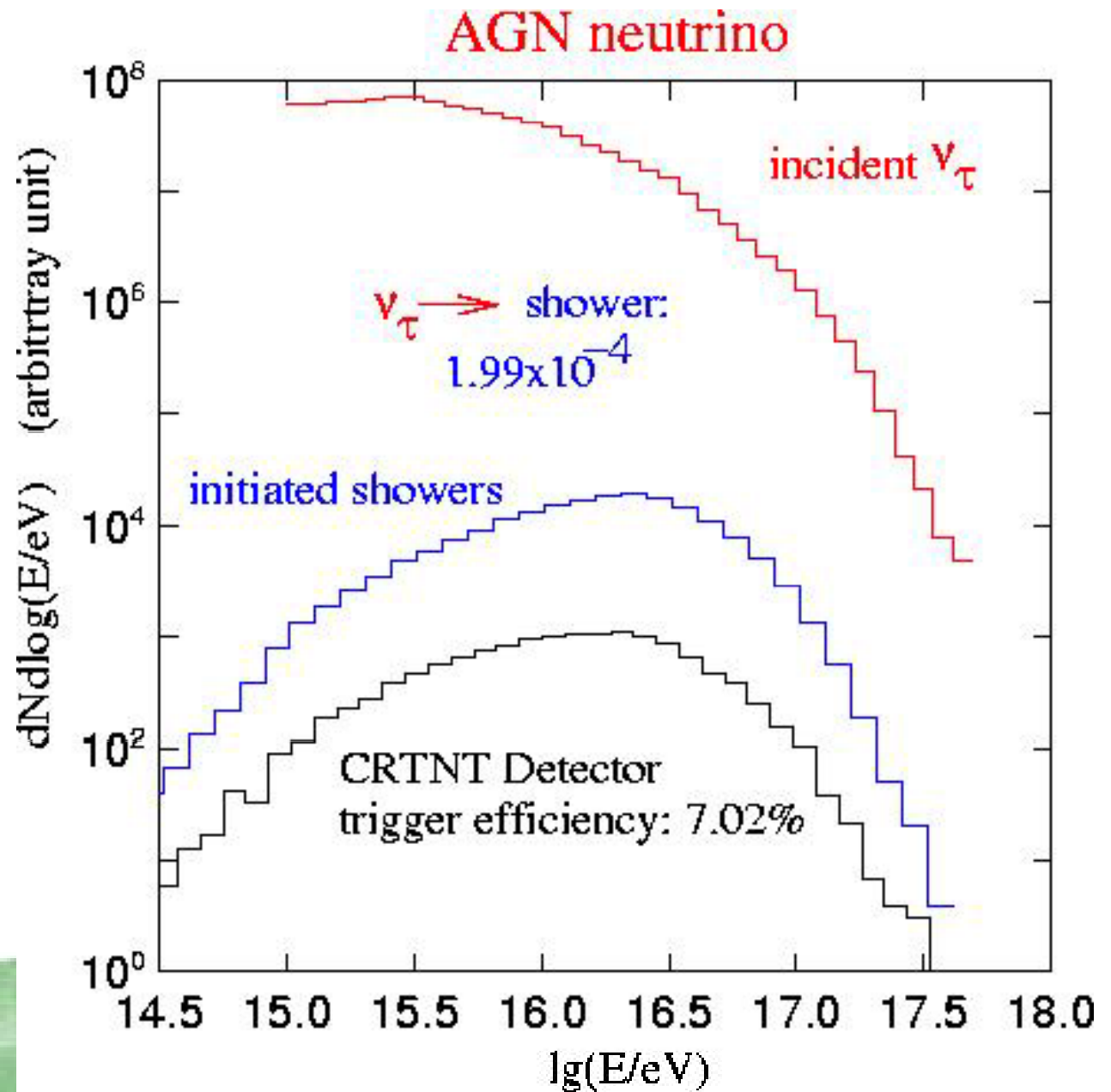
Highlight of the year 2005 of JPG

The total detection efficiency of tau neutrinos from AGN is 1.4×10^{-5}

The expected event number per year is

8~10 events

A duty cycle of 15% & 4 sites are assumed considering a possibility of running with moon partially



Prototype





**5.0m²
Spherical
mirror**

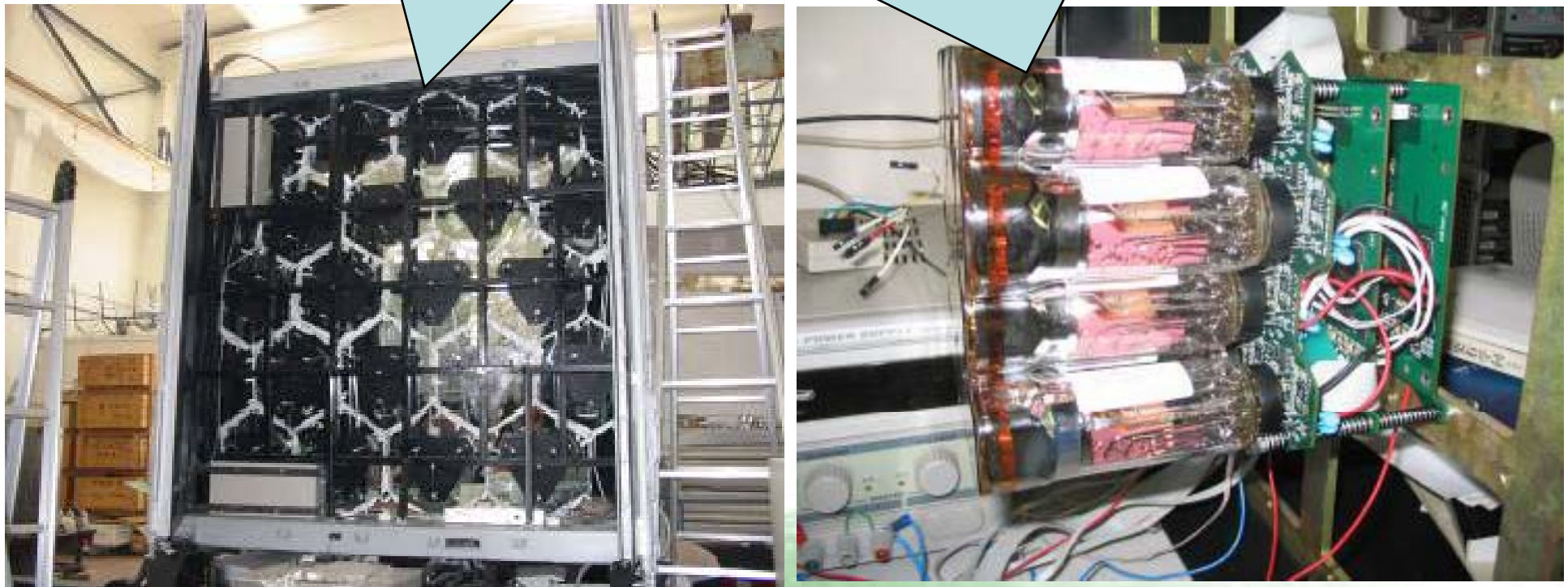
**UV filter
(un-installed)**

**Focal plane camera:
256 PMT's cluster**

Back plane of PMT cluster

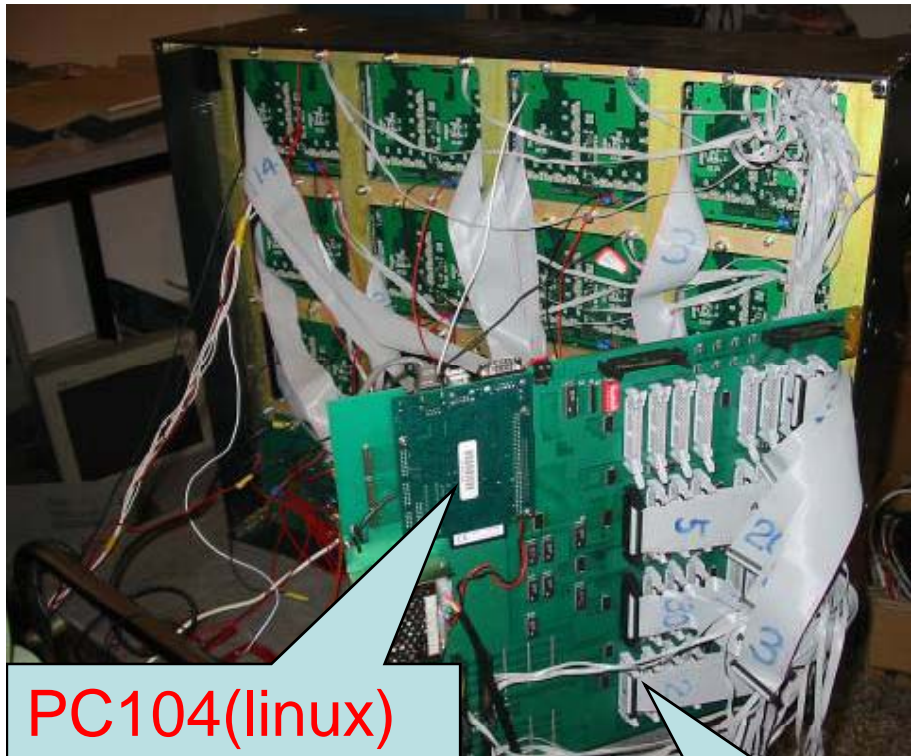
20 mirror sections
(back)

Each photo/digi-pulse
convertor. contains PMT,
shaping, dual-chann-VGA,
FADC & FPGA trigger

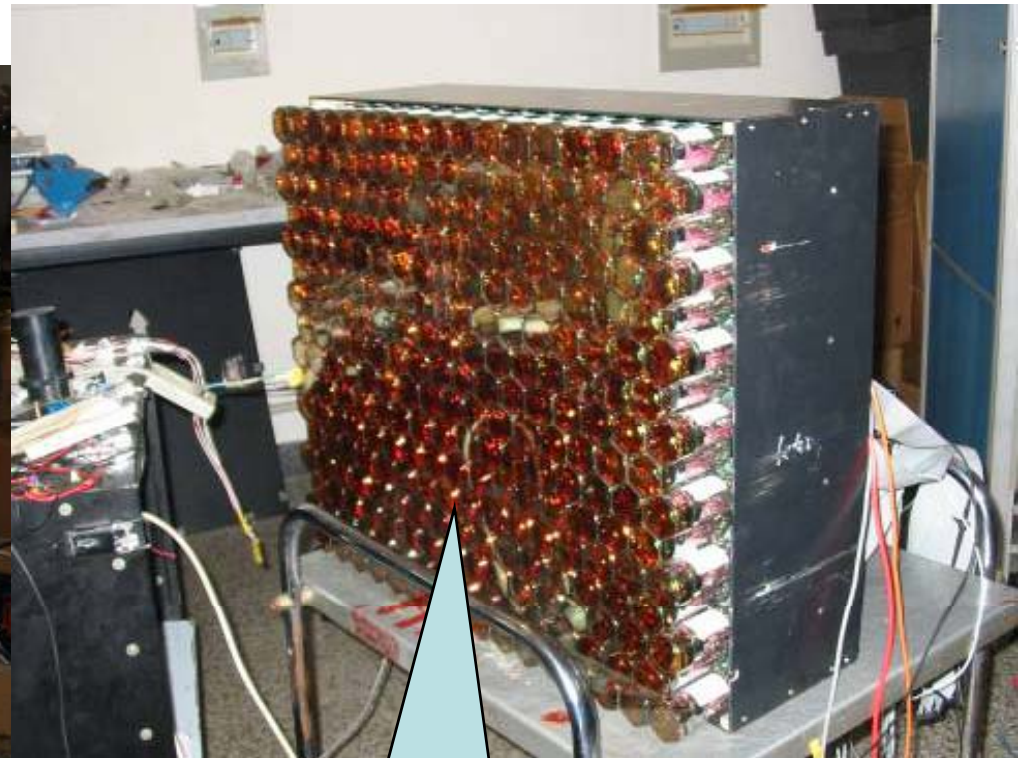


All-in-one design

- ❖ Only processed data are transmitted to central computer via TCP/IP network.
- ❖ Modularized design of photon-digitized-pulse converter 4x4 pixels.



PC104(linux)
Control one
cluster



Assembled
cluster

data bus

Telescope housing

Telescope control:
remote control & monitoring of door open/close, LV & HV turn on/off

Dump-truck
Hydraulic lift



Test Run : coincident with ARGO-YBJ RPC Array

- 1.Sky background
- 2.Monocular coincident with ARGO
- 3.Stereoscopic coincident with ARGO



CRTNT@YBJ

Air Cherenkov &
Fluorescence Detector



Test run

- ❖ Lift to high elevation angle (60° or 83°) for observation of cosmic ray shower.
- ❖ Test @
ARGO-YBJ site:, Tibet
 - Coincident with ARGO-YBJ
 - Cross-calibration

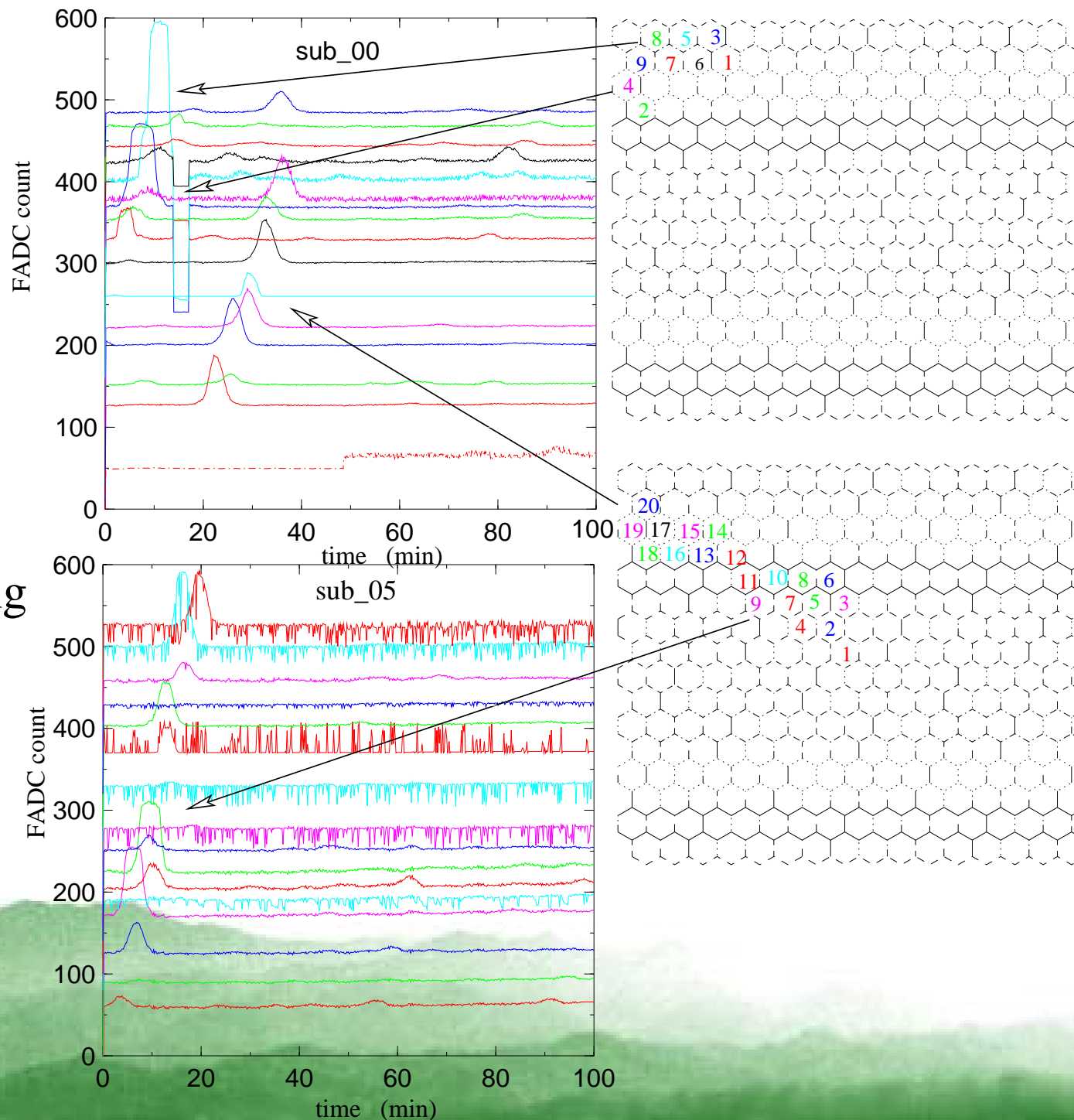


YBJ Sky background

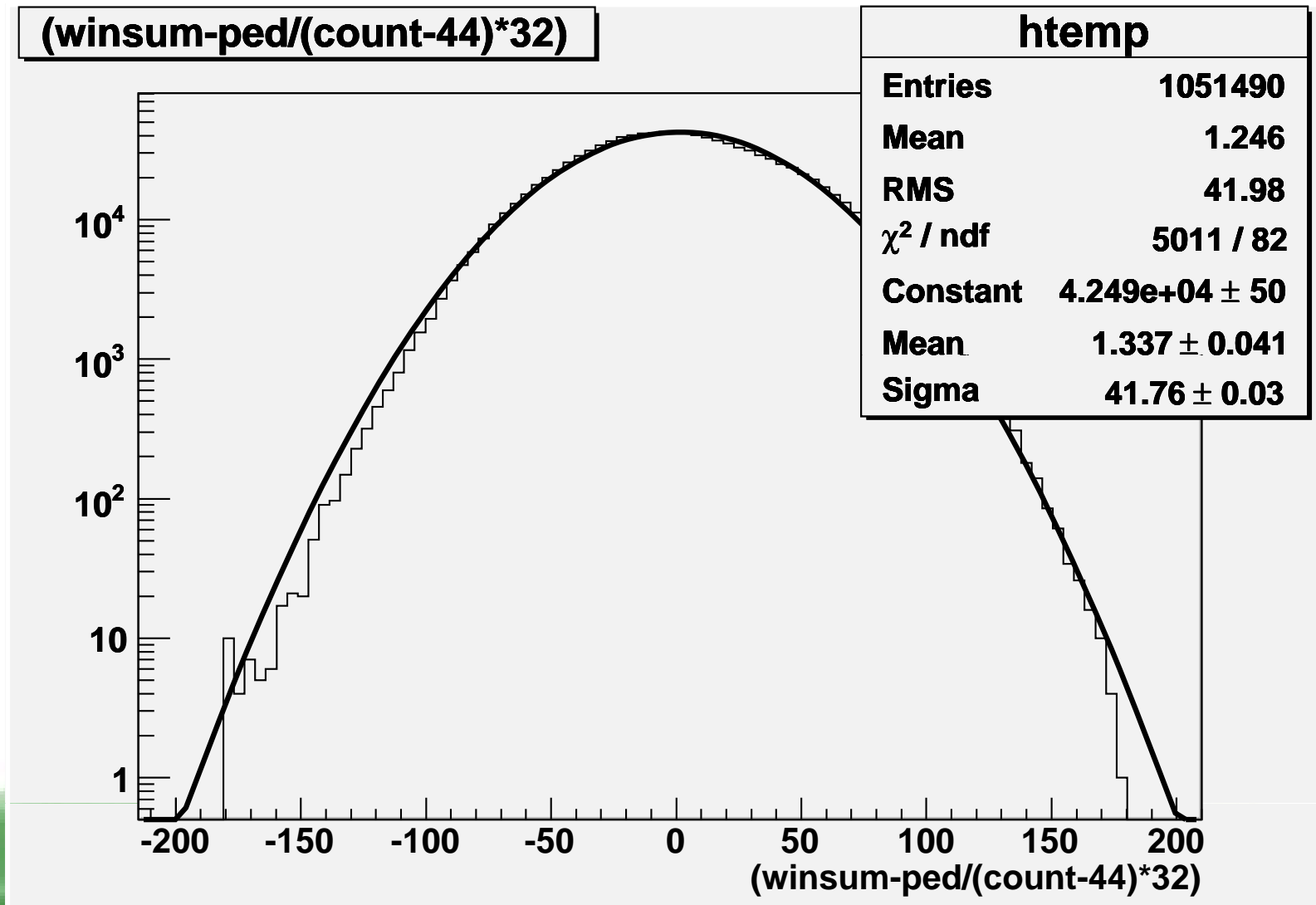
Star trajectories

Test on DC coupling & PMT responses

Stability of Telescopes during Hours of operation



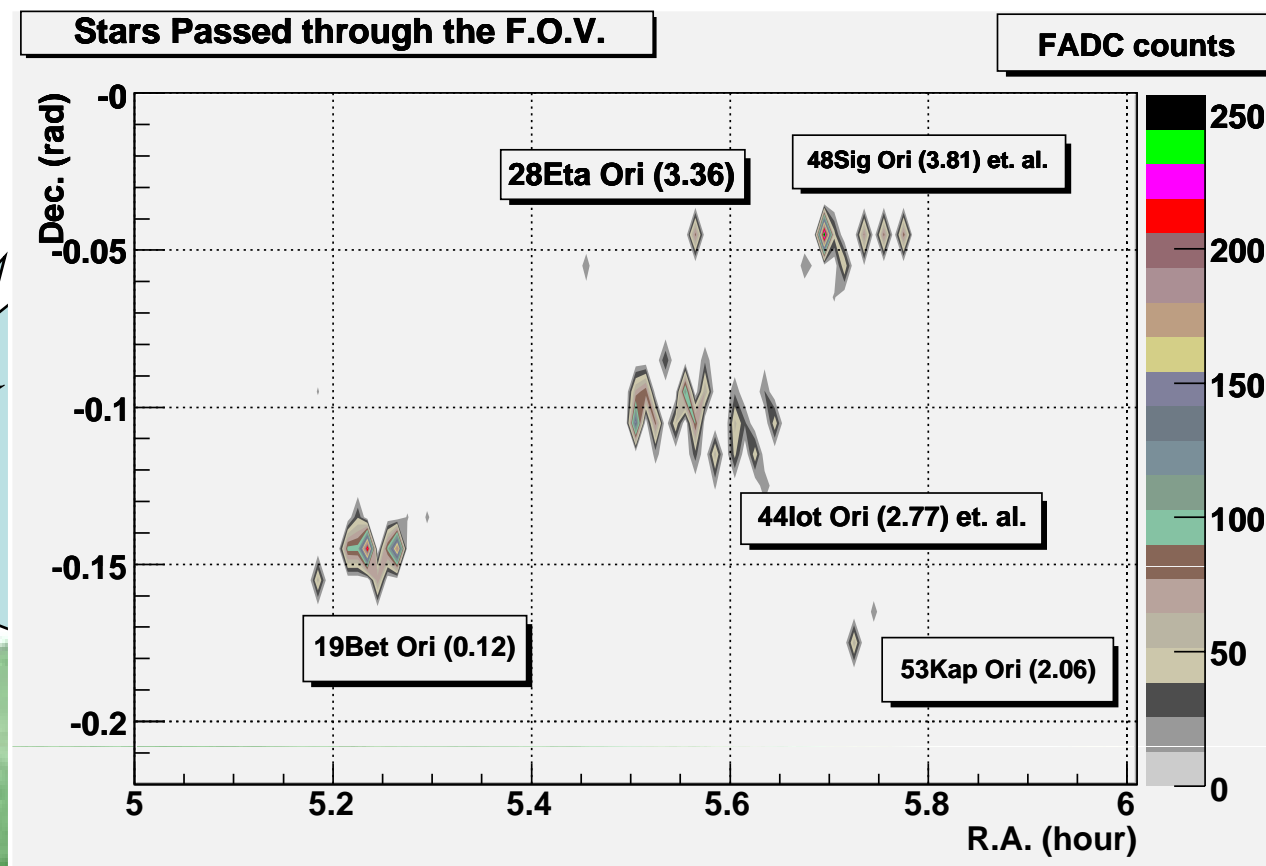
Background signal amplitude distribution



Locating Possible Stars

- ❖ Each “fired” PMT is used to predict the R.A. and Dec. of the stars

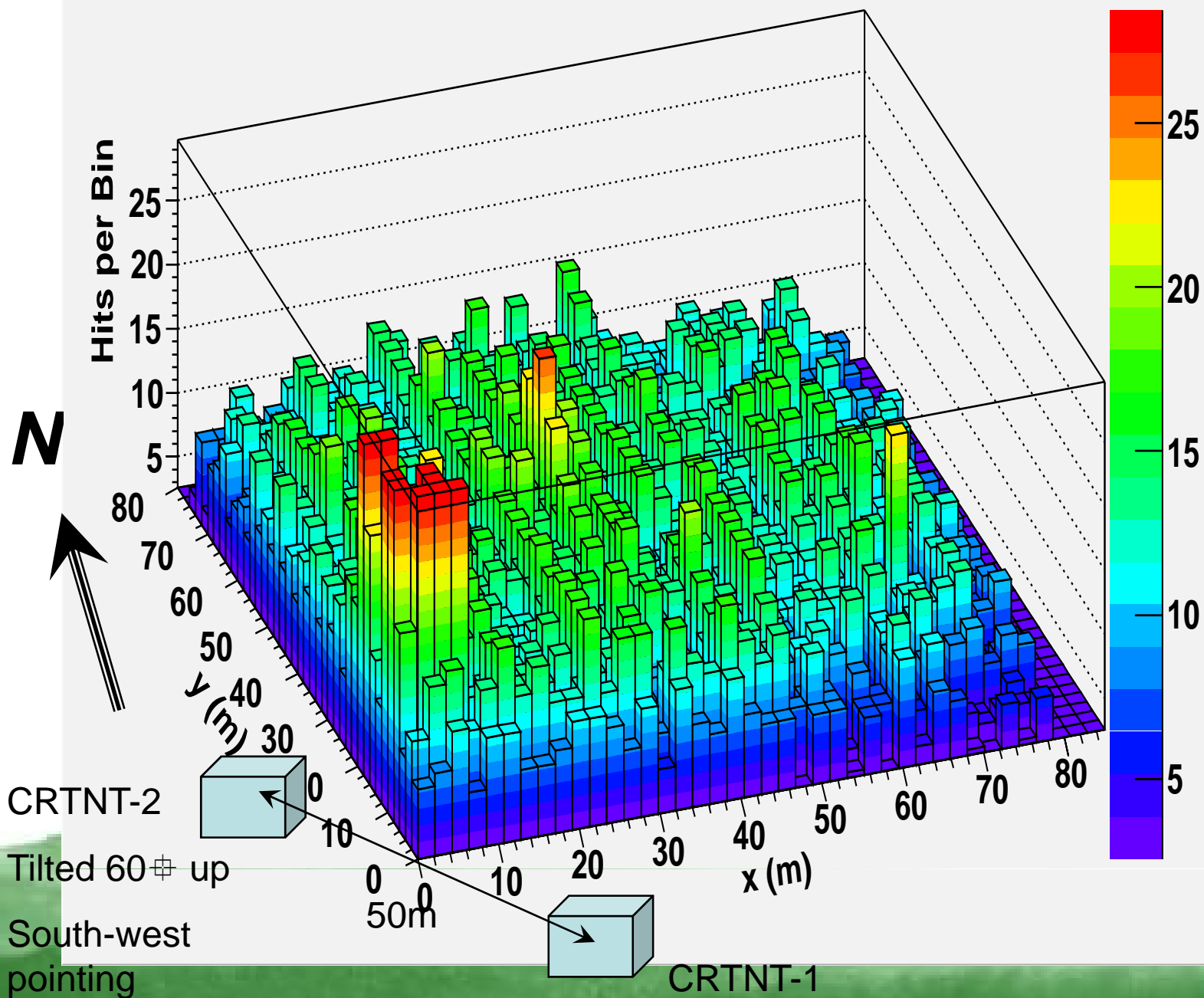
Pointing error
Adjusted



Cosmic Rays



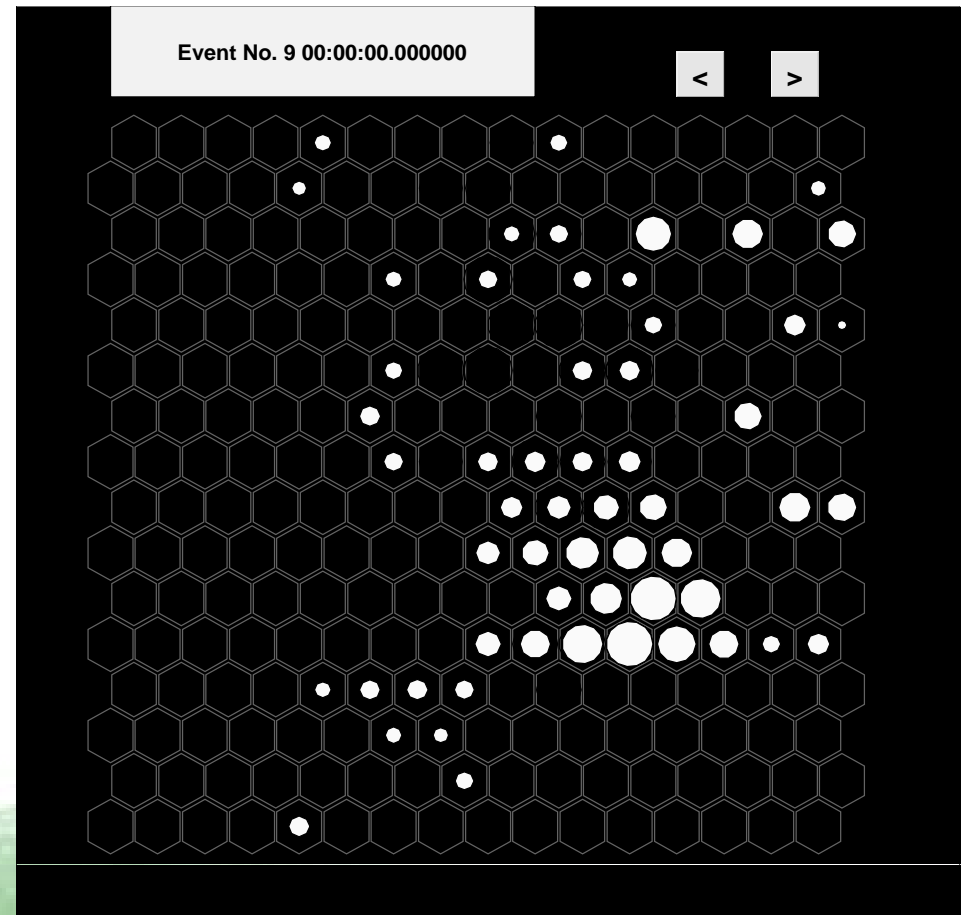
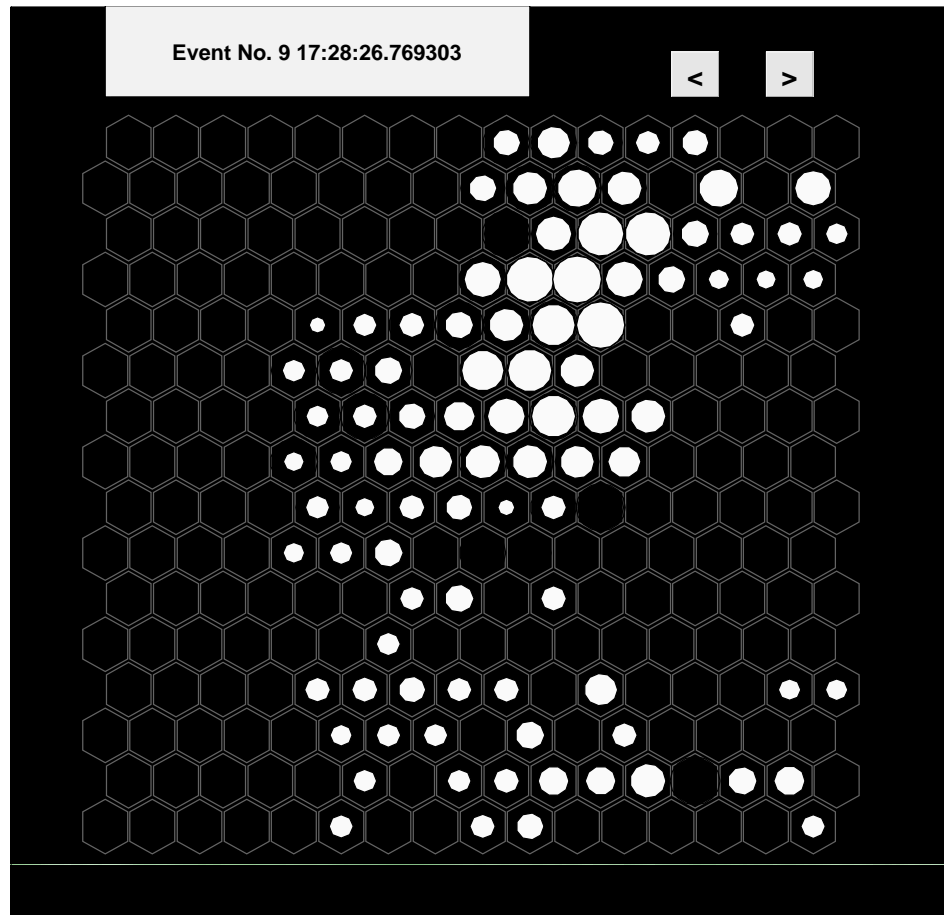
ARGO Event No. 18162863, nhit=15112, A=231.7°, Z=29.5°, t=17:28:25.76928650



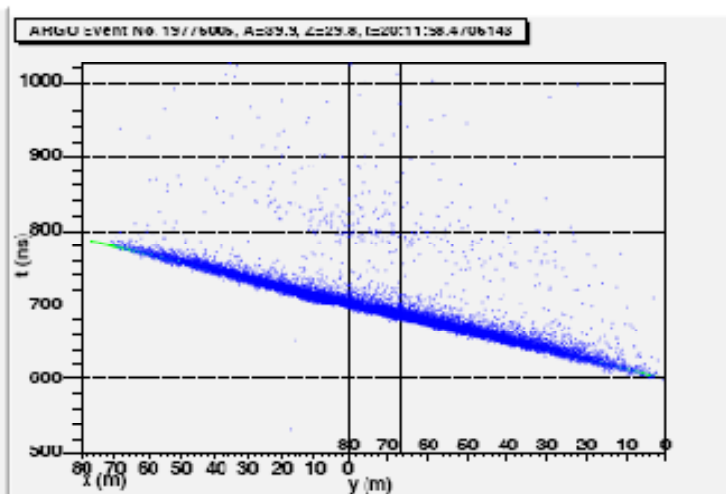
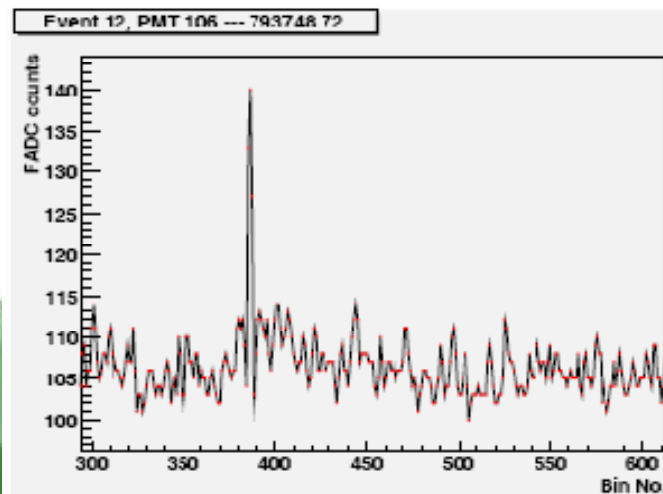
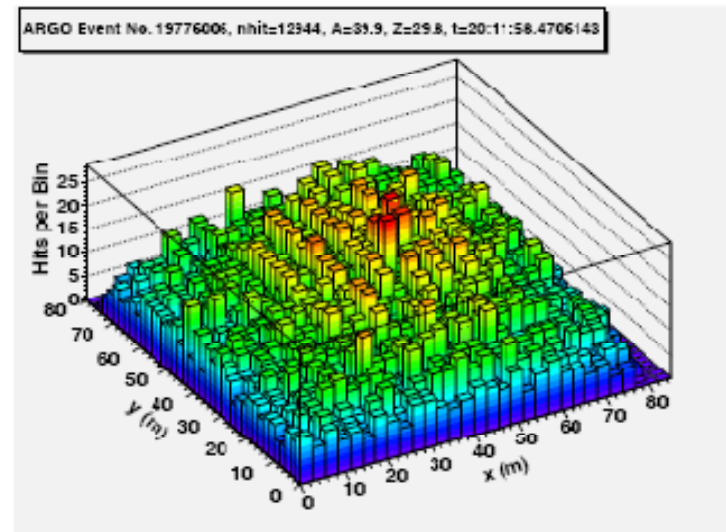
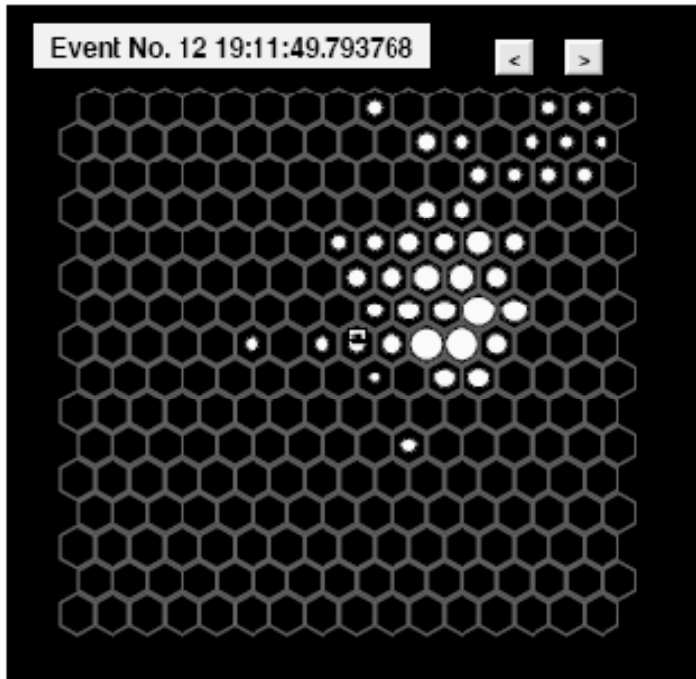
Stereoscopic View of a Shower

CRTNT-01

CRTNT-02

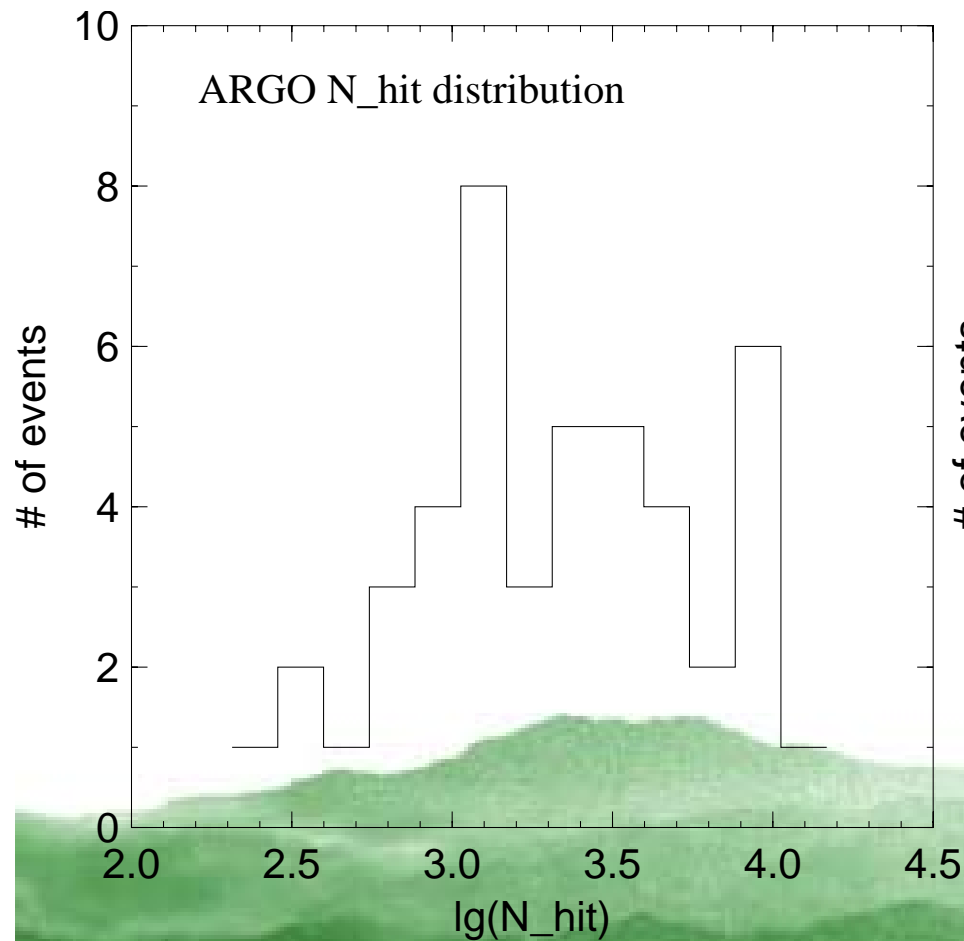


Monocular Coincident with ARGO

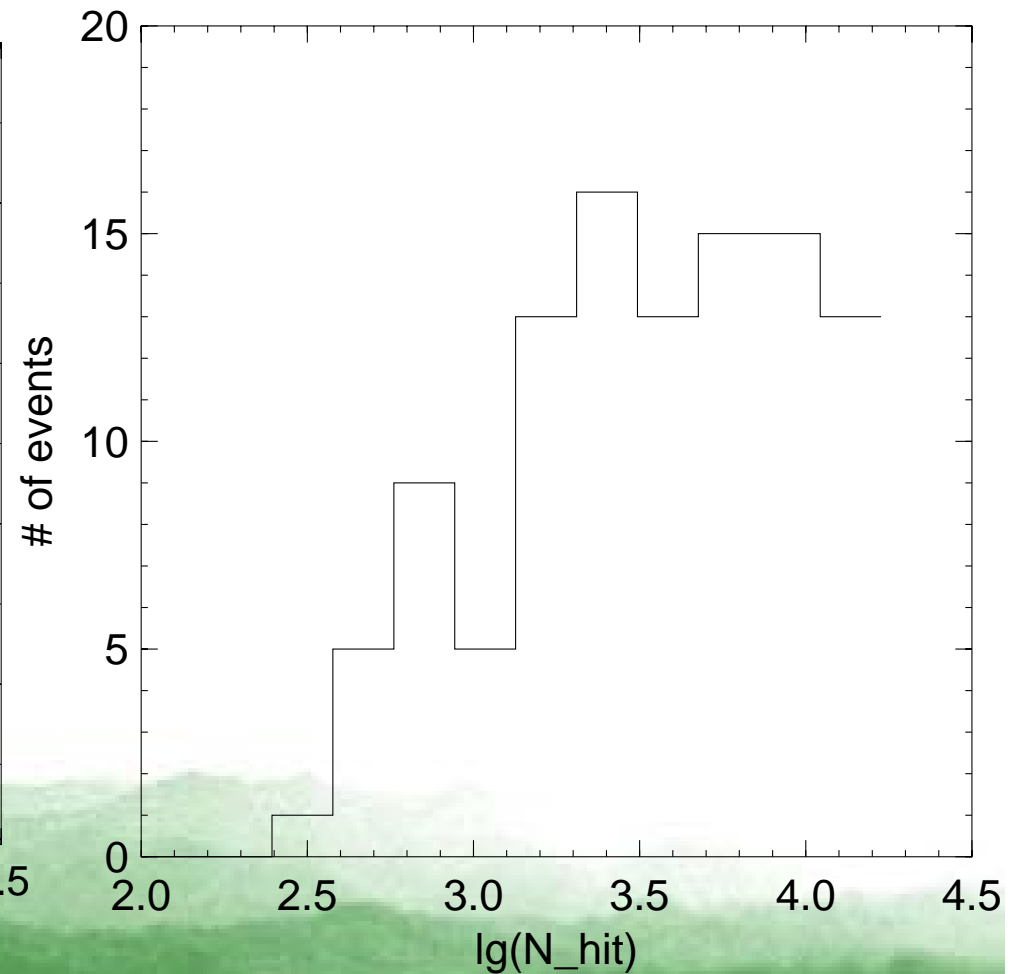


Estimate of Threshold Energy

Mono-hybrid



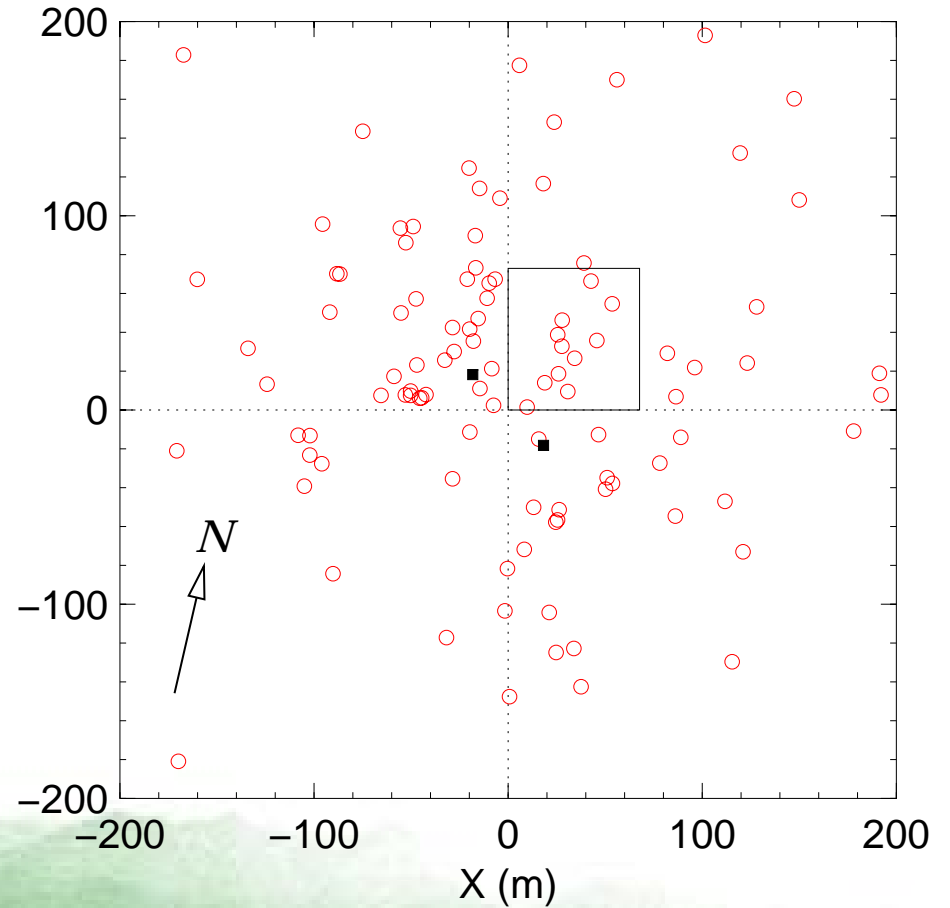
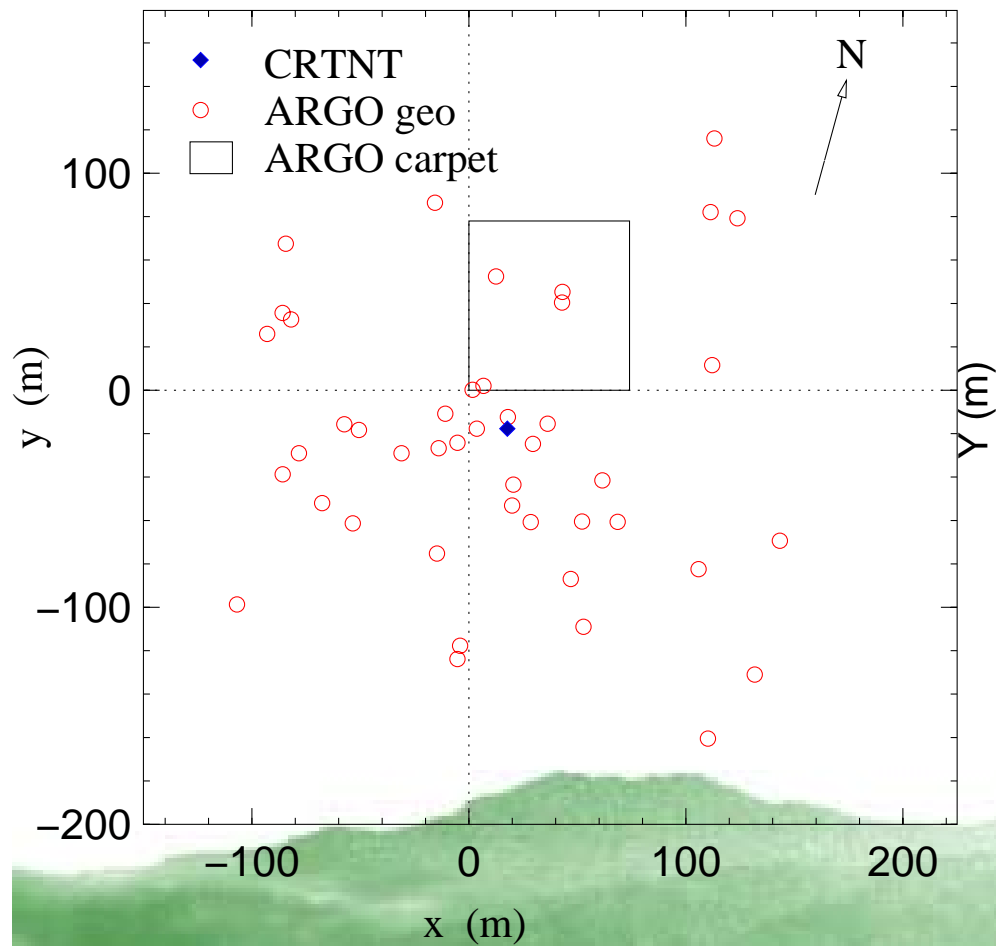
Stereo-hybrid



Shower core distribution

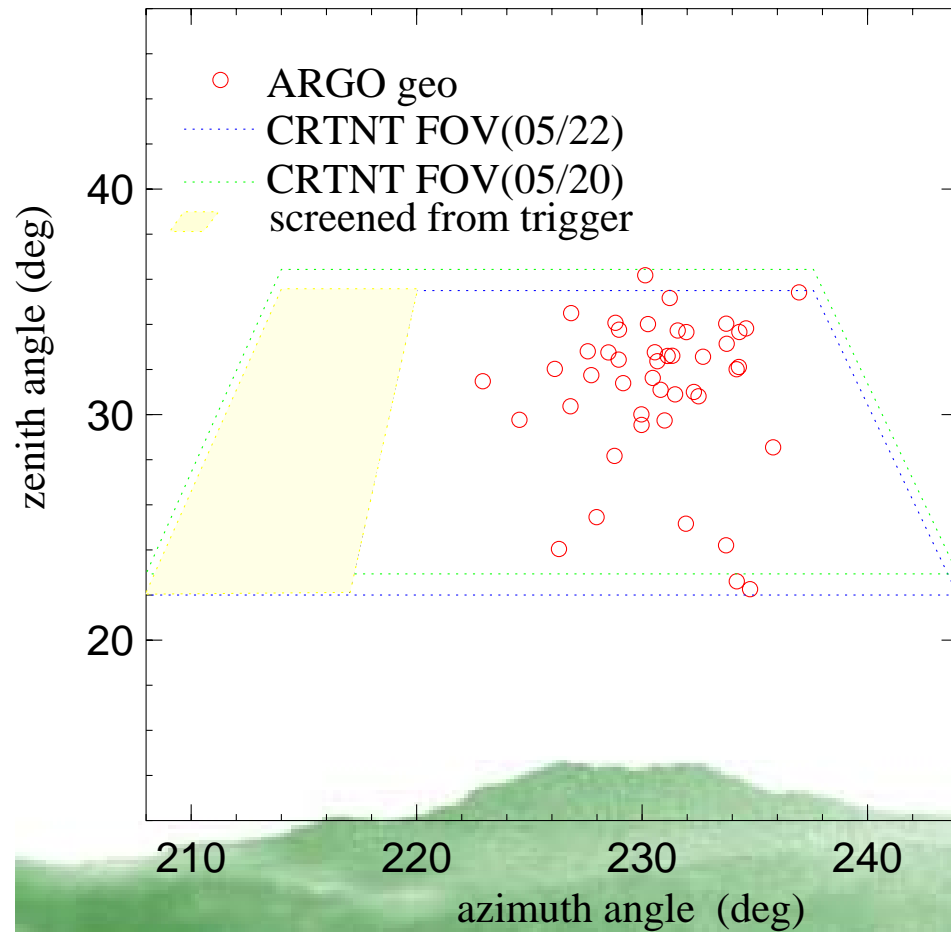
mono

stereo

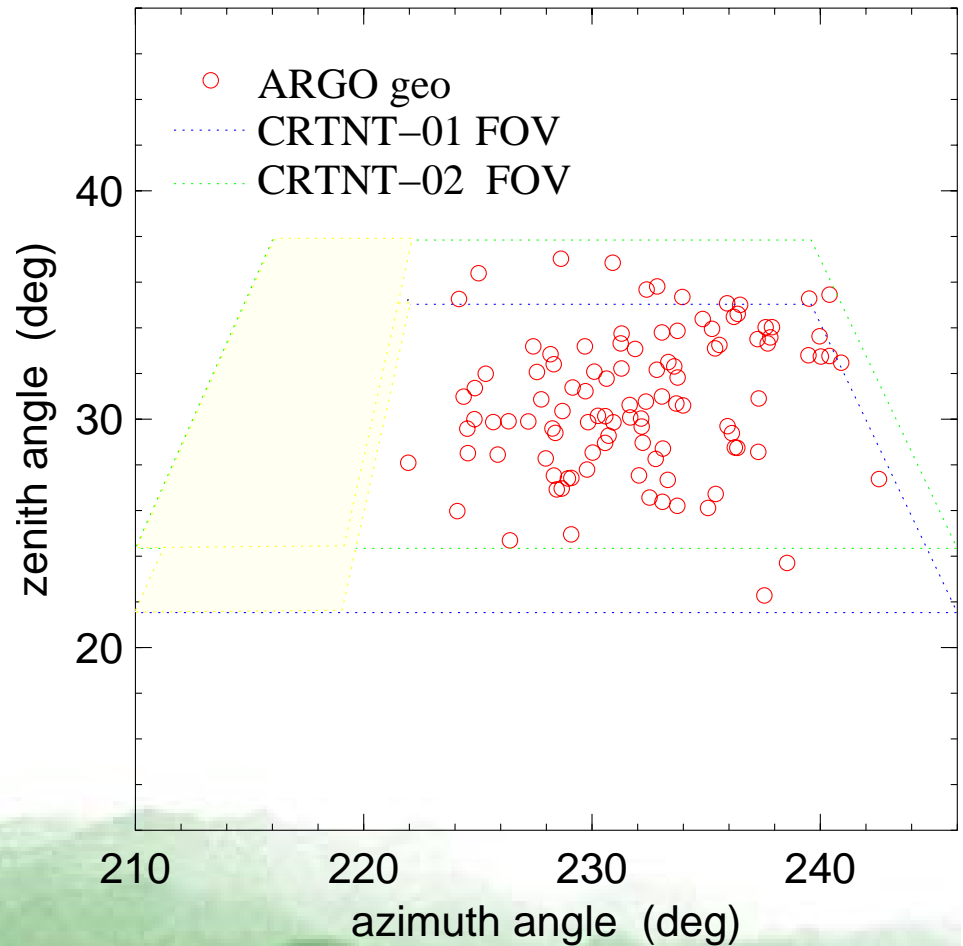


Arrival direction distribution

mono



stereo



Full Scale CRTNT Exp.

4 stations, each has 4 telescopes,
covering $14^\circ \times 64^\circ$ field of view.

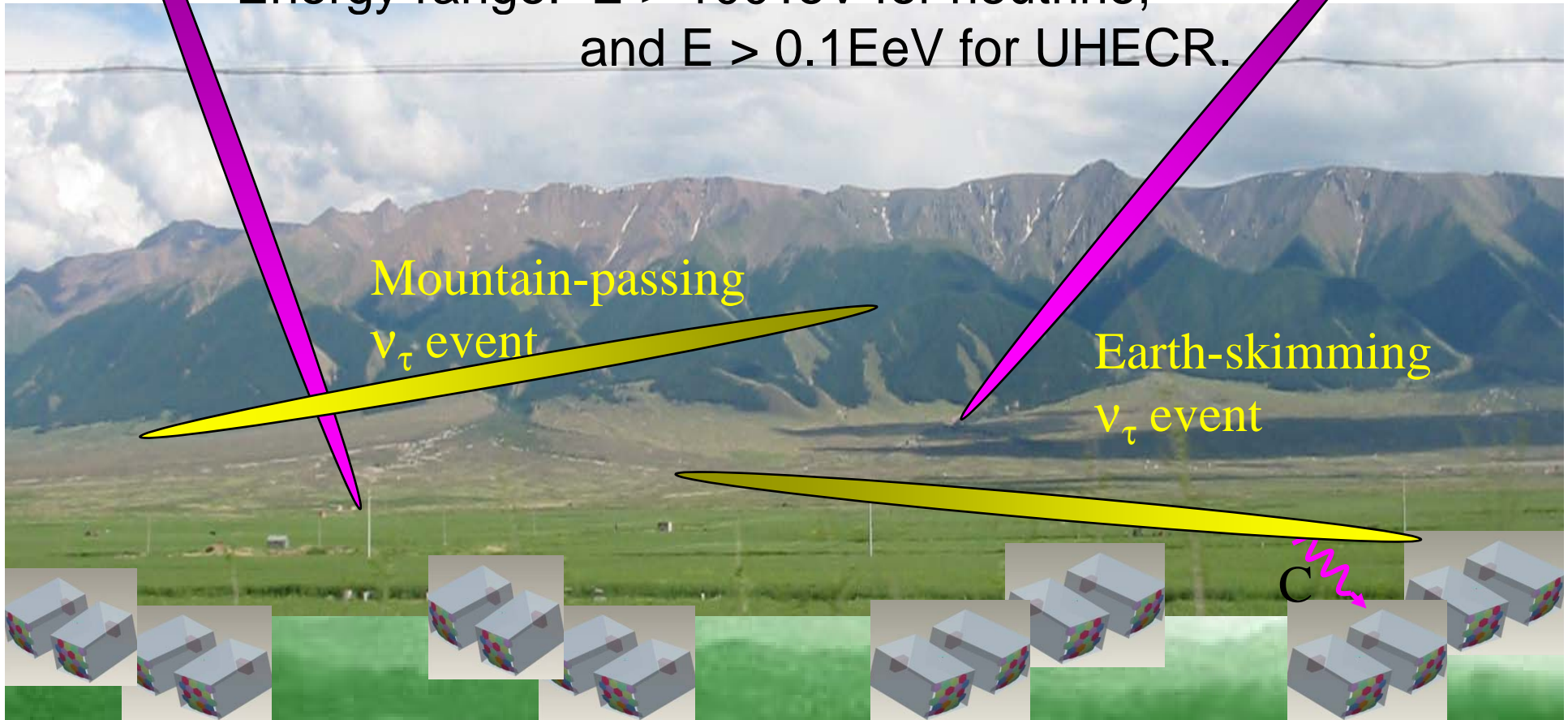
Site: Balikun, Xingjiang, China

Energy range: $E > 100\text{TeV}$ for neutrino,
and $E > 0.1\text{EeV}$ for UHECR.

UHECR

Mountain-passing
 ν_τ event

Earth-skimming
 ν_τ event



Potential sites

Mt. Balikun, Xinjiang, China
10km from Town Balikun
~2000km from Beijing



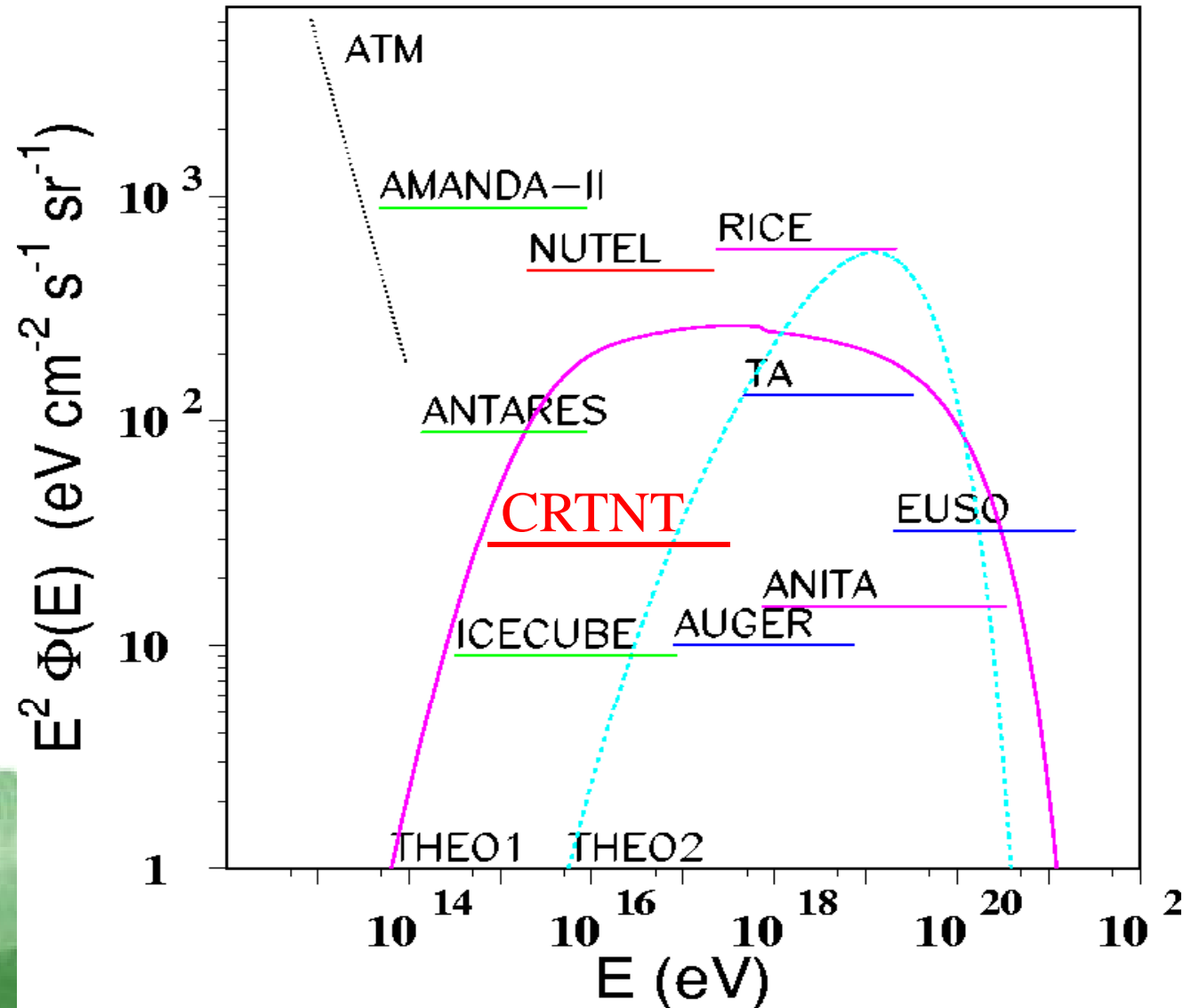
Mt. Wheeler Peak, Nevada, USA
36 mi from Ely,
~300mi from Las Vegas



Sensitivity Summary

Defined as flux upper limit of

- Assume $\phi(E_\nu) \propto E_\nu^{-2}$
- Assume no signal in 2 years of observation
- Feldman-Cousin method for upper limits: 2.44 signal events



Further schedule

- ❖ 2005 ~ 2007: 2 prototype telescopes completed, now testing at YBJ, Tibet
- ❖ 2007~2008: Phase-1,
 - Build 8 telescopes.
 - Prototype telescope operation (addition of each new built telescope)
- ❖ 2009: Phase-2,
 - Build the rest of telescopes
- ❖ 2010 ~ : Next stage

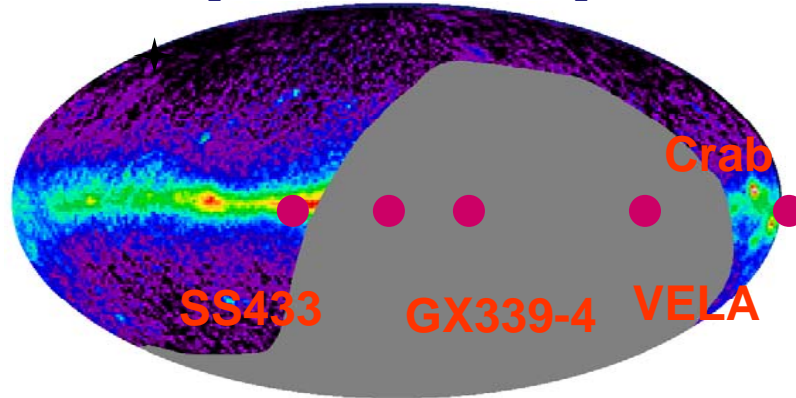


Updates on Physics

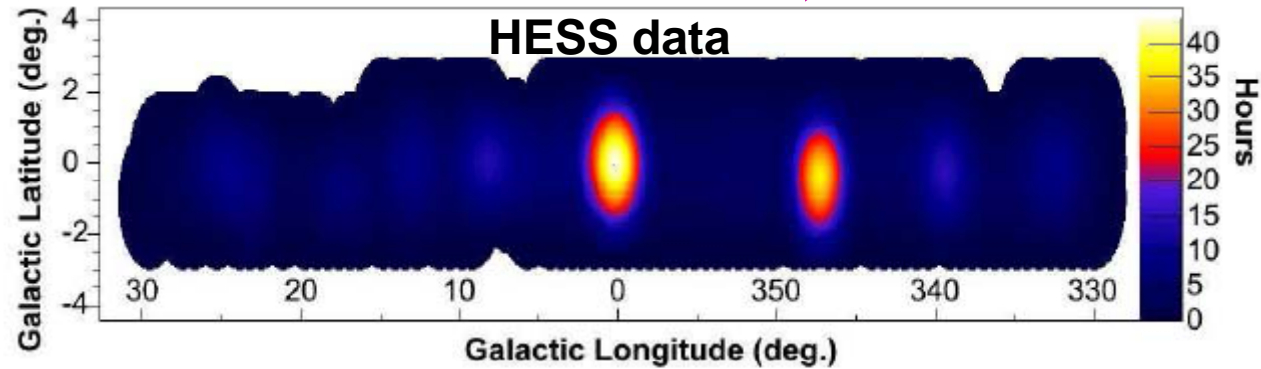
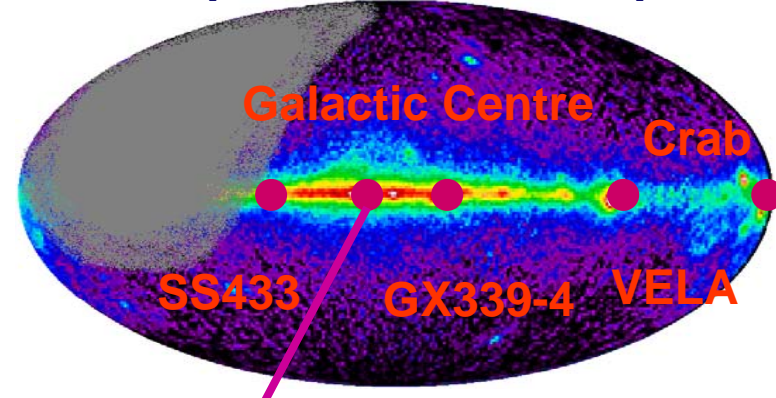
- ❖ Traditional Physics Topics
 - Diffusive flux from AGN, GRB and GZK
- ❖ Galactic Sources
- ❖ Pulsar may contribute VHE- ν flux, just next to diffuse AGN flux. However, Near-by galactic pulsar may be strong point source! L.Zhang (2006)
- ❖ SWIFT: near-by ($Z < 0.033$) GRBs 500x more than predicted, neutrinos are more energetic (N.Gupta&B.Zhang, 2006)
- ❖ Cosmogenic neutrinos with IR background (T.Stanev on CRIS, 2006)
- ❖ New Physics beyond SM



Telescopes in south hemisphere



Telescopes in north hemisphere



- The whole sky coverage needs two telescopes in different Hemispheres
- The Galactic Centre is observable only from the Northern Hemisphere

Summary

- ❖ CRTNT is complimentary to underground neutrino detectors watching the south hemisphere
 - CRTNT is as effective as IceCube with a smaller price.
- ❖ 2 prototype telescopes are completed and testing at YBJ, Tibet.
- ❖ CRs are observed coincident with ARGO-YBJ ground RPC carpet array
- ❖ 8 telescope proposal (2007)
 - Recommendation by academic committee of IHEP



CRTNT Collaborators

PI of each institution:

- ❖ Z. Cao (PI), Z.Z. Xing, H.H. He
 - Institute of High Energy Physics
- ❖ C. Liu
 - Institute of theoretical Physics
- ❖ L. Zhang, X. Zhang
 - Yunnan Univ. & Yunnan Observatory
- ❖ T. Lu
 - Zijinshan Observatory & NanKing University
- ❖ M.A. Huang
 - National United University, Taiwan

❖ New Collaborators are welcome!

