Web-based Cloud Computing for High Energy Neutrino Simulation

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Outline

- Neutrino interaction program :SHINIE
- web-site version

Simulation of High-energy Neutrinos Interacting with the Earth

What can SHINIE do ?

- *SHINE include all neutrino interaction inside the Earth*
- *Link the tau-induced EAS generated from Earth-skimming neutrino*
- *Simulation with the real geometry data for experiment*
- *Friendly graphical user web interface to change the simulation parameter*

Neutrino Interaction Process

- *$\nu - N$ interaction (c-teq 6)*

  Neutral current interaction
  Charge current interaction

- *Lepton energy loss*

  ionization
  pair production
  photon-nuclear
  bremsstrahlung

- *Tau & muon Decay*

Neutrino events

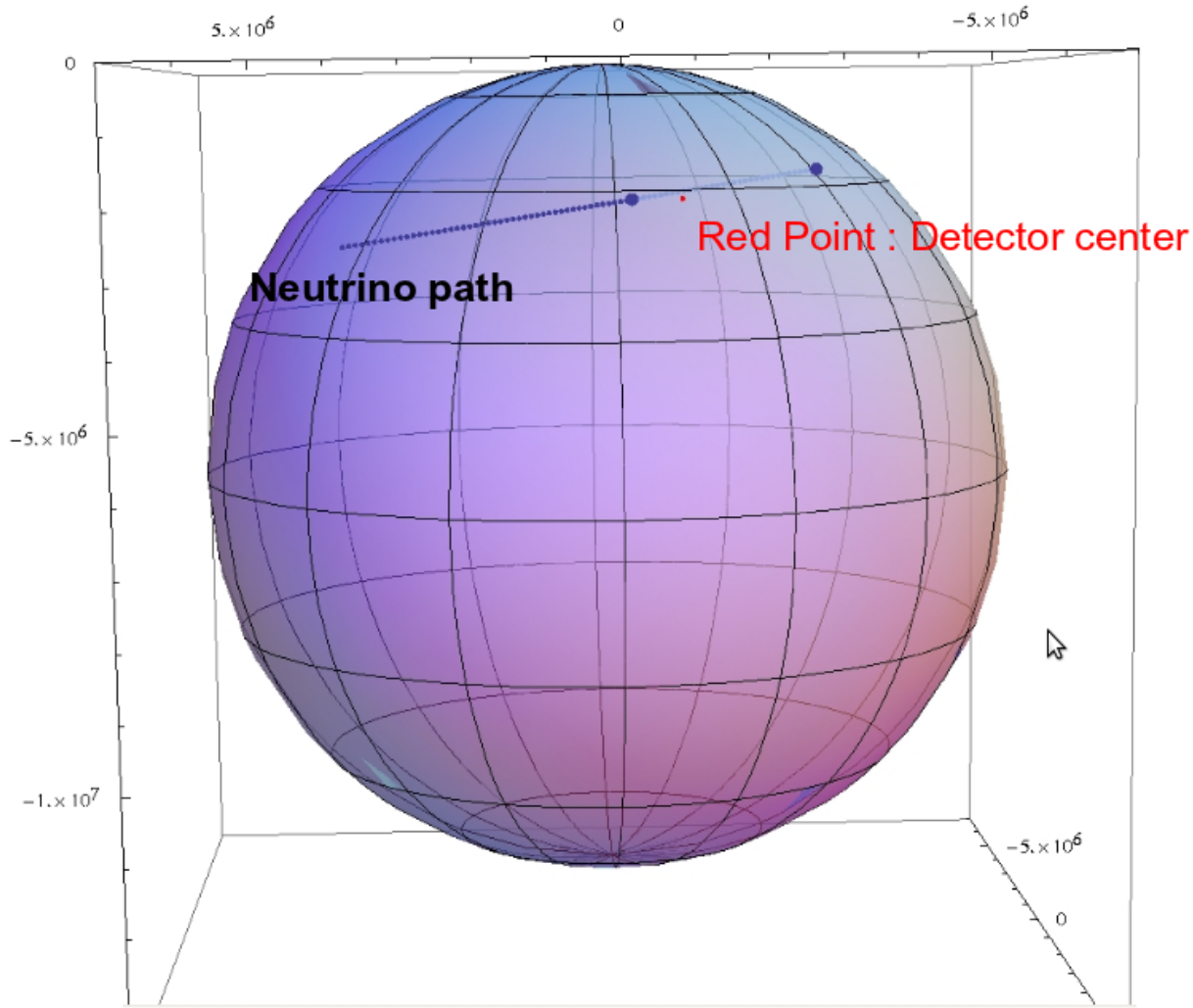
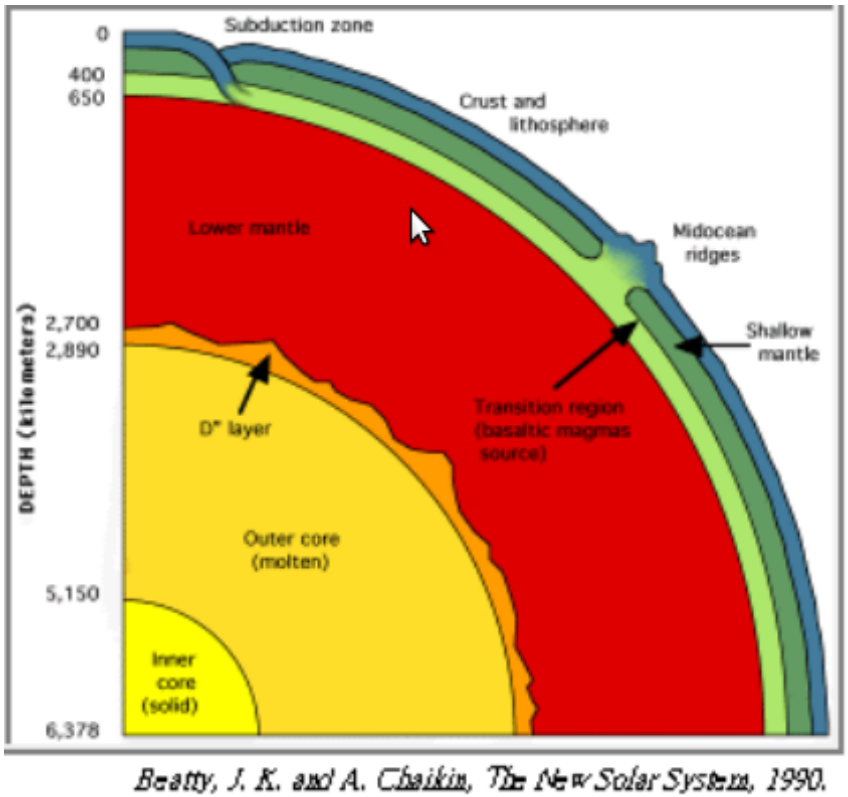


Figure: Due to the small cross section of the neutrinos, detecting the neutrinos need the huge interaction media, such as Earth.

Earth Model



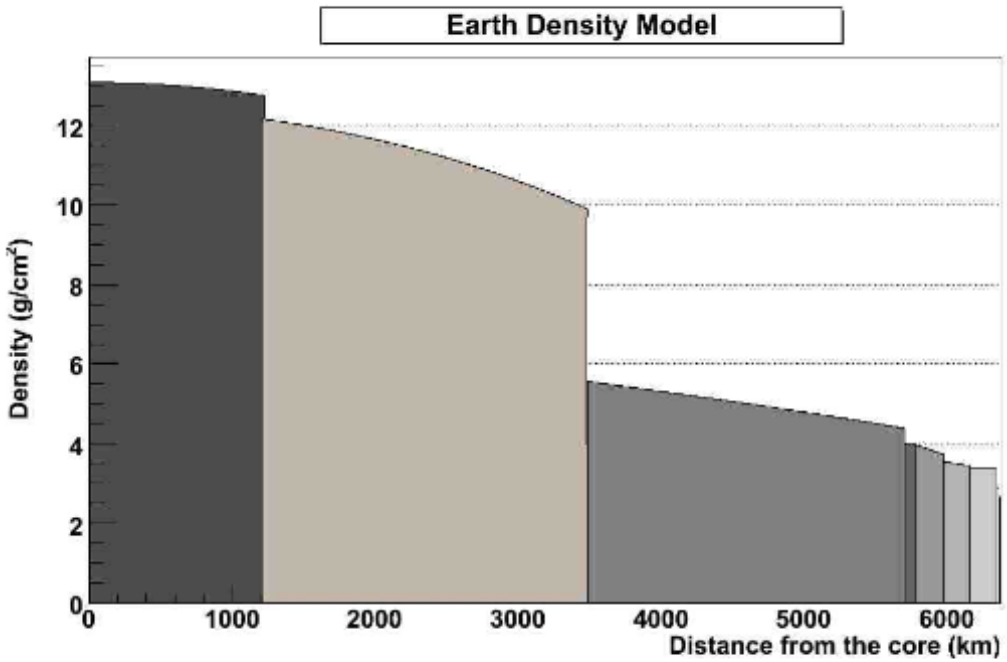
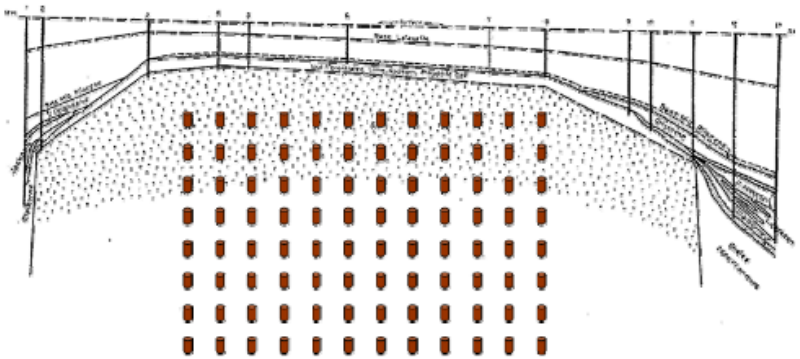
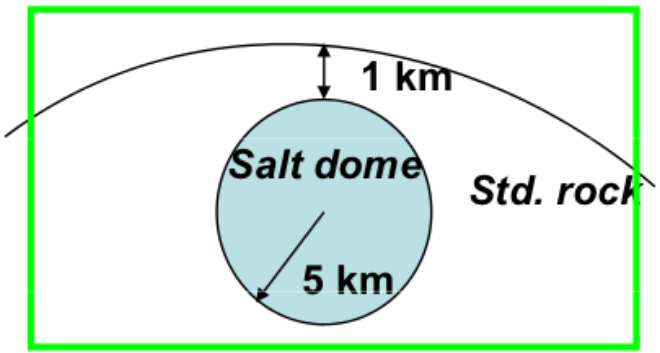
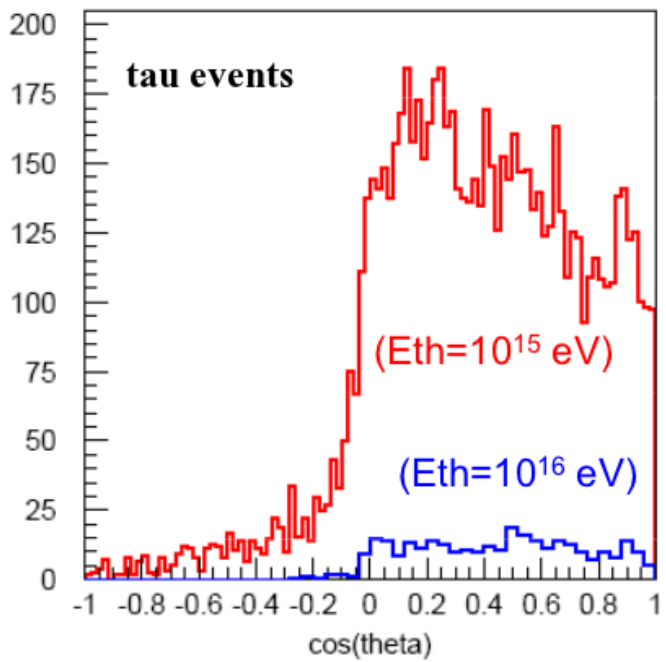


Figure: 10 layers Earth model build in the SHINIE program

Example 1 : Underground Ground detector







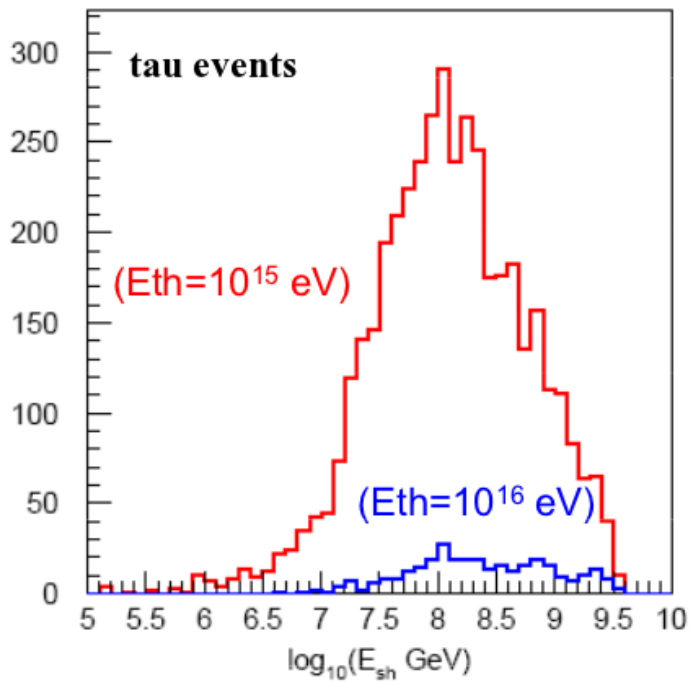


Figure: The simulation for SalSA project

Example 2: Balloon experiment

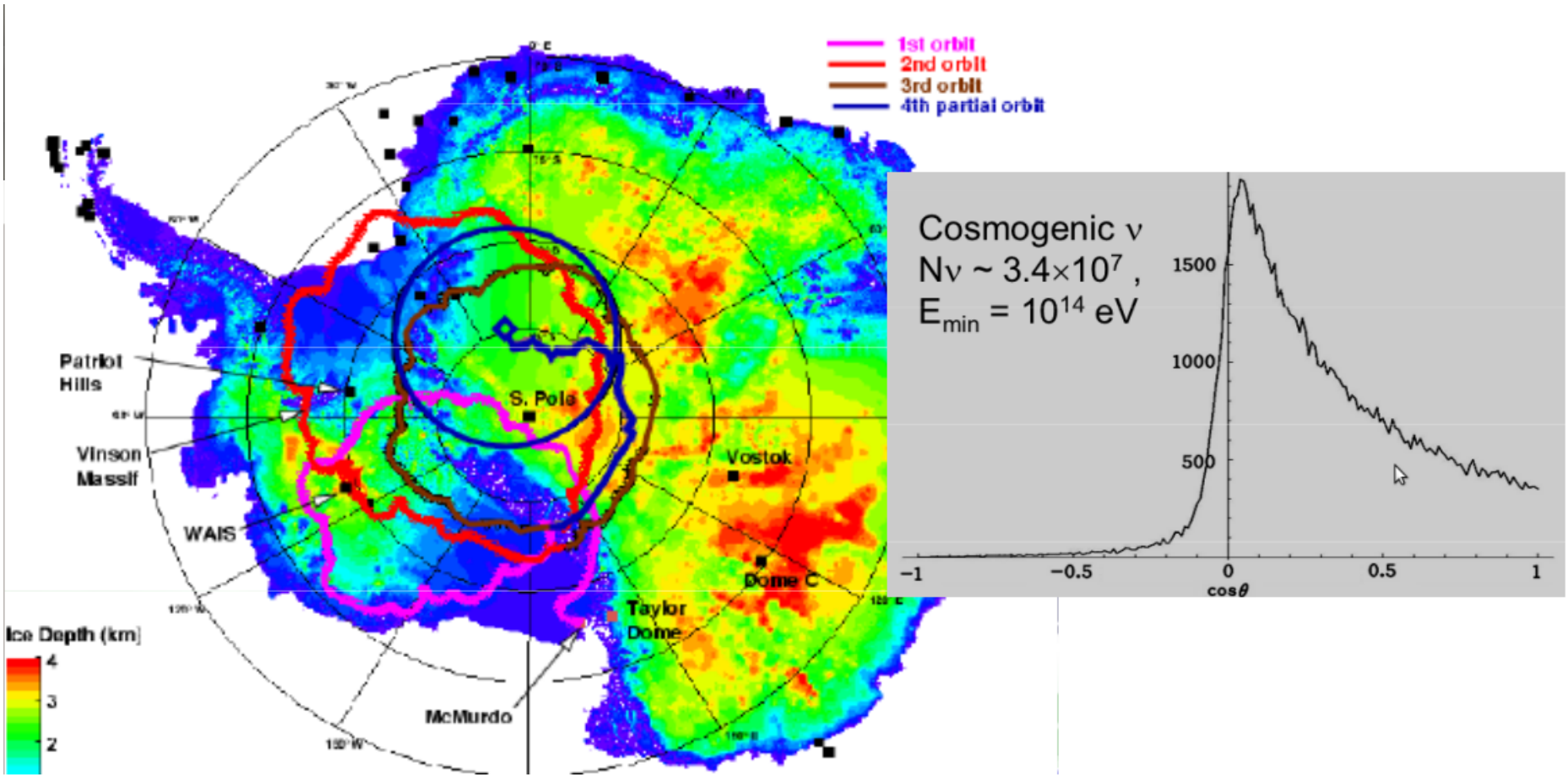


Figure: The simulation for antarctic balloon project

The Simulation for High Energy Neutrino physics

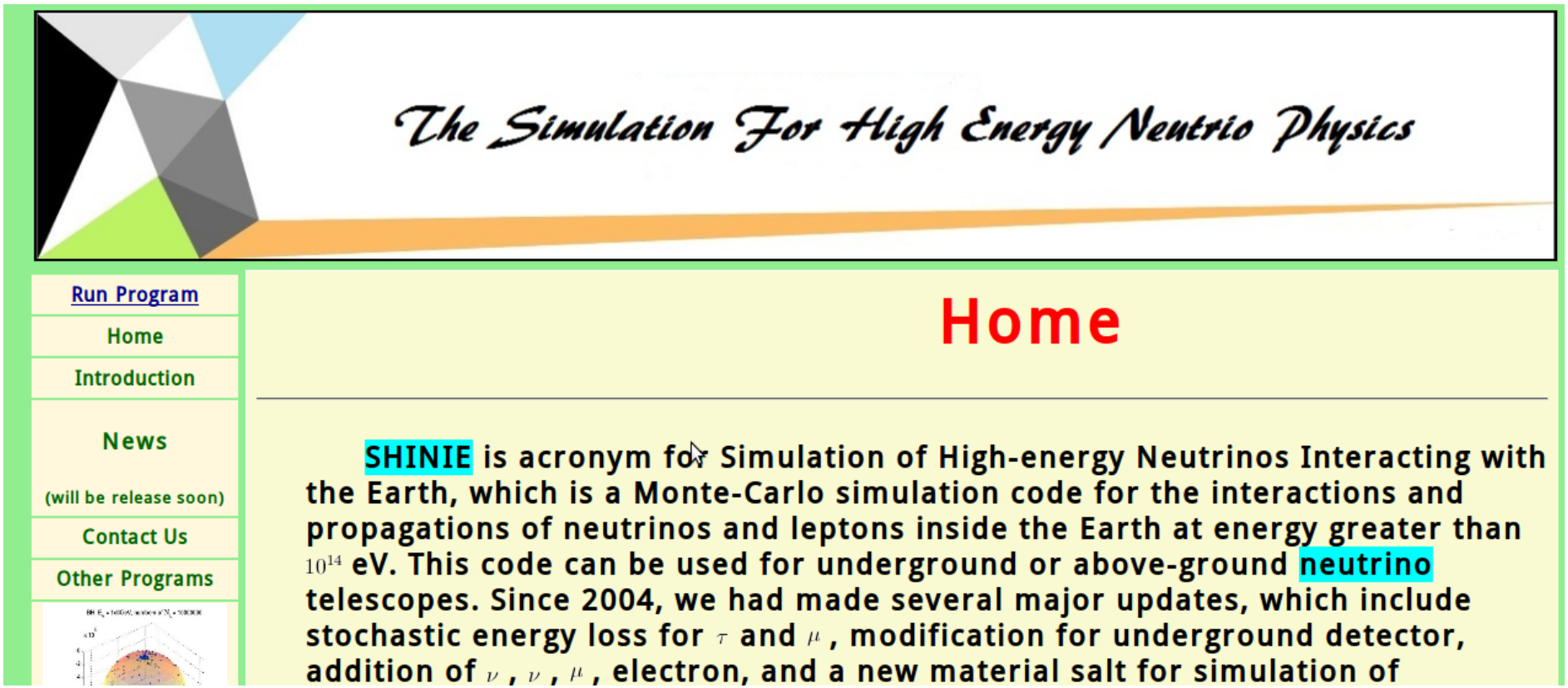
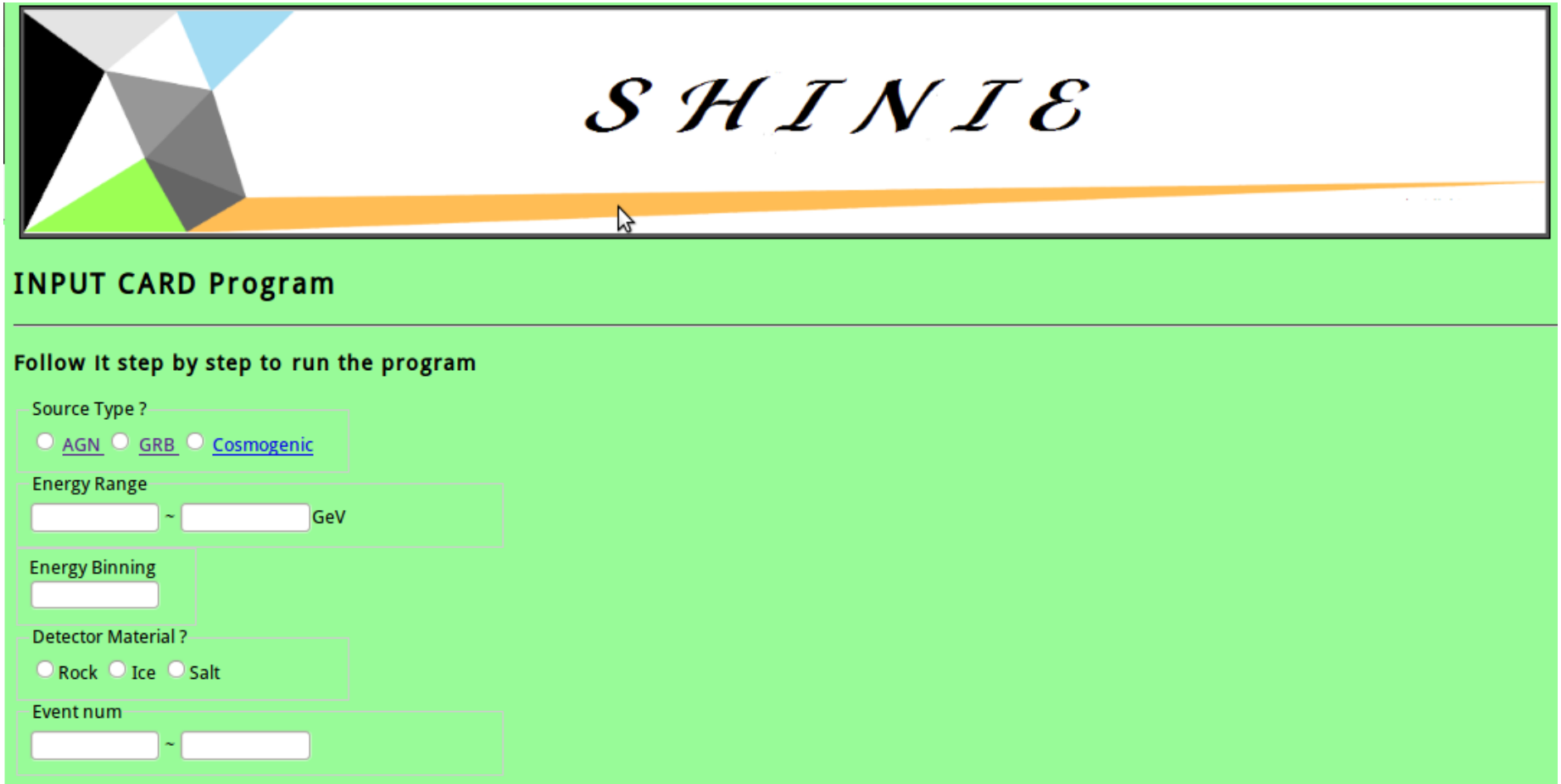


Figure: pre.tir.tw/012

Run Program


SHINIE
INPUT CARD Program
Follow It step by step to run the program
Source Type ?
AGN GRB Cosmogenic
Energy Range
~ GeV
Energy Binning
Detector Material ?
Rock Ice Salt
Event num
~

Source

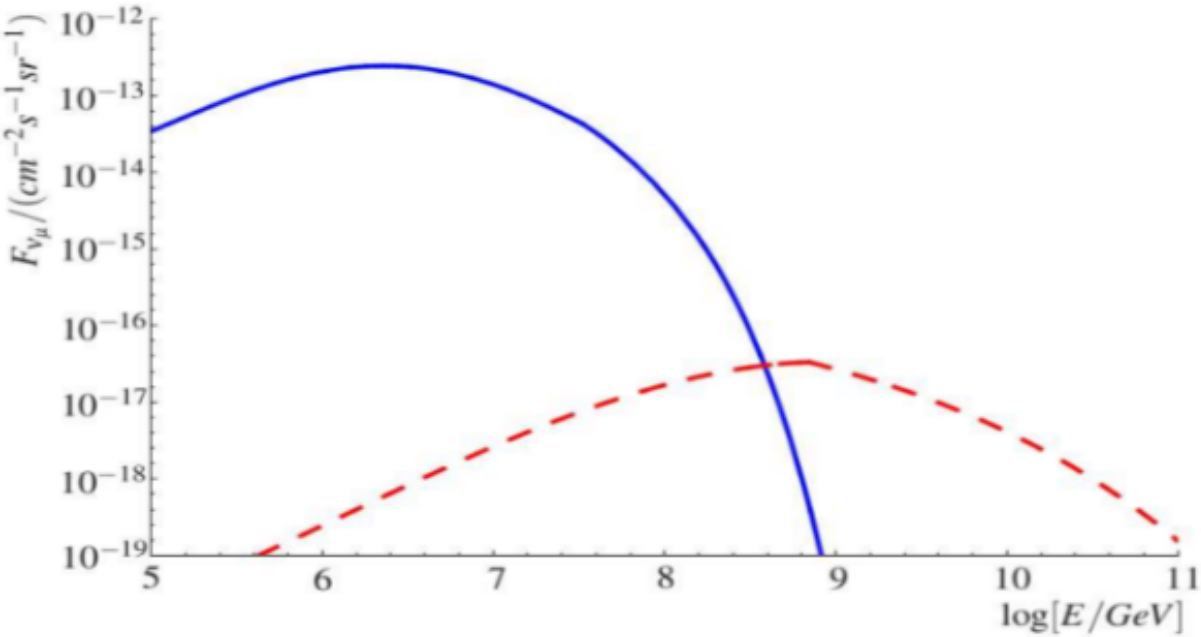
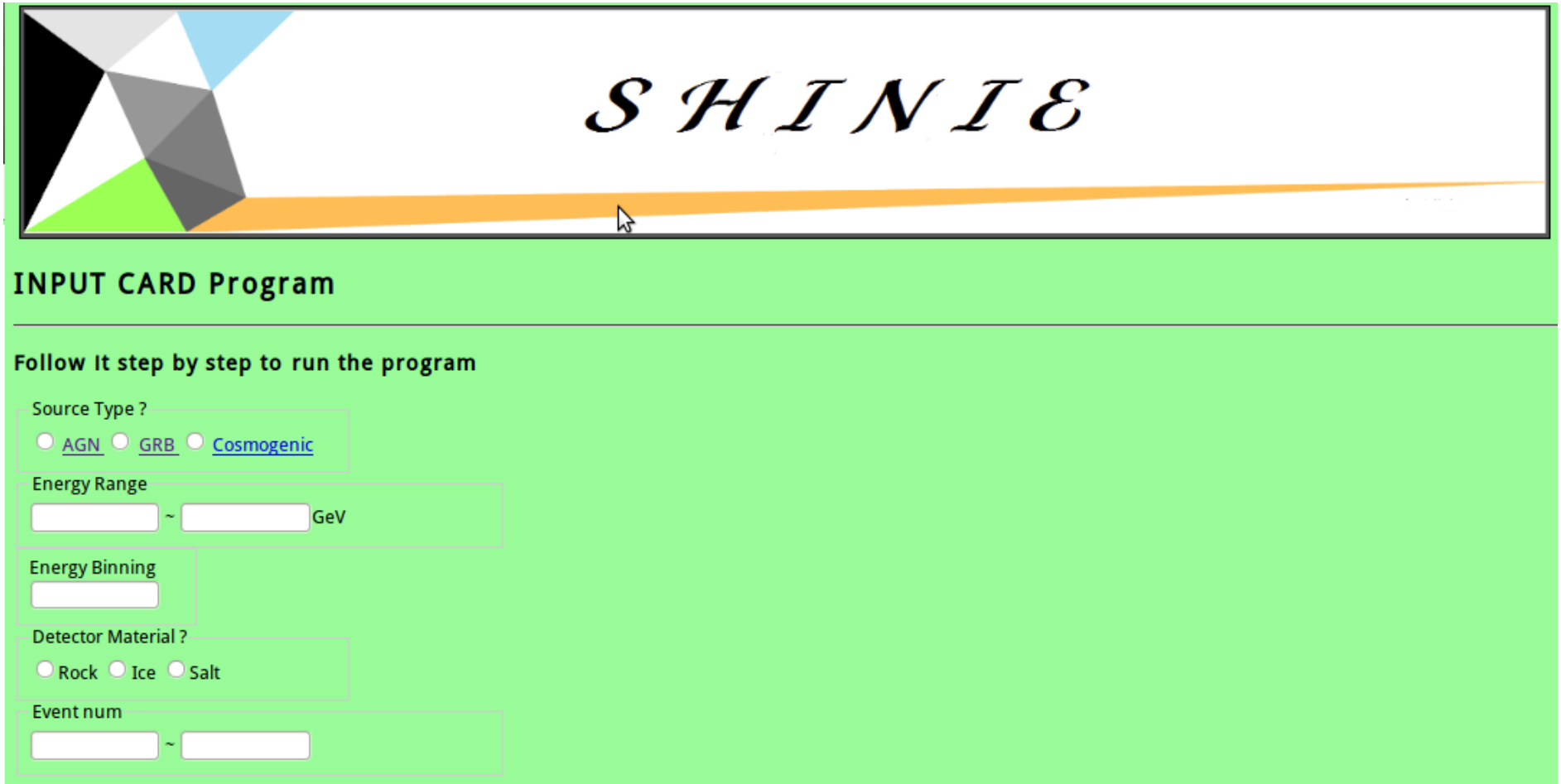


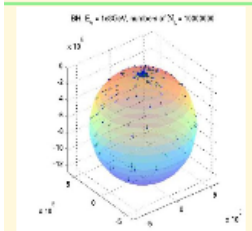
Figure: The spectrum of AGN and Cosmogenic muon neutrino flux. The blue solid line shows the muon neutrino spectrum from AGN source. The red dashed line shows the muon neutrino spectrum from Cosmogenic source.

Run Program-help



Run Program-help

Run Program
Home
Introduction
News
(will be release soon)
Contact Us
Other Programs



Introduction to Cosmogenic Neutrino

The distribution of ultra high energy cosmic ray is isotropic and homogeneous. The major com position of cosmic ray are protons and nuclei. The ultra high energy proton, $E_p > 10^{19} eV$, has a possibility of interacting with the 2.7 K microwave background radiation during its propagation [13, 14]. In this interaction, proton and microwave background photon collide into the resonance state Δ^+ , which decays to neutron and pion. Finally, the pion decays to neutrinos. The chain of interactions and decays is the same as Eq. (2.1) in introduction of AGN. The Cosmogenic effect leads to a cutoff of the cosmic ray spectrum around 10^{20}eV. The energy of neutrinos produced in this decay chain is around 10^{17} to 10^{18} eV. Fig. 2.1.2 shows the Cosmogenic tau neutrino spectrum [15].

Input card

INPUT CARD Program

Follow it step by step to run the program

Source Type ?

○ AGN ◉ GRB ○ Cosmogenic Neutrino

Energy Range

100000 ~ 1000000 GeV

Energy Binning

100000

Detector Material ?

○ Rock ◉ Ice ○ Salt

Event num

1000000

Submit

Back

Confirm

Energy Range

100000 ~ 1000000 GeV

Energy Binning

100000

Detector Material ?

○ Rock ◉ Ice ○ Salt

Event num

1000000

Submit

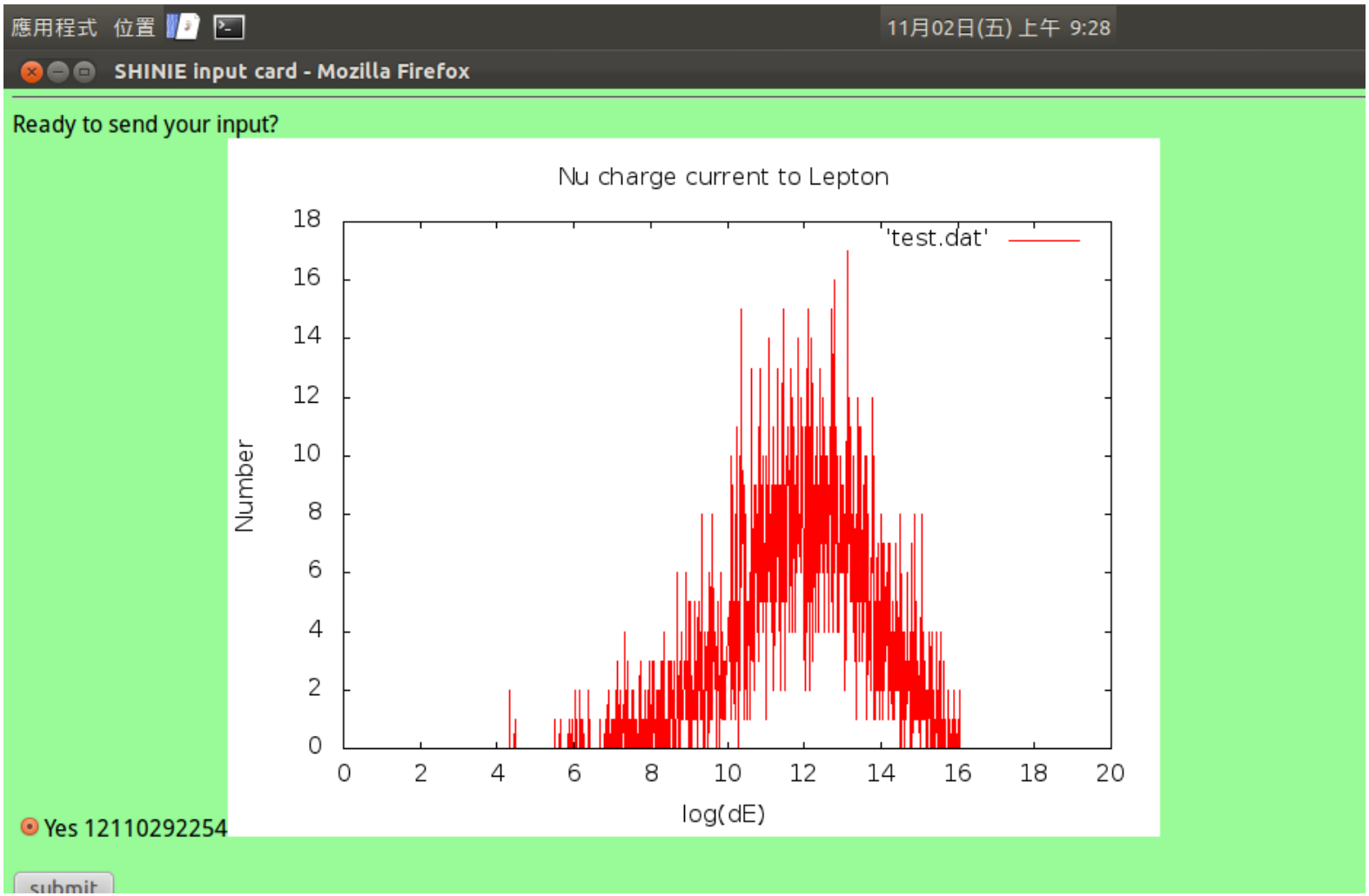
SourceType = grb
Energy range is from 100000 to 1000000
Energy Binning = 100000
Detector Material = 2
Event number = 1000000

Ready to send your input?

○ Yes

submit

Result


應用程式 位置
11月02日(五) 上午 9:28
SHINIE input card - Mozilla Firefox
Ready to send your input?
Nu charge current to Lepton
'test.dat'
Number
log(dE)
0
2
4
6
8
10
12
14
16
18
20
Yes 12110292254
submit

Future plans

- Release the SHINIE before 2013.
- Support the angular distribution plot, energy loss spectrum, lepton location distribution.etc
- Setup the database system for User download the raw data
- Built the geometry map for User's experiment.

Next Example

ARA Collaboration
P. Allison et al.
arXiv: 1105.2854

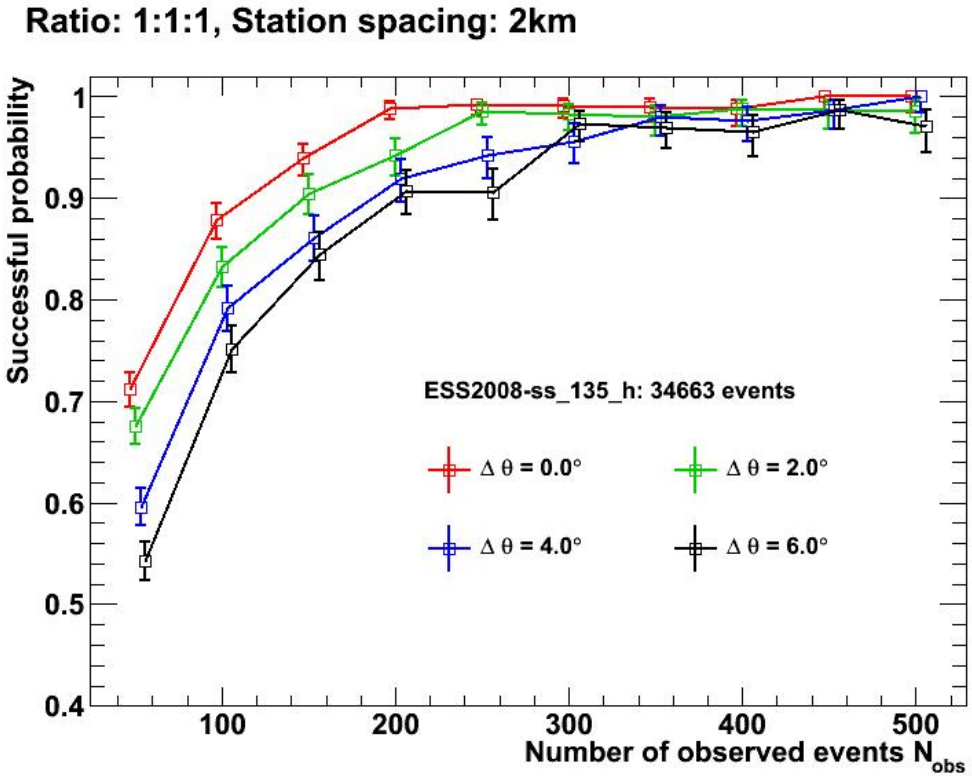
$E_\nu > 10^{16}$ eV

ν_e may be separated from other flavors by LPM effect

TABLE II: Expected numbers of events N_ν from several UHE neutrino models, comparing published values from the 2008 ANITA-II flight with predicted events for a three-year exposure for ARA-37.

Model & references N_ν:	ANITA-II, (2008 flight)	ARA, 3 years
Baseline cosmogenic models:		
Protheroe & Johnson 1996 [27]	0.6	59
Engel, Seckel, Stanev 2001 [28]	0.33	47
Kotera, Allard, & Olinto 2010 [29]	0.5	59
Strong source evolution models:		
Engel, Seckel, Stanev 2001 [28]	1.0	148
Kalashev *et al.* 2002 [30]	5.8	146
Barger, Huber, & Marfatia 2006 [32]	3.5	154
Yuksel & Kistler 2007 [33]	1.7	221
Mixed-Iron-Composition:		
Ave *et al.* 2005 [34]	0.01	6.6
Stanev 2008 [35]	0.0002	1.5
Kotera, Allard, & Olinto 2010 [29] upper	0.08	11.3
Kotera, Allard, & Olinto 2010 [29] lower	0.005	4.1
Models constrained by Fermi cascade bound:		
Ahlers *et al.* 2010 [36]	0.09	20.7
Waxman-Bahcall (WB) fluxes:		
WB 1999, evolved sources [37]	1.5	76
WB 1999, standard [37]	0.5	27

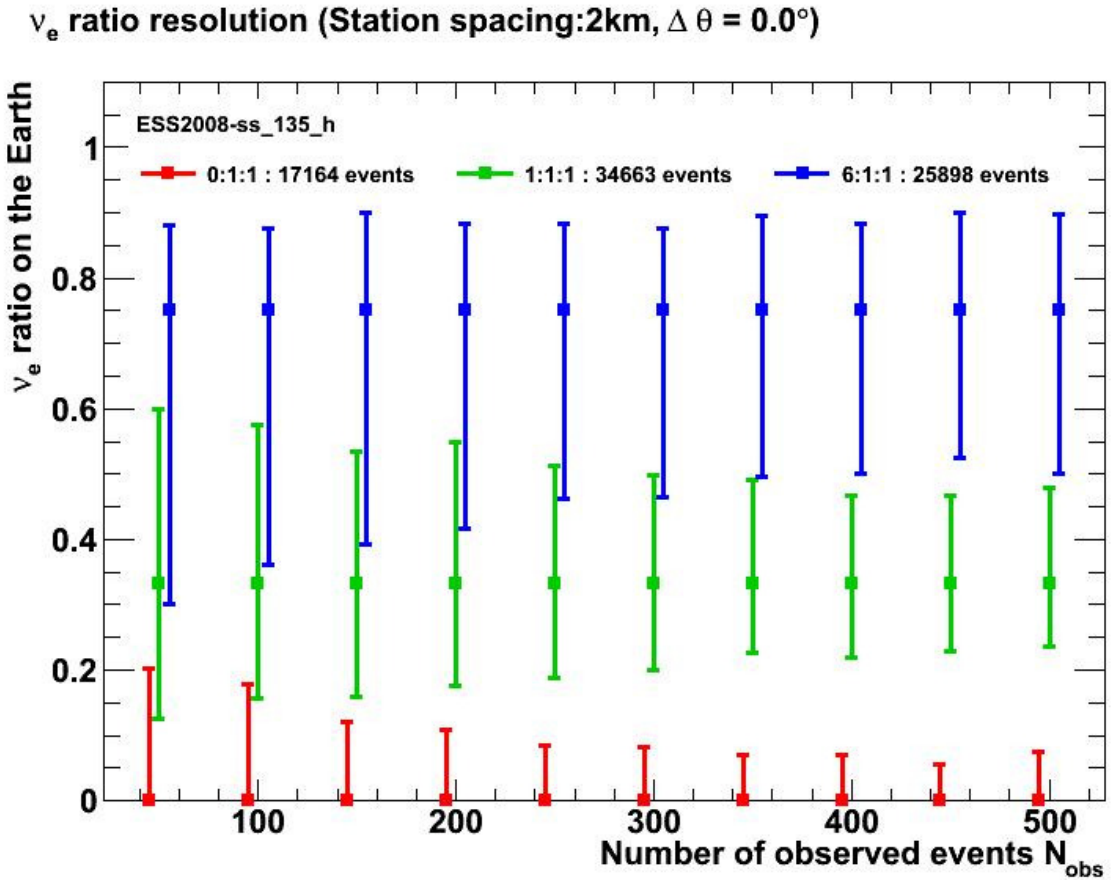
The probability of successful flavor ratio reconstruction



The probability of successful flavor ratio reconstruction as a function of the number of observed events N_{obs}, assuming initial ratios of $1/3 : 1/3 : 1/3$, where N_{obs} ranges from 50 to 500 with interval of 50. Results for different angular resolution of detector are plotted: $\triangle\theta = 0^o$(red),$\triangle\theta = 2^o$(green), $\triangle\theta = 4^o$(blue), $\triangle\theta = 6^o$(black).[5]

[6] poster section of LeCosPA, Shi-Hao Wang, Pisin Chen, Melin Huang,and Jiwoo Nam

The resolution of ν_e ratio on the Earth



The resolution of ν_e ratio on the Earth.[5]

[6] *poster section of LeCosPA, Shi-Hao Wang, Pisin Chen, Melin Huang,and Jiwoo Nam*

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Chun-Yun Ke