HE solar atmospheric neutrinos from the sun

GRAPPA seminar, Monday 14 October, 11am, Kenny Ng (GRAPPA)

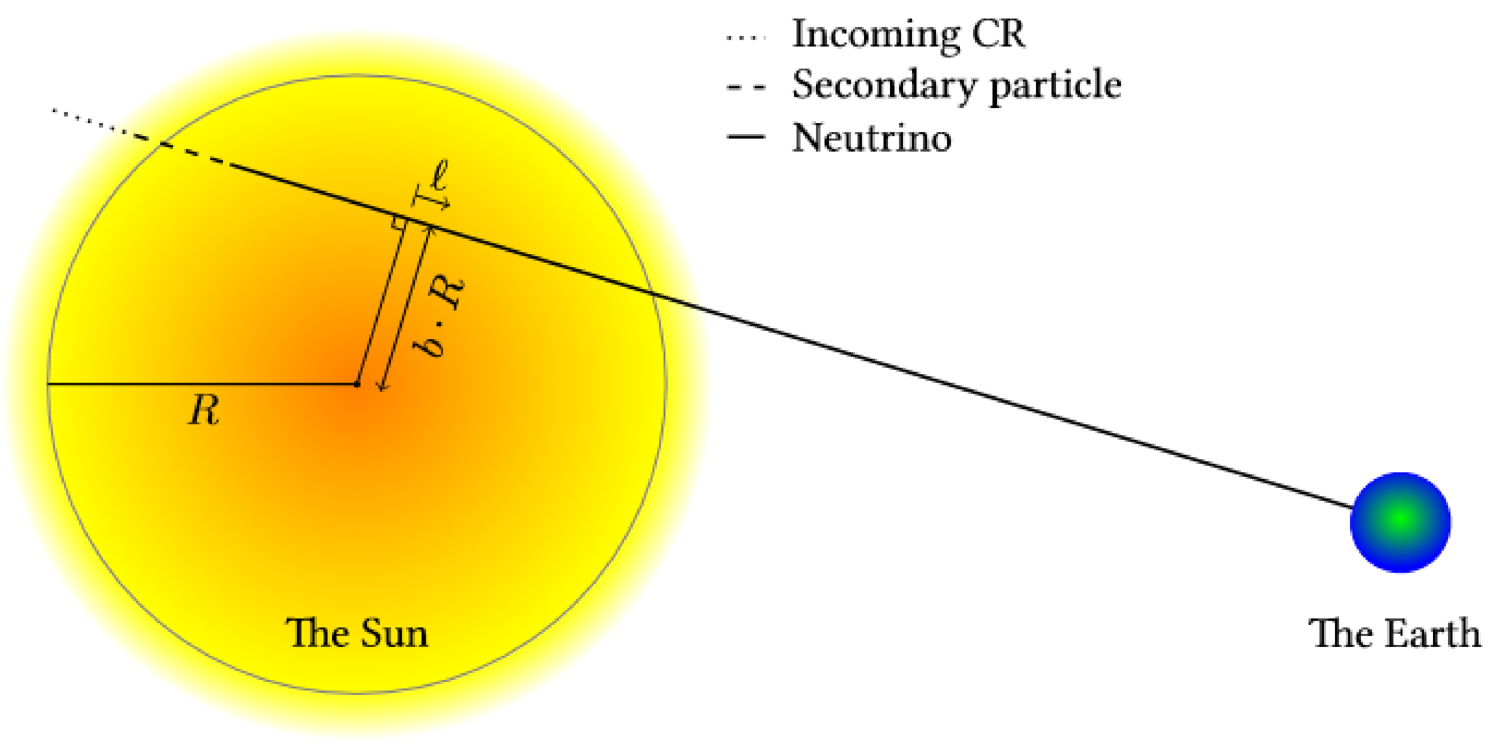

Figure 1. A schematic geometry showing how the particles travel through the Sun. Incoming CRs interact with the Sun creating secondary particles which decay into/interact creating neutrinos.

ArxiV: 1704.02892

ArxiV: 1703.10280

Dear all,

I'm very happy to announce that our recent new postdoc arrival Kenny Ng agreed to give on very short notice the GRAPPA seminar on Monday. He replaces Anna Watts, who will give her talk later this year.

Title: High-energy?Gamma?Rays?and Neutrinos from the?Sun

Abstract: I will discuss recent results on?gamma-ray?observations of the?Sun?with Fermi, which revealed many interesting and surprising features. These?gamma?rays?are expected to be produced by hadronic interactions between cosmic?rays?and the solar atmosphere. The high flux of?gamma?rays?observed from the?Sun?requires a large boost of?gamma-ray?production by some mechanism, which is likely related to solar magnetic fields. Our new results include the first resolved image of the?Sun?and a mysterious dip in the spectrum between 30-50 GeV. In particular, we also find that the solar?gamma-ray?spectrum during solar minimum is hard (~E?2.1) and reaches at least 200 GeV. This suggests that ground based experiments like HAWC and LHAASO will be important for probing the?Sun?at TeV regime. Understanding solar?gamma?rays?is crucial for predicting the solar atmospheric neutrino flux, which can potentially be detected by IceCube/KM3NeT, and is important for many aspects of solar dark matter searches.

Details: Monday 14 October, 11 am, C4.174

Best wishes,
Christoph

EVIEW D **96,** 103006 (2017)

ew neutrino floor for dark matter searches

,[2,3,4,†] Annika H. G. Peter,[2,3,4,‡] and Carsten Rott[5,§]
ysics, Weizmann Institute of Science, Rehovot 76100, Israel
Particle Physics (CCAPP), Ohio State University,
us, Ohio 43210, USA
State University, Columbus, Ohio 43210, USA
State University, Columbus, Ohio 43210, USA
yunkwan University, Suwon 440-746, Korea
17; published 13 November 2017)

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PHYSICAL REVIEW D **96,** 103006 (2017)

Solar atmospheric neutrinos: A new neutrino floor for dark matter searches

Kenny C. Y. Ng,[1,2,3,*] John F. Beacom,[2,3,4,†] Annika H. G. Peter,[2,3,4,‡] and Carsten Rott[5,§]

[1]*Department of Particle Physics and Astrophysics, Weizmann Institute of Science, Rehovot 76100, Israel*
[2]*Center for Cosmology and AstroParticle Physics (CCAPP), Ohio State University, Columbus, Ohio 43210, USA*
[3]*Department of Physics, Ohio State University, Columbus, Ohio 43210, USA*
[4]*Department of Astronomy, Ohio State University, Columbus, Ohio 43210, USA*
[5]*Department of Physics, Sungkyunkwan University, Suwon 440-746, Korea*

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As is well known, dark matter direct detection experiments will ultimately be limited by a "neutrino floor," due to the scattering of nuclei by MeV neutrinos from, e.g., nuclear fusion in the Sun. Here we point out the existence of a new neutrino floor that will similarly limit indirect detection with the Sun, due to high-energy neutrinos from cosmic-ray interactions with the solar atmosphere. We have two key findings. First, solar atmospheric neutrinos $\lesssim 1$ TeV cause a sensitivity floor for standard weakly interacting massive particles (WIMP) scenarios, for which higher-energy neutrinos are absorbed in the Sun. This floor will be reached once the present sensitivity is improved by just 1 order of magnitude. Second, for neutrinos $\gtrsim 1$ TeV, which can be isolated by muon energy loss rate, solar atmospheric neutrinos should soon be detectable in IceCube. Discovery will help probe the complicated effects of solar magnetic fields on cosmic rays. These events will be backgrounds to WIMP scenarios with long-lived mediators, for which higher-energy neutrinos can escape from the Sun.

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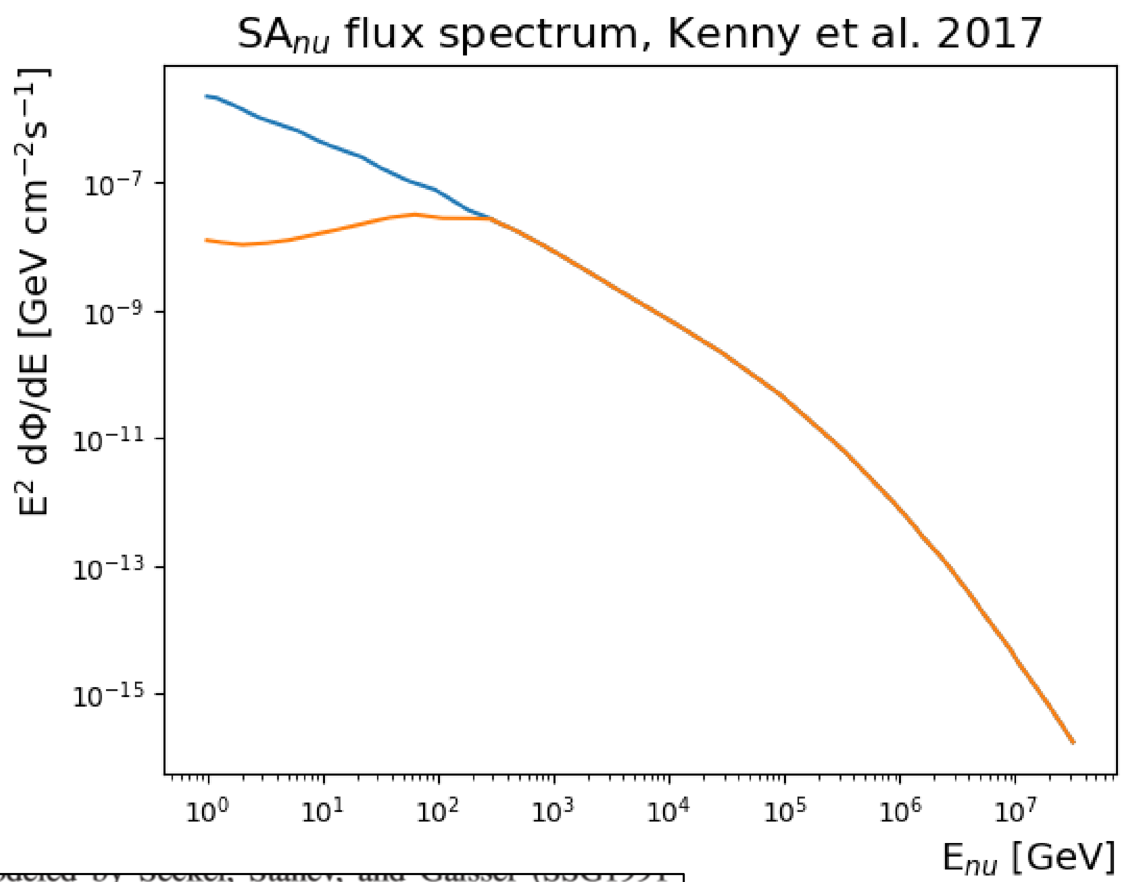


[32]). In their *Nominal* model, the rate of cosmic rays interacting with the solar atmosphere is reduced due to reflection by the magnetic flux tubes in the solar surface. This leads to a strong suppression of the neutrino flux at low energies. In their *Naive* model, where magnetic effects are ignored, the SAν intensity is indeed comparable to the EAν intensity near ~1 GeV. At sufficiently high energies, magnetic effects should diminish. In the SSG1991 models, this

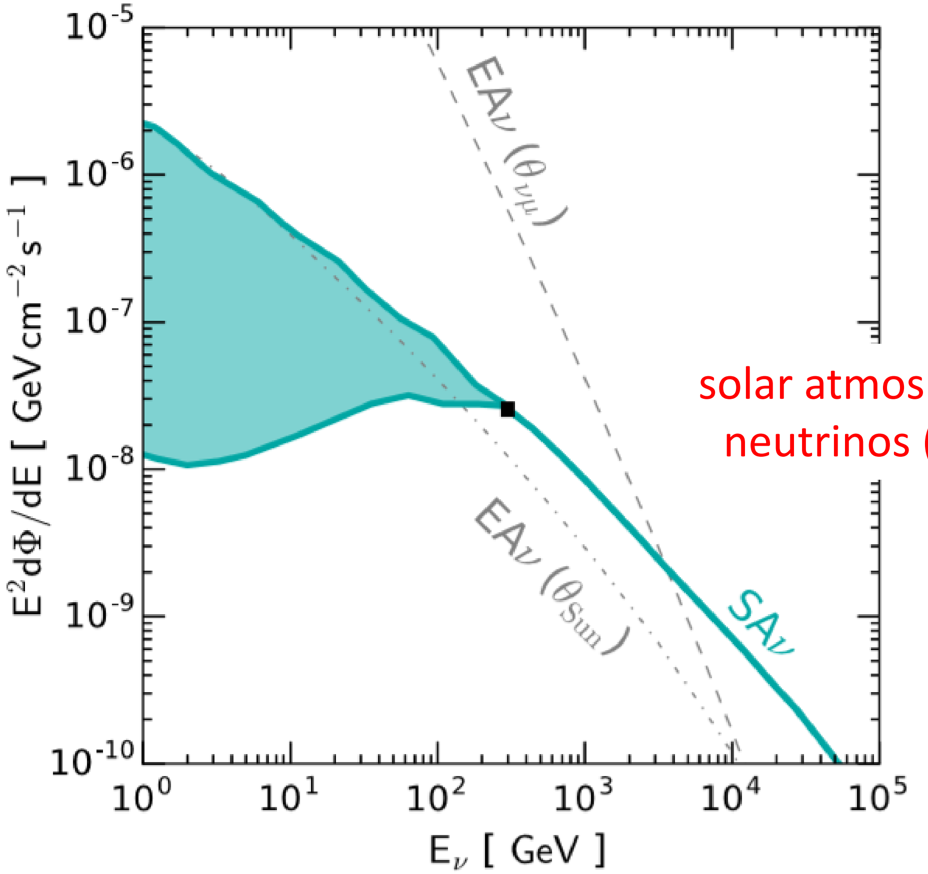
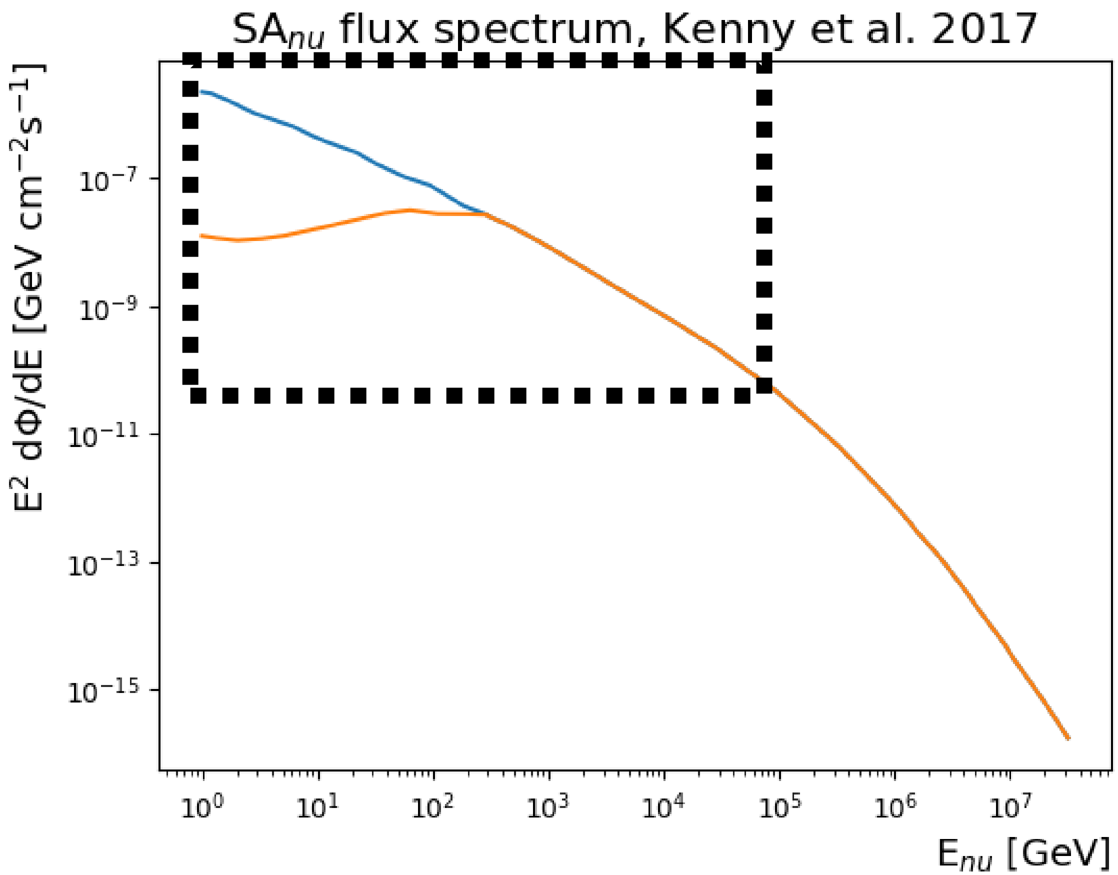
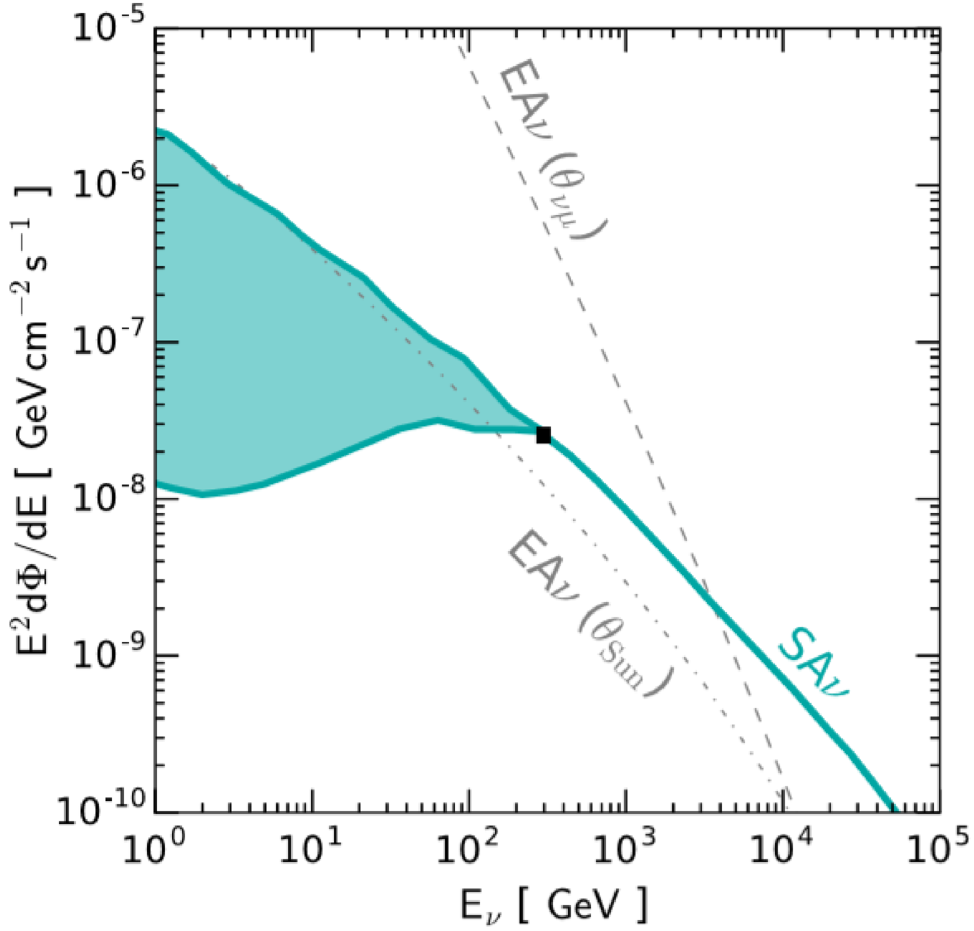


FIG. 1. The SAν flux spectrum. Below 300 GeV, we use the SSG1991 models [32] (upper: *Naive*; lower: *Nominal*); above 300 GeV, we use the IT1996 model [34]. All are shown within the angular cone of the Sun (θ_{Sun}). We also show the EAν flux spectrum within θ_{Sun} and within the neutrino-muon separation angle ($\theta_{\nu\mu}$).

solar atmospheric neutrinos (SAν)





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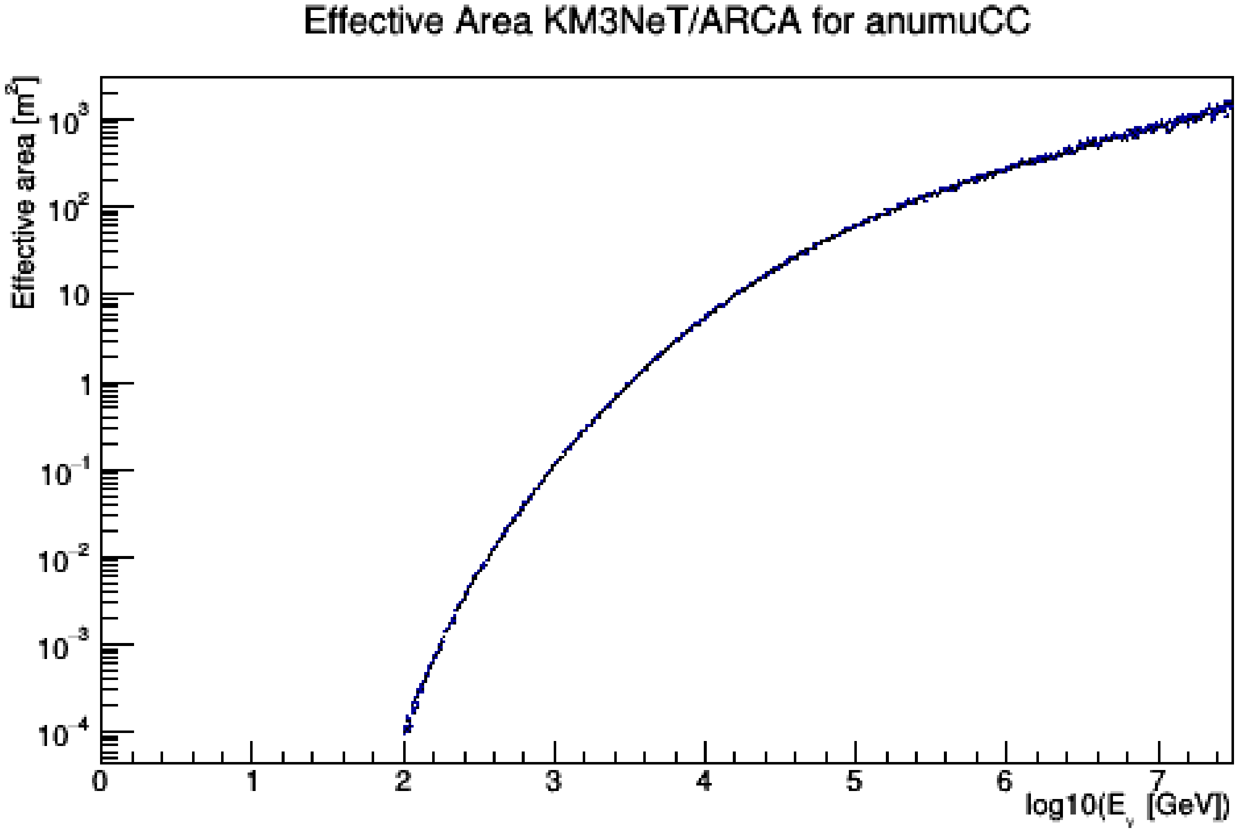
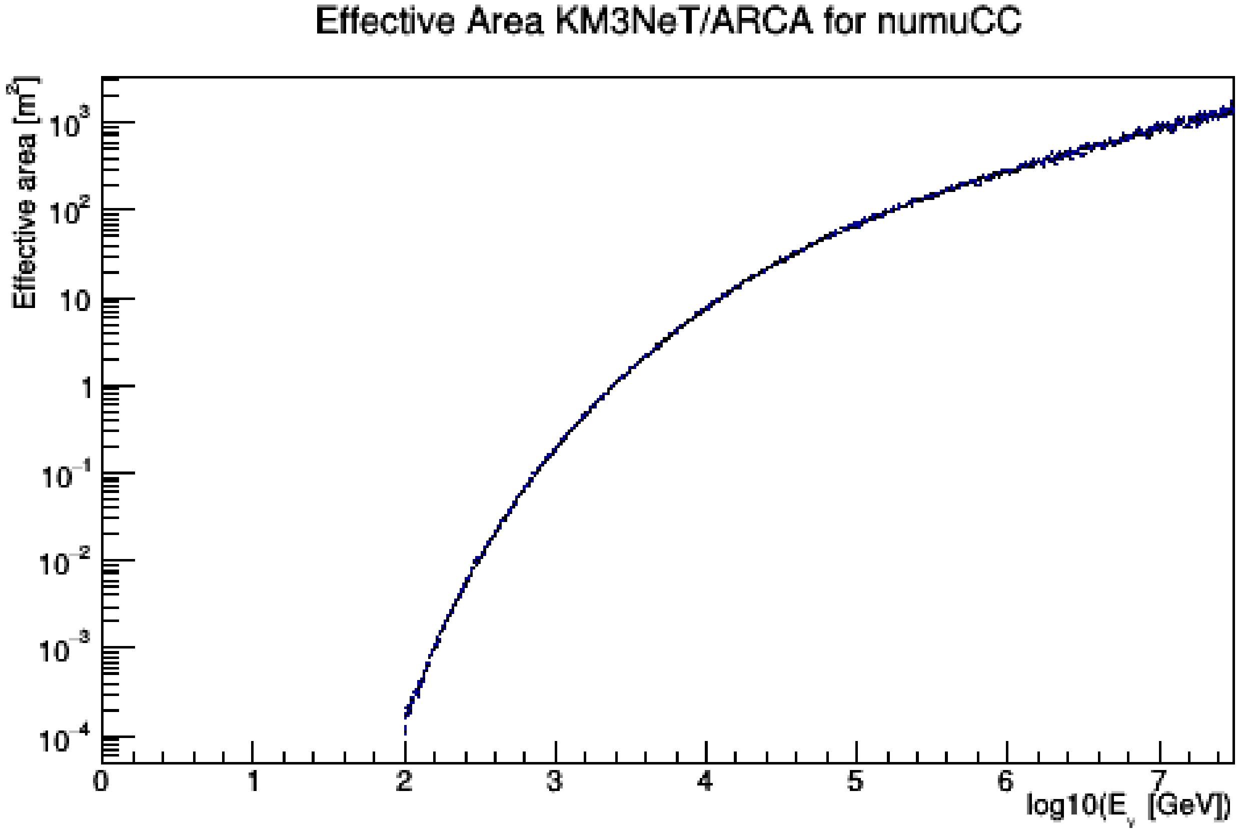
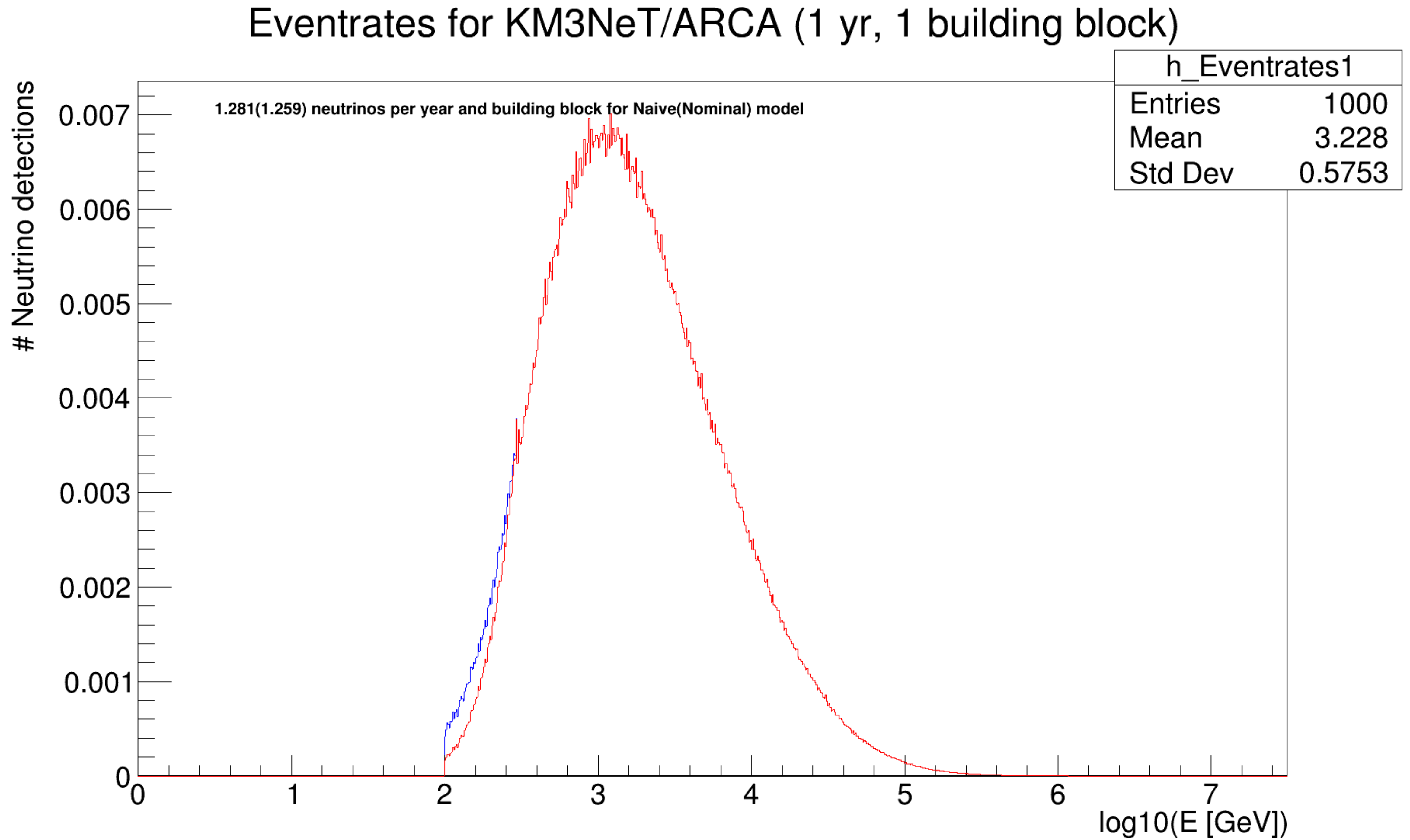
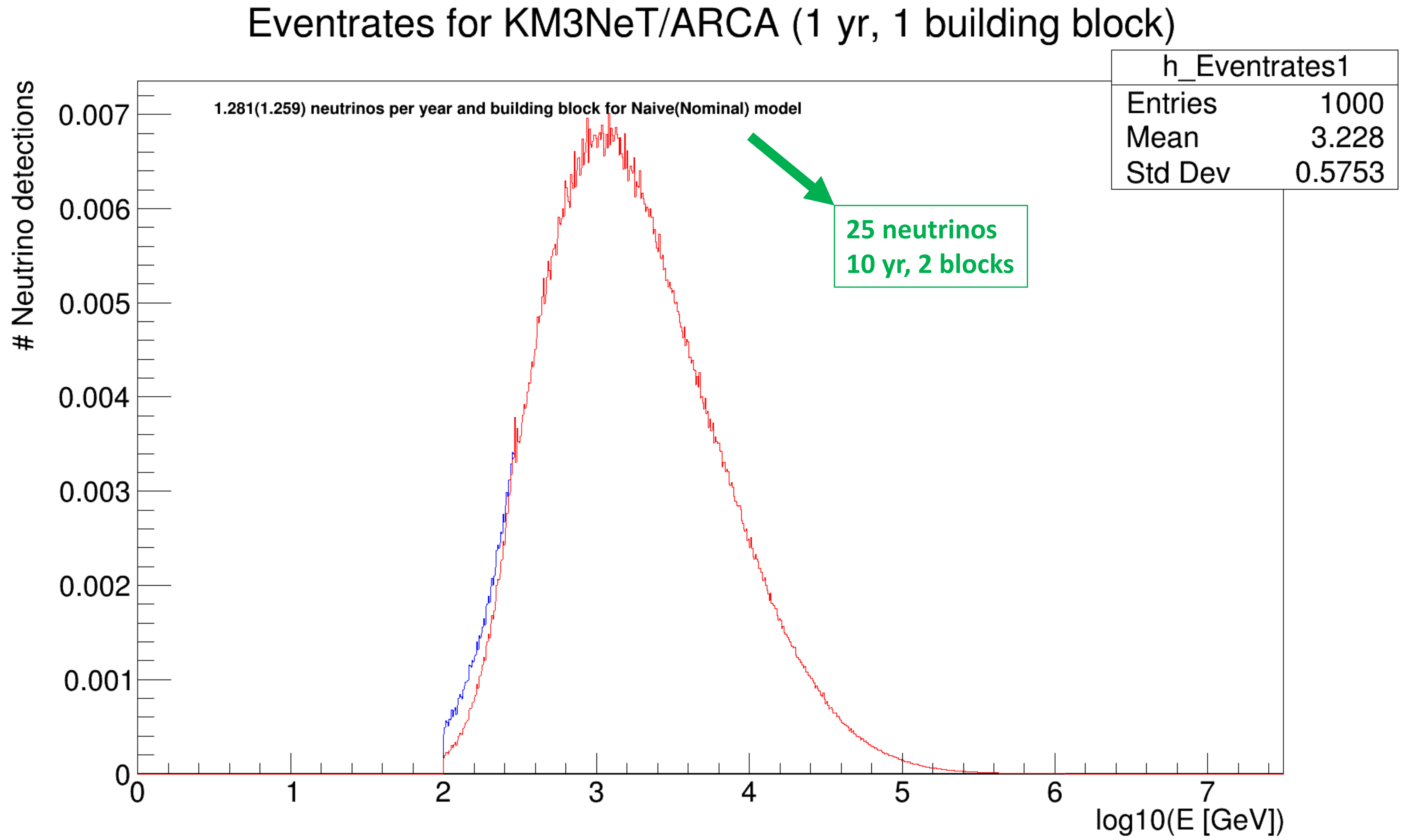
1 yr
4pi
1 building block

Effective area's (a)numu CC






Eventrates for KM3NeT/ARCA (1 yr, 1 building block)
h_Eventrates1
Entries 1000
Mean 3.228
Std Dev 0.5753
1.281(1.259) neutrinos per year and building block for Naive(Nominal) model
# Neutrino detections
log10(E [GeV])
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
0
1
2
3
4
5
6
7

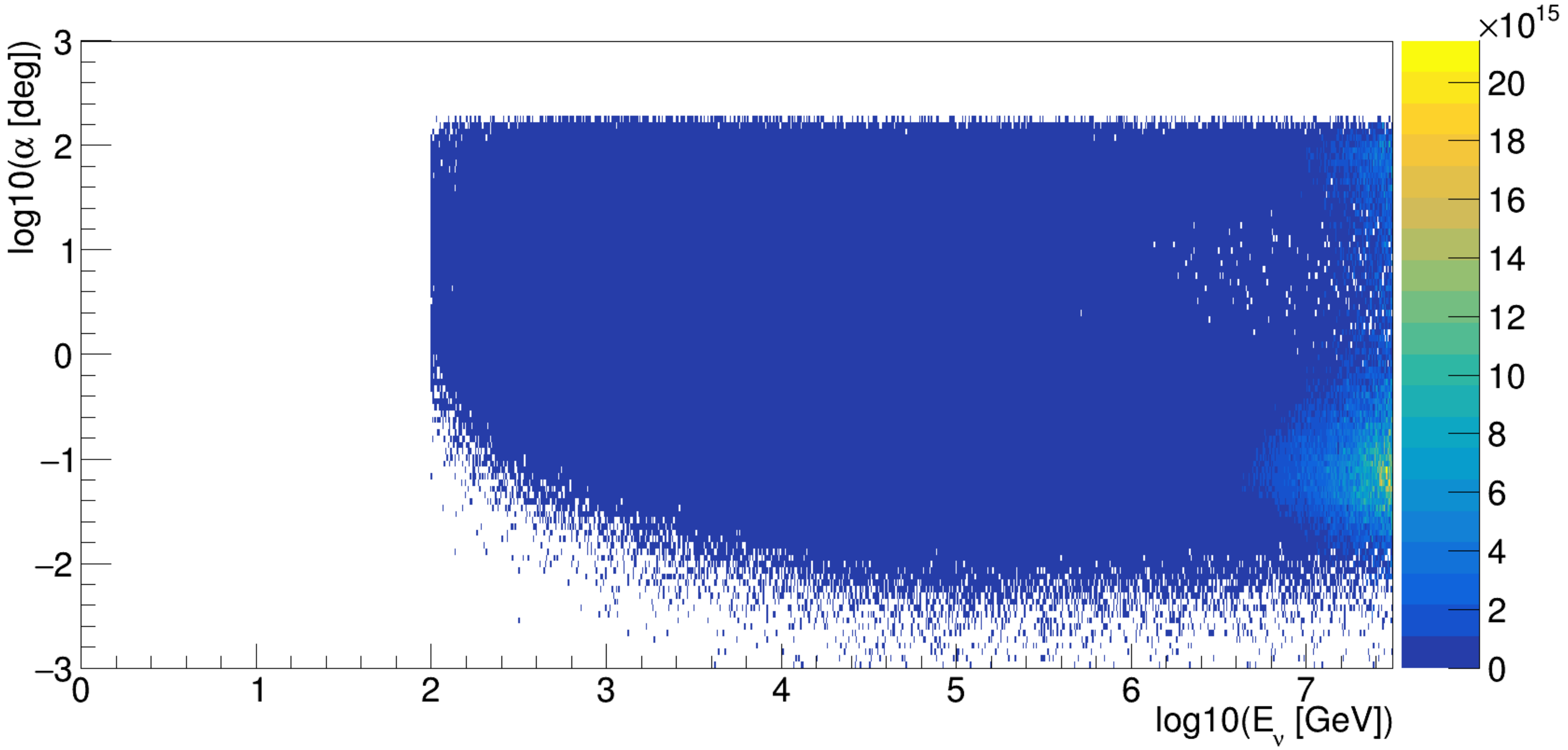


Eventrates for KM3NeT/ARCA (1 yr, 1 building block)
h_Eventrates1
Entries 1000
Mean 3.228
Std Dev 0.5753
1.281(1.259) neutrinos per year and building block for Naive(Nominal) model
25 neutrinos
10 yr, 2 blocks
Neutrino detections
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
0
1
2
3
4
5
6
7
log10(E [GeV])

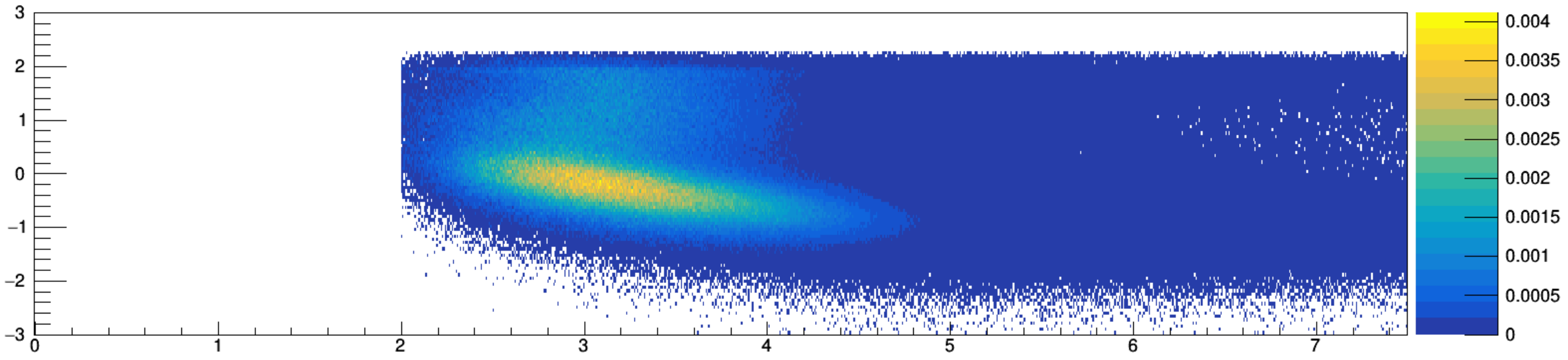
Angular resulution, no flux

1 yr
4pi
1 building block

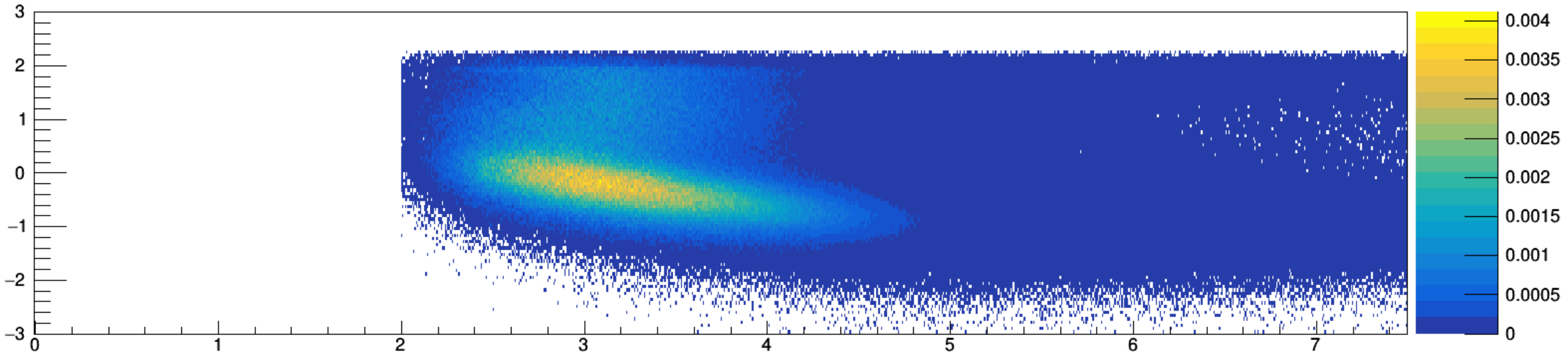
best_reco_track



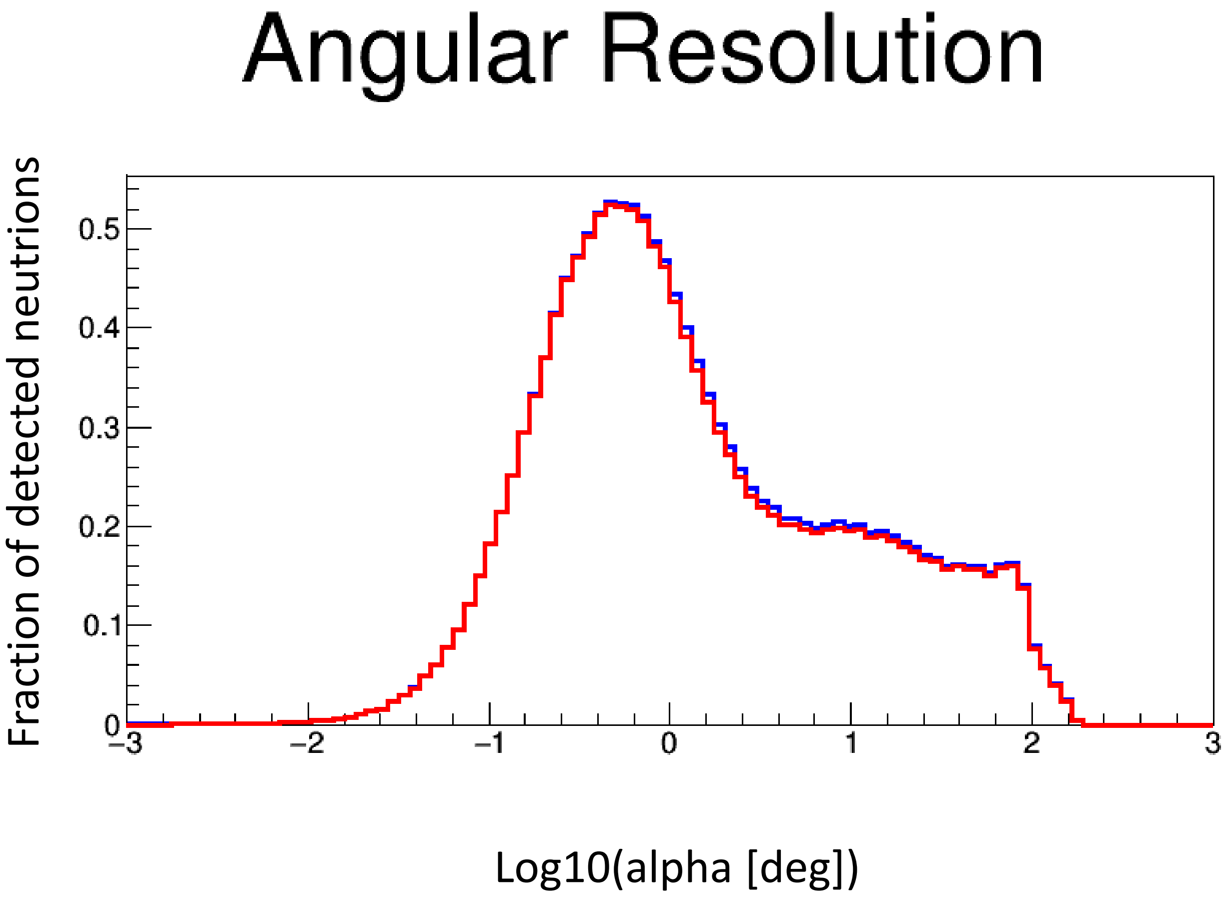
Angular Resolution for HE ATM solar neutrinos (naive)



Angular Resolution for HE ATM solar neutrinos (nominal)



Ratio



Ratio, cumulatieve