

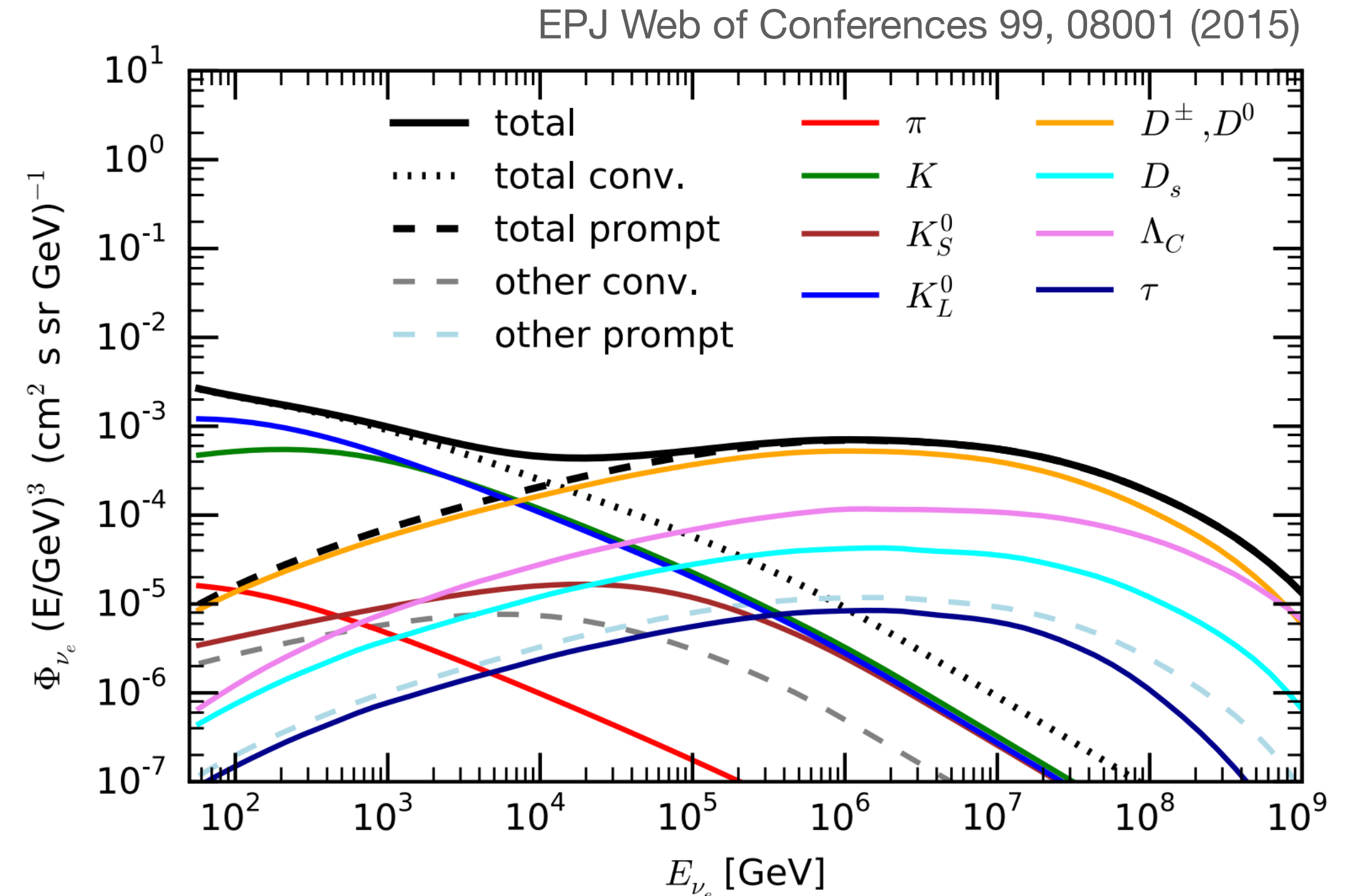
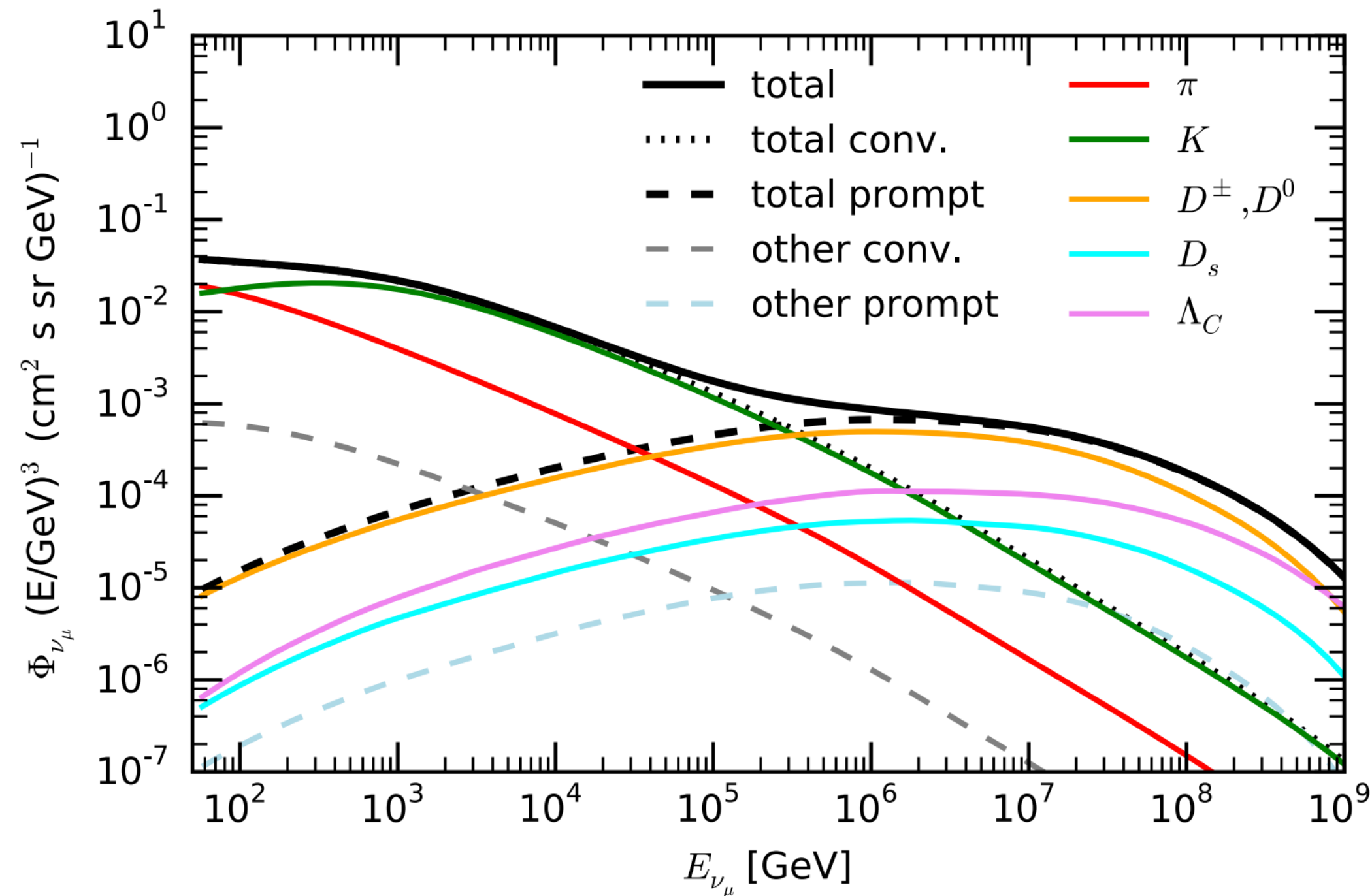
Potential to detect atmospheric prompt neutrinos with TRIDENT



Yue Feng, Weilun Huang, on behalf of TRIDENT collaboration, 2026.8.31

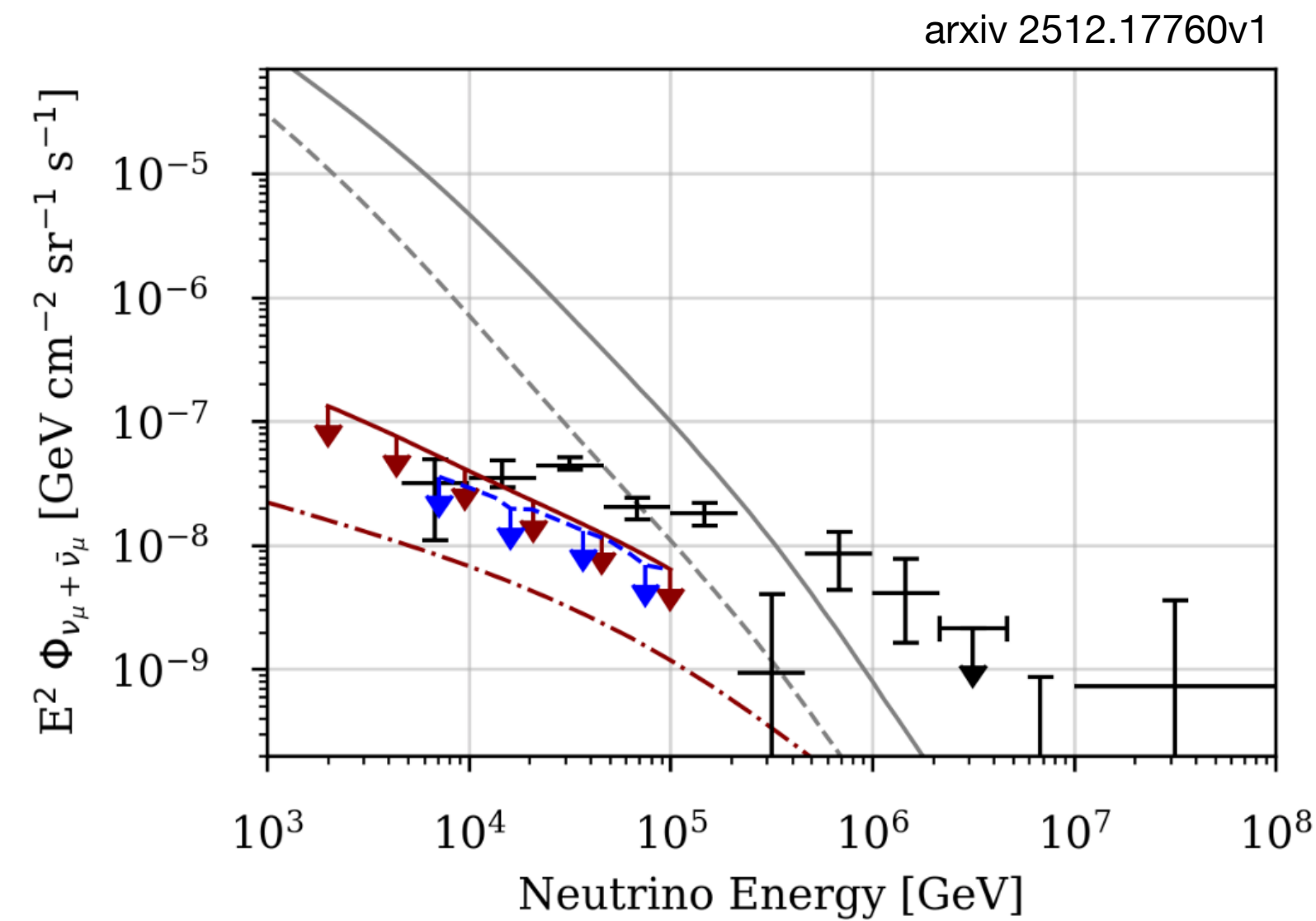
Tsung-Dao Lee Institute
Shanghai Jiao Tong University

Atmospheric prompt neutrino

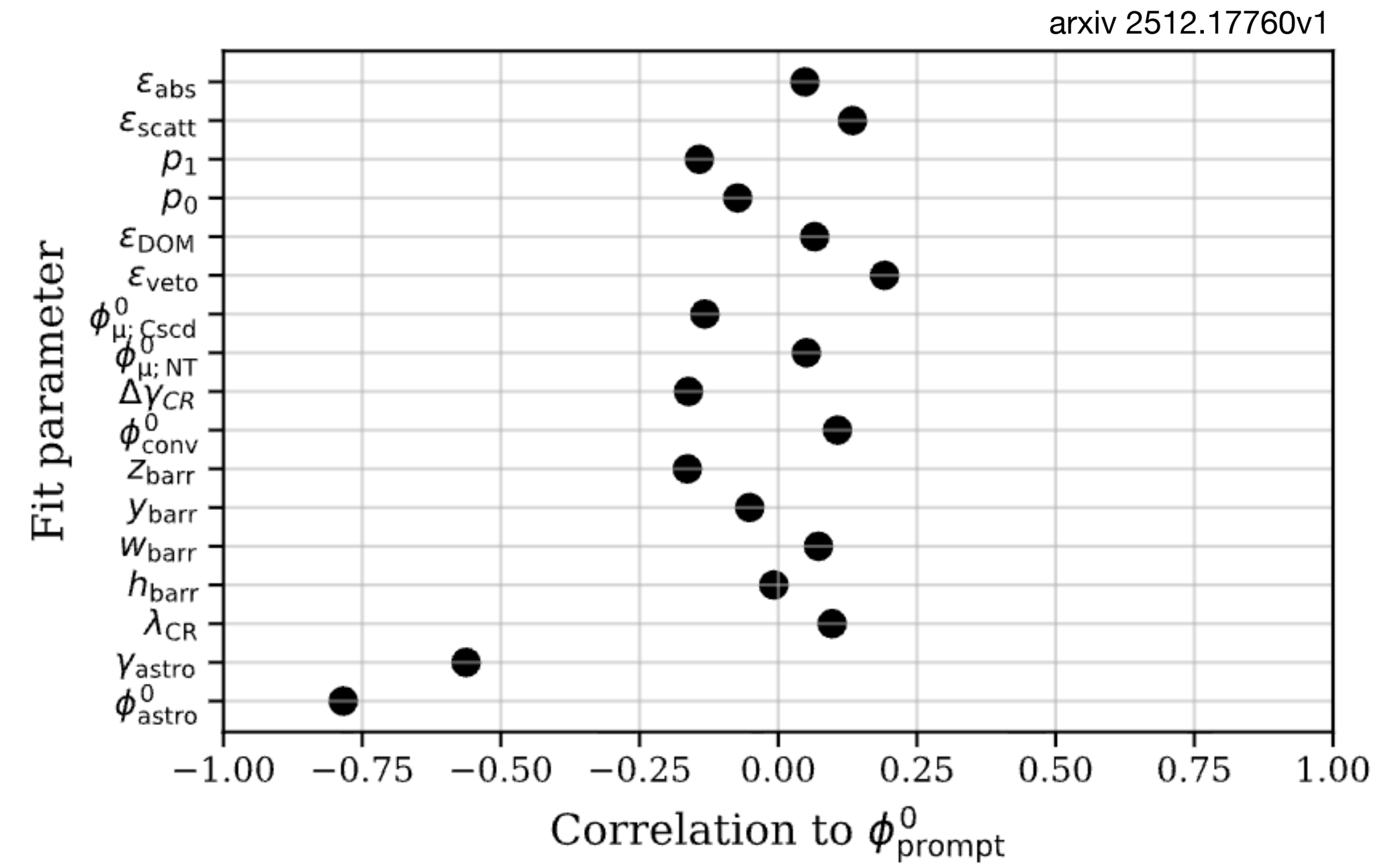


- Atmospheric prompt neutrinos have harder spectrum compare with conventional atmospheric neutrinos
- They are major backgrounds of astrophysical neutrinos, and vice versa.
- Measuring prompt neutrinos can give unique information of forward region of charm physics. That region is inaccessible in colliders.

Atmospheric prompt neutrino

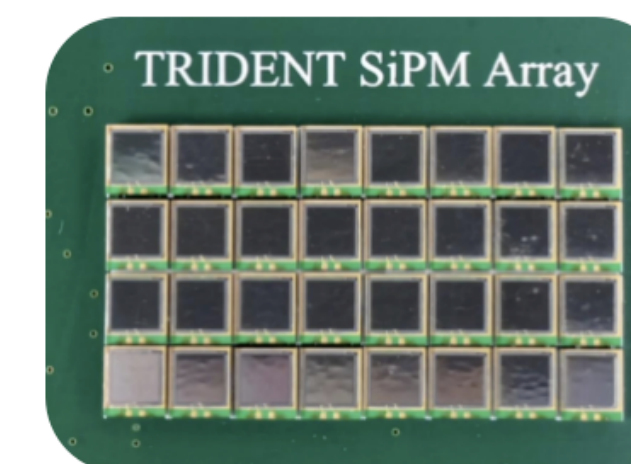
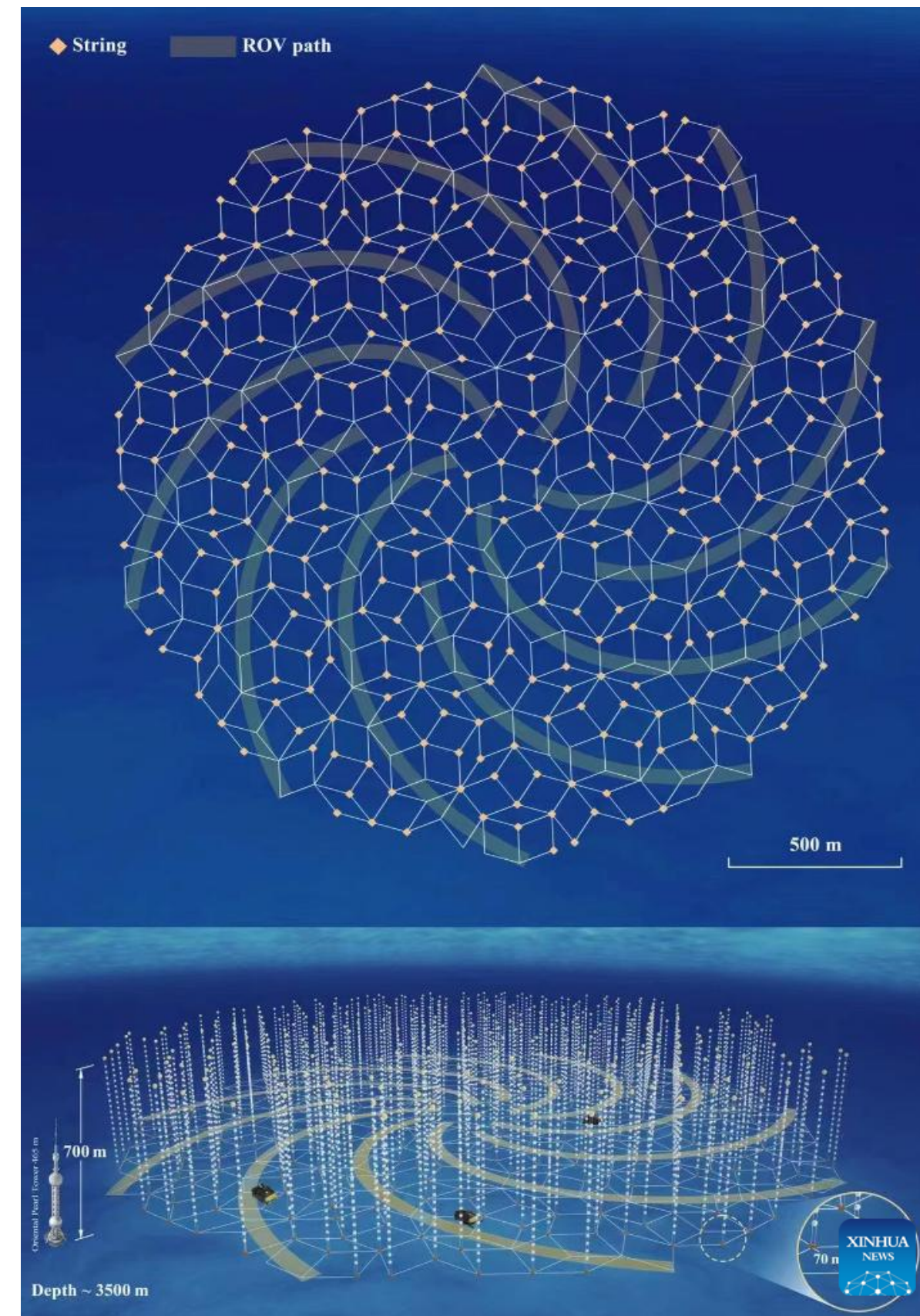
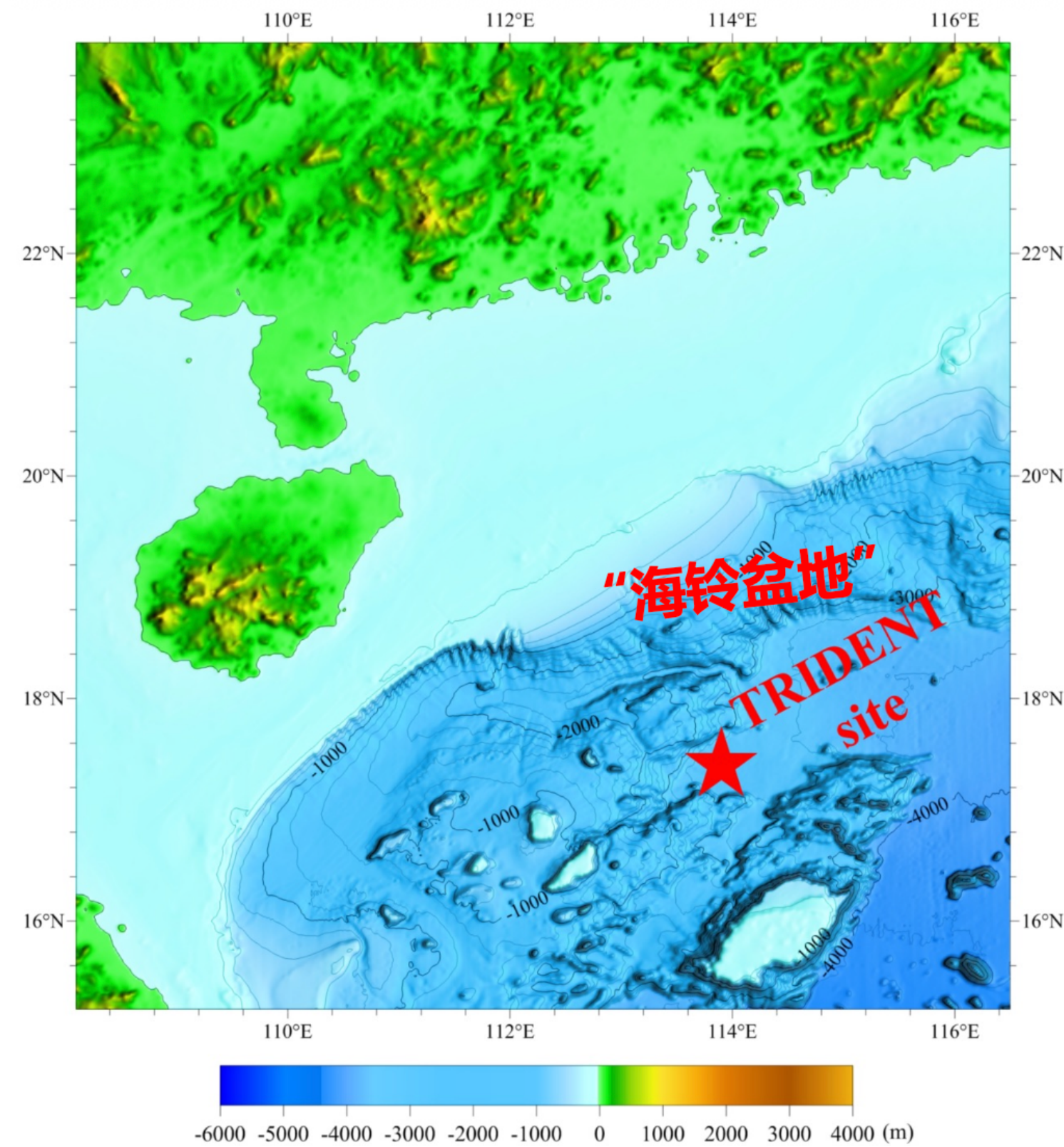


Conv. Atmospheric:
 - - - $\theta = 180^\circ$
 — $\theta = 90^\circ$
Astrophysical:
 + Segmented Fit (this work)
Prompt:
 —+— 90% CL this work
 - · - · - Best-fit S2.3c (0.65σ)
 - + - 90% CL 6y NT



- IceCube results show strong correlation between astrophysical neutrinos and prompt neutrinos.
- This requires isolation of prompt neutrinos from astrophysical neutrinos.
- Isolation is possible by requiring an accompanying muon with the neutrino, an "Inverse self-veto".

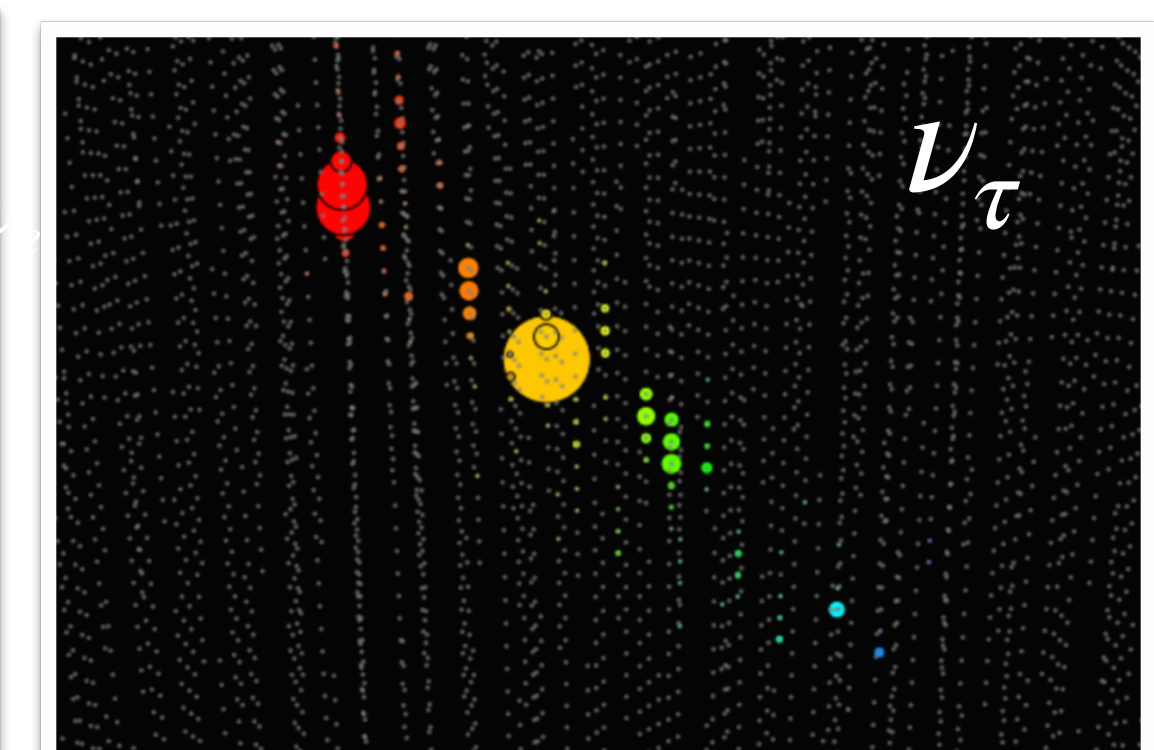
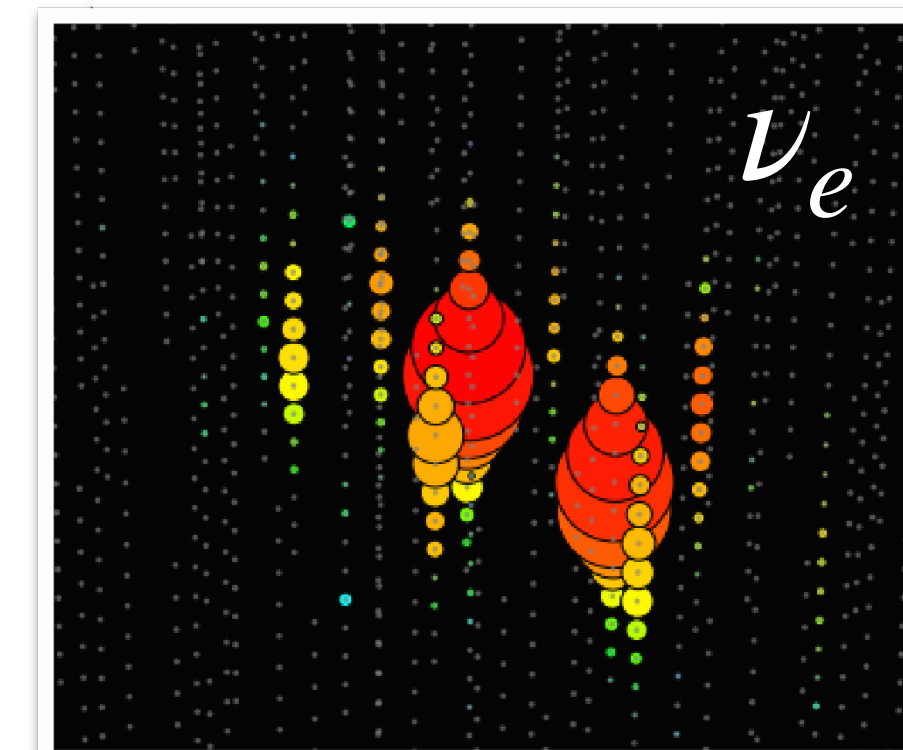
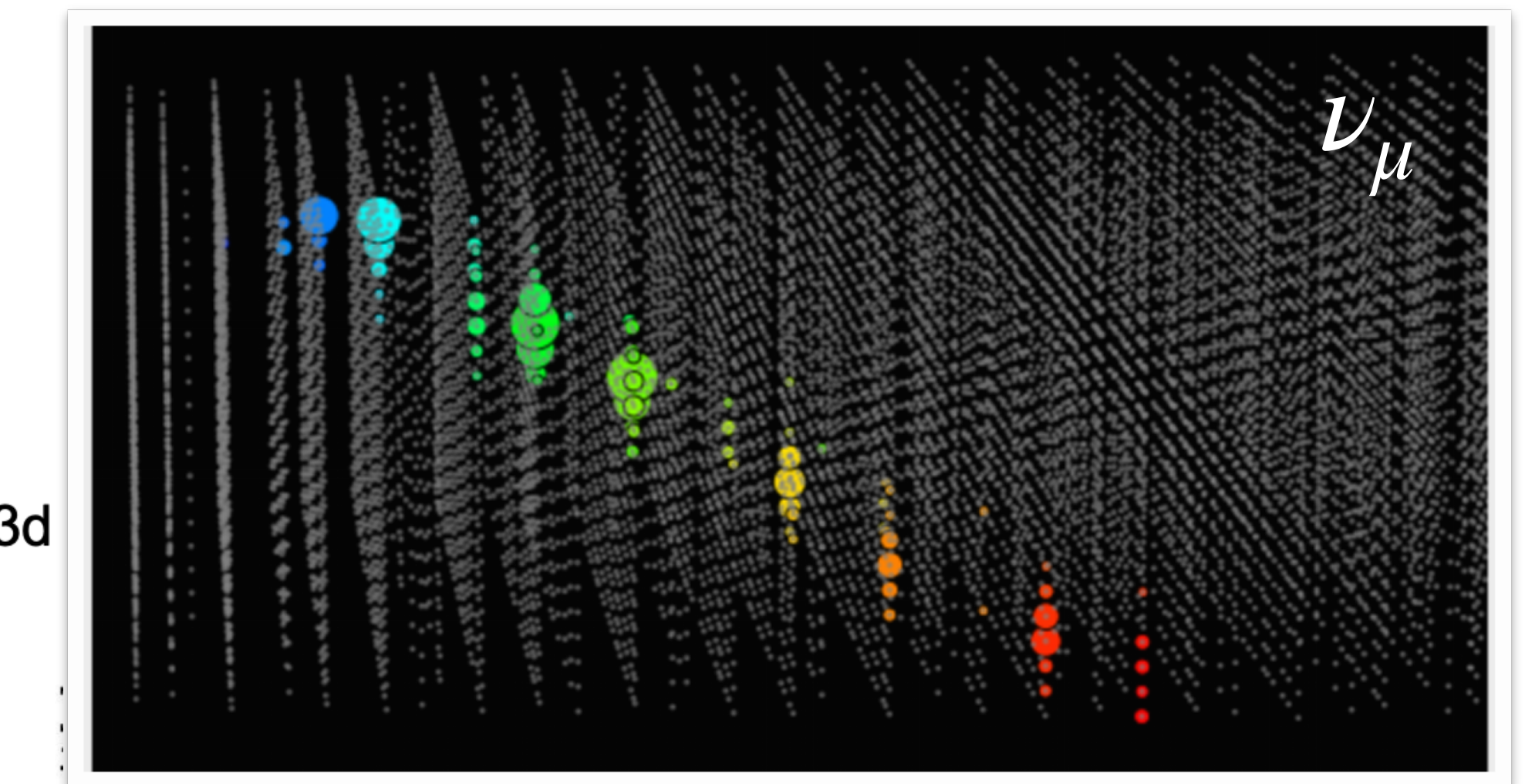
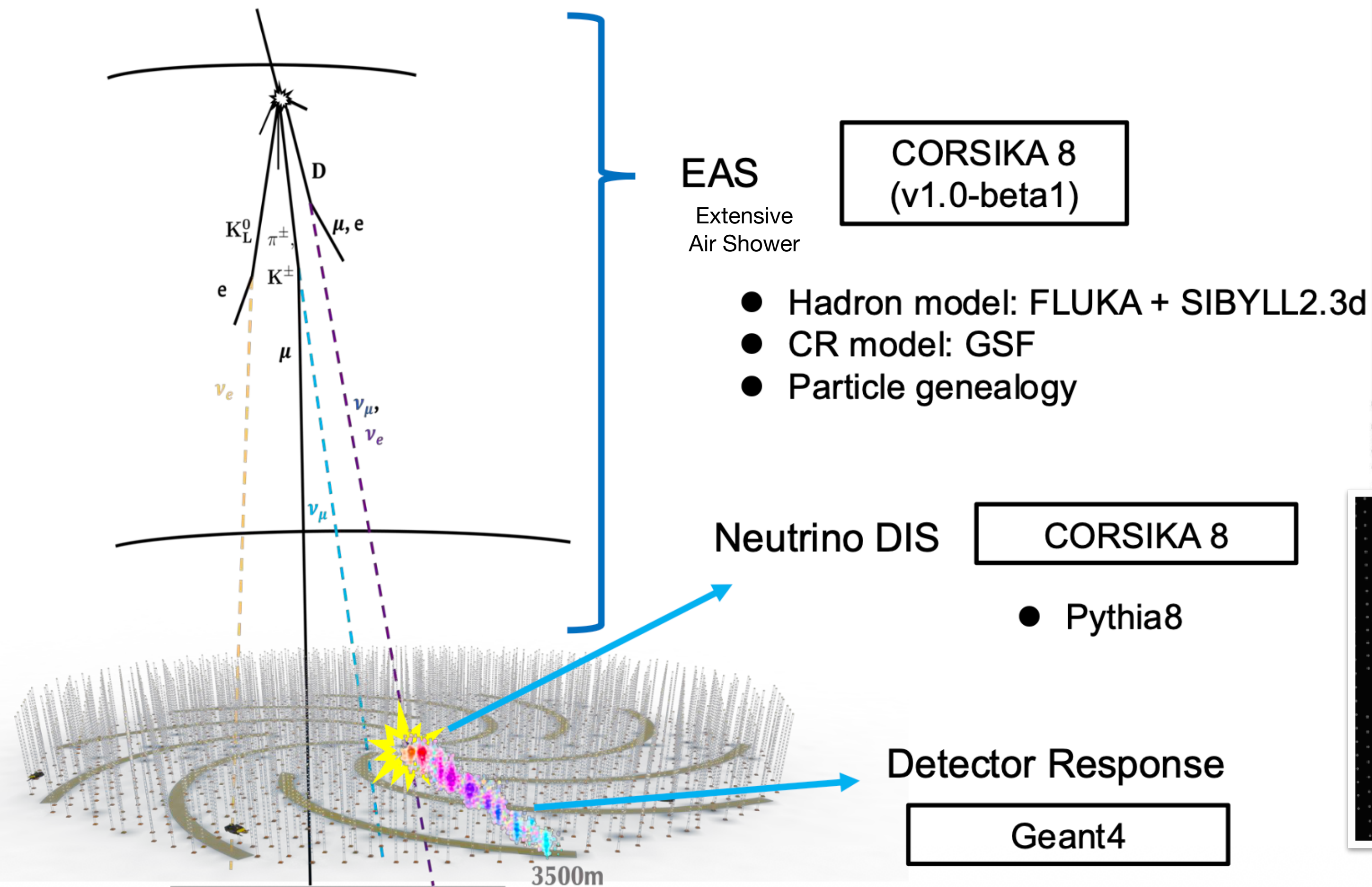
Detect prompt neutrino - TRIDENT



- 3.5km deep, $\sim 8\text{km}^3$ volume, ~ 1000 strings upcoming neutrino telescope in the South China Sea.
- Irregular 70-110m spacing in a Penrose tiling pattern, 700m length per string, each string has 20 hDOMs with both PMT and SiPM arrays.

TRIDENT simulation

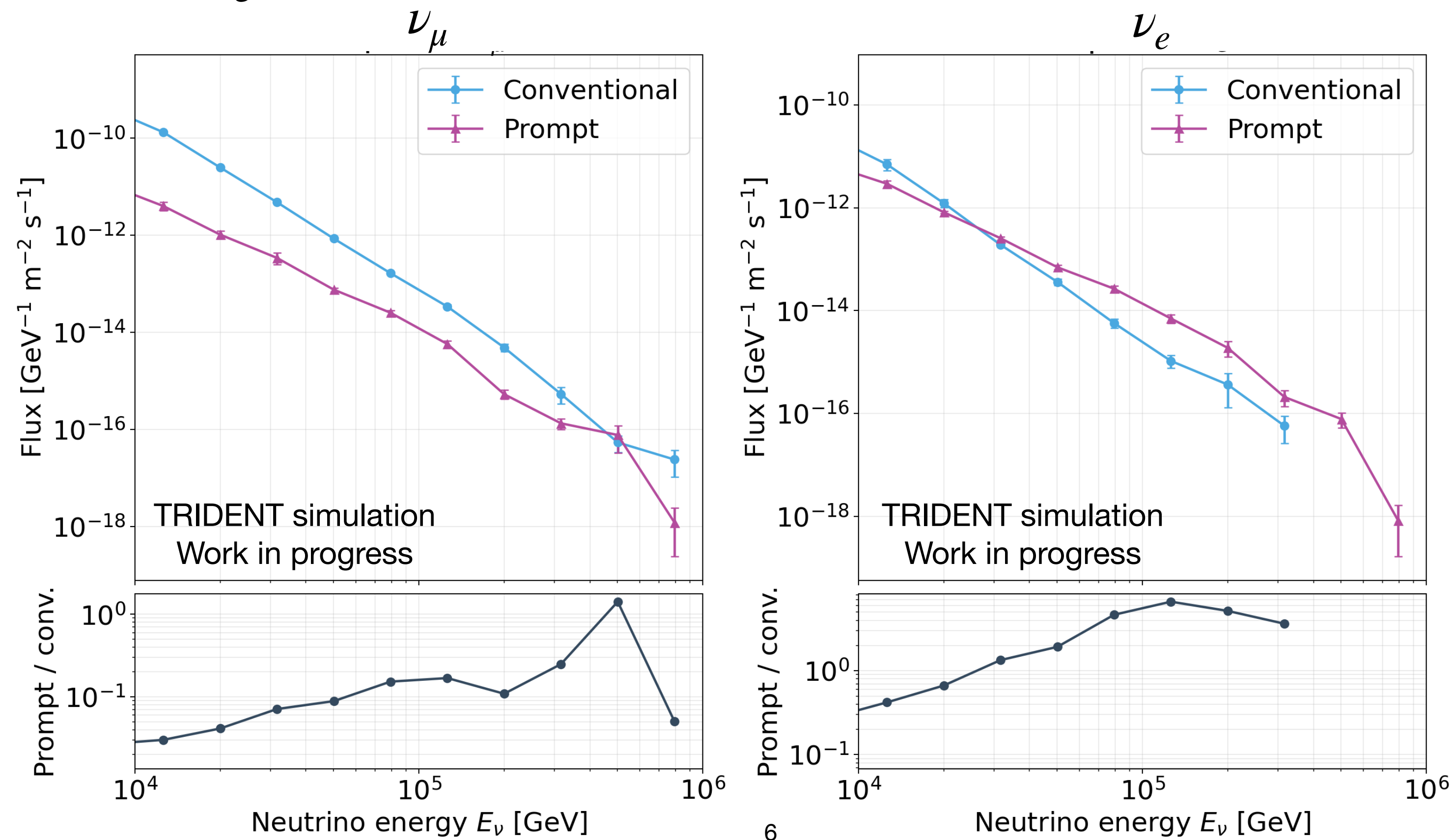
TRIDENT simulation



CORSIKA 8, arxiv:2308.05475
 Global Spline Fit cosmic-ray model, arxiv:1711.11432
 FLUKA, Frontiers in Physics 9, 788253 (2022)
 SIBYLL2.3d, arxiv:1912.03300
 PYthia 8, arXiv:2203.11601

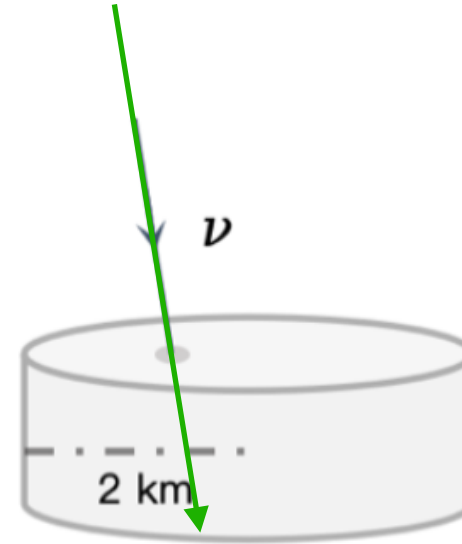
Prompt neutrino flux at TRIDENT

- Prompt and conventional neutrino fluxes are comparable around 500 TeV for ν_μ and 20 TeV for ν_e .

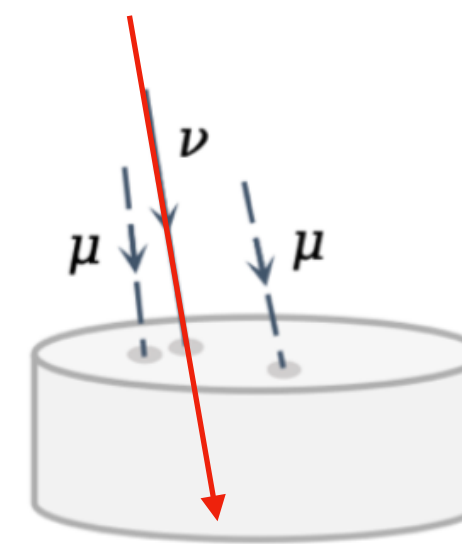


Self-veto efficiency

Self-veto events
No accompany muons

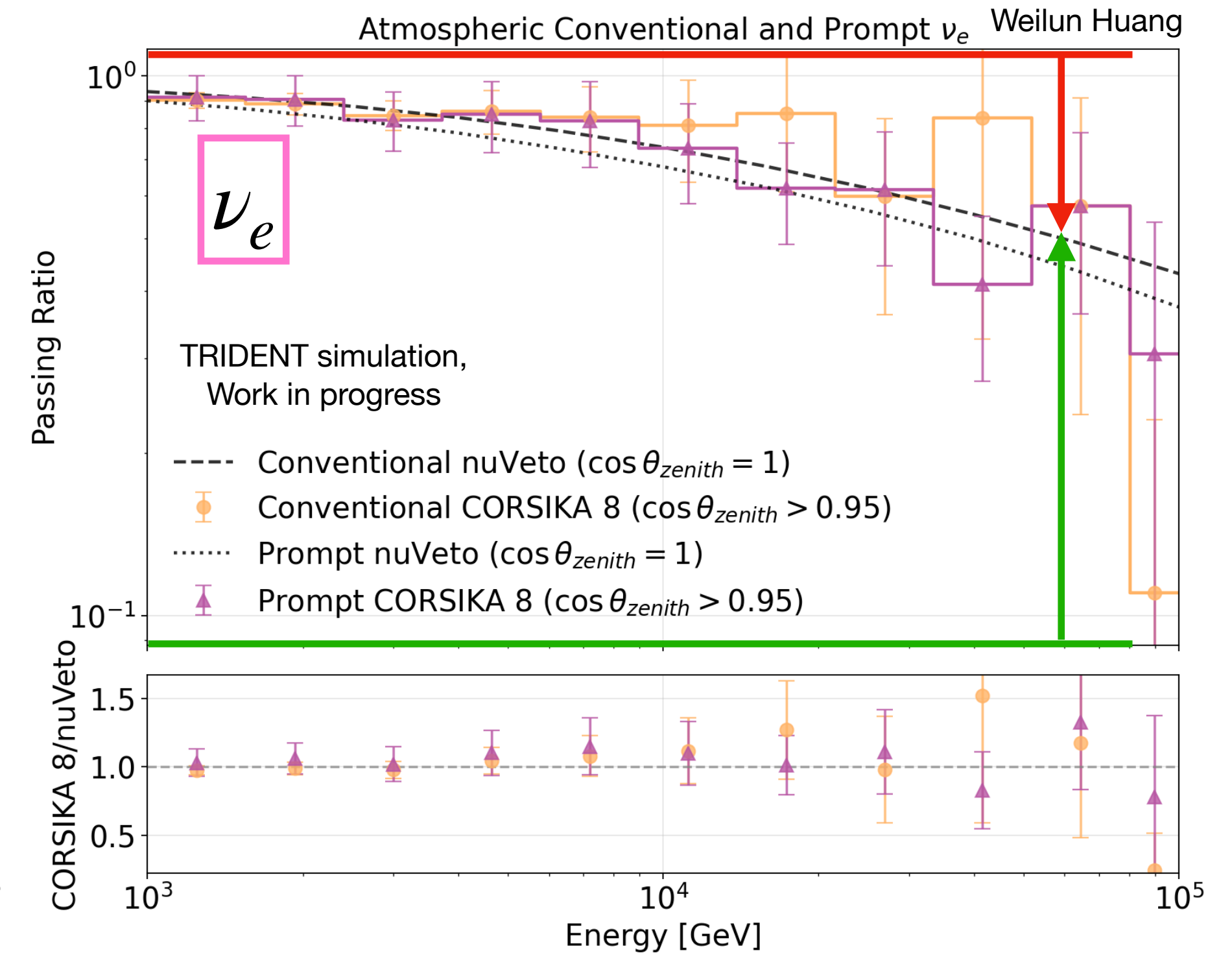
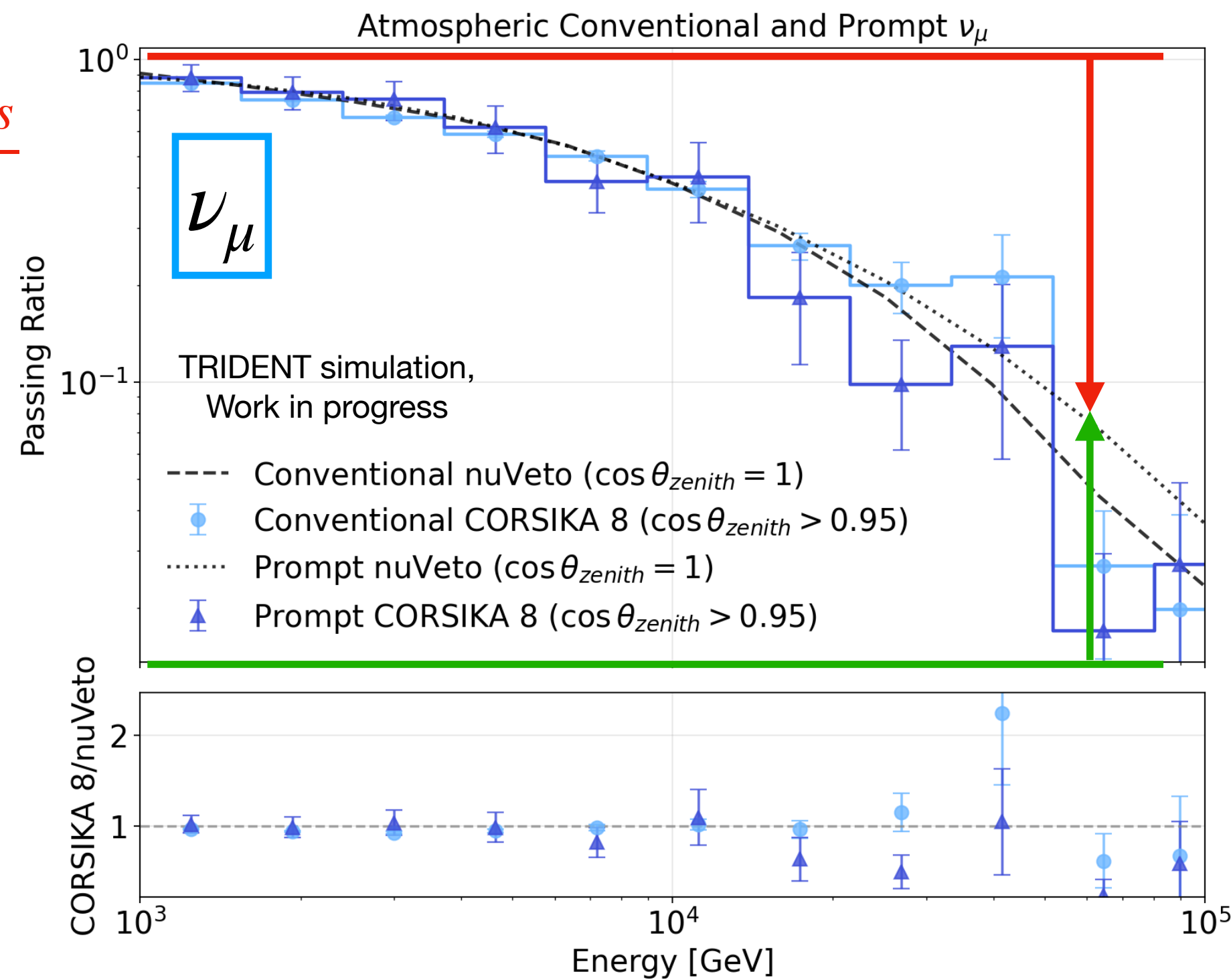


Inverse Self-veto events
Accompanying muons



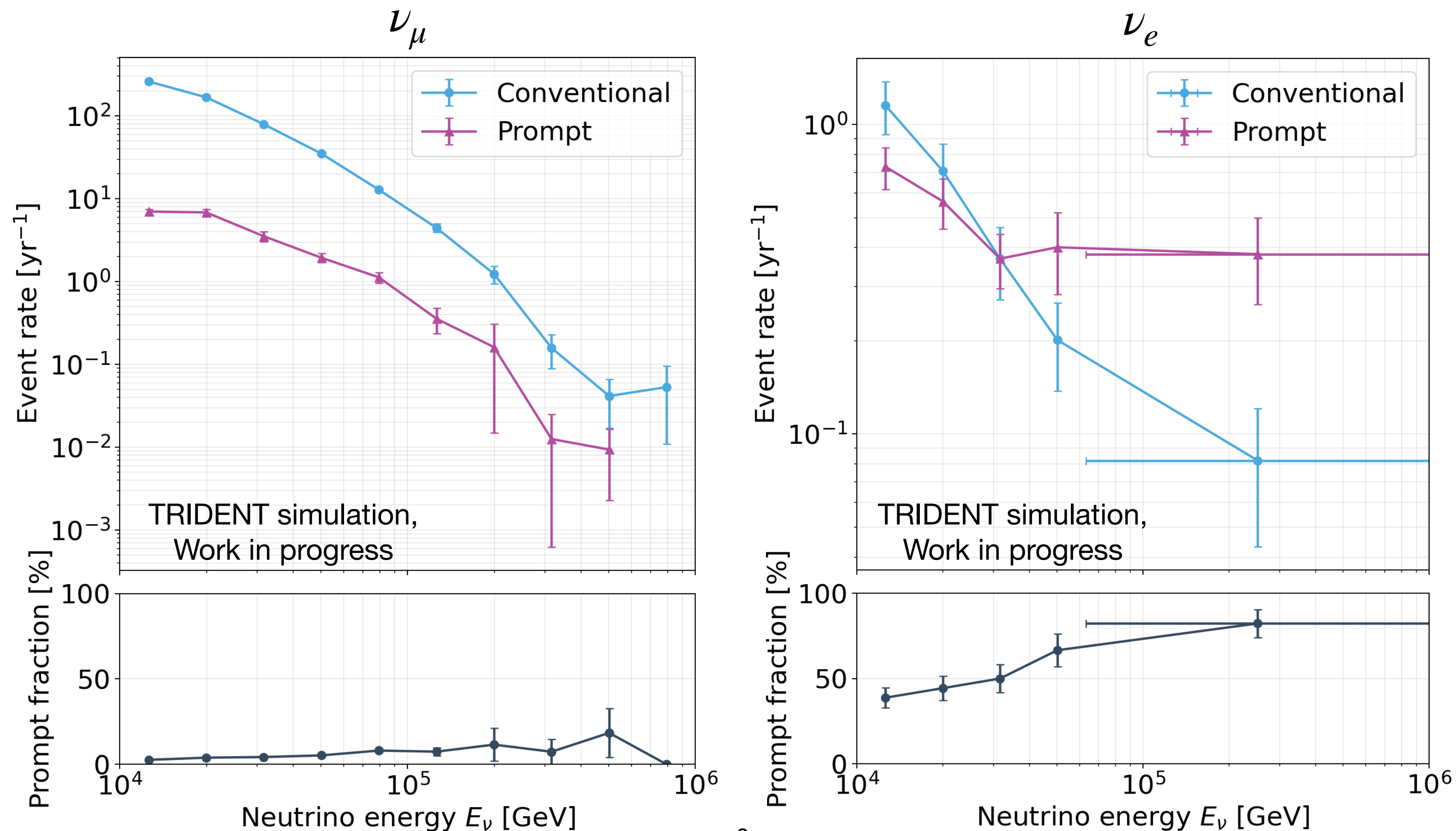
Inverse self – veto events
Total events

Self – veto events
Total events



Inverse self-veto spectrum

- The selected prompt ν_μ is always less than selected conventional ν_μ , but the selected prompt ν_e is higher than selected conventional ν_e around 50 TeV.



Expected event rates

- GSF CR model, only contains p from 10 TeV to 10 PeV, without any reconstruction selection.
- Expect **~20 prompt events per year** for full TRIDENT array.

TRIDENT simulation,
Work in progress

Type	Conventional (Events per year)	Prompt (Events per year)
Pure ν_μ	410.6 ± 10.4	13.5 ± 0.9
Pure ν_e	41.9 ± 1.6	30.3 ± 1.1
$\nu_\mu + \mu$	559.7 ± 10.6	21.0 ± 0.9
$\nu_e + \mu$	2.5 ± 0.3	2.4 ± 0.2
Pure μ	$(3.2 \pm 0.07) \times 10^9$	

Take away

- Inverse self-veto can be used to select prompt neutrinos in TRIDENT.
- In the selected sample, the prompt ν_e flux may exceed conventional flux at around 50 TeV.
- Early simulation results **expect ~20 prompt ν_μ and ν_e events per year** detectable TRIDENT.
- **The major backgrounds are atmospheric muons.**
- Rejecting atmospheric muons is the main challenge for detecting prompt neutrino using inverse self-veto.