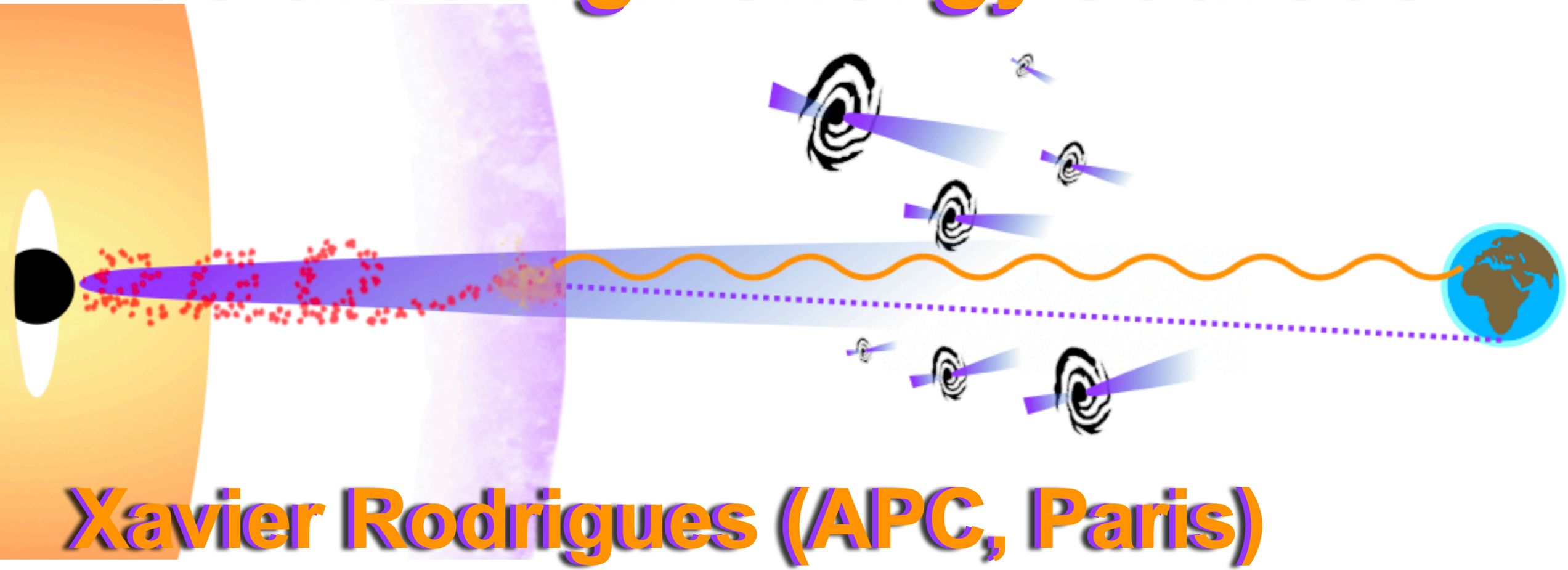
The case for blazars as ultrahigh-energy sources



Xavier Rodrigues (APC, Paris)

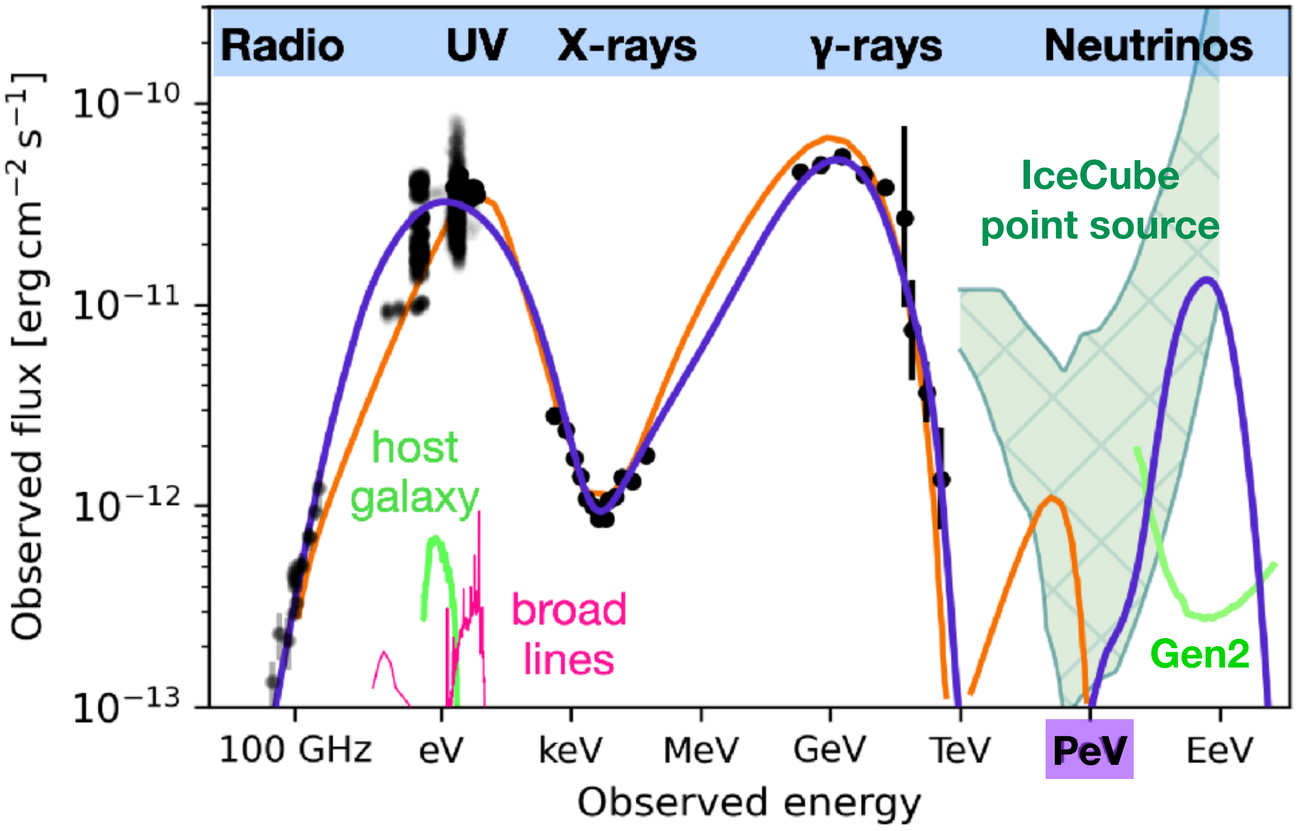
TeVPA, 5 November 2025

What neutrino emission from blazar TXS 0506+056 do models actually predict?

Gao et al. (2019) Nature Astron.

Sub-PeV neutrinos

Super-Eddington proton power



XR, Rieger, Bohdan & Padovani (2025) 2508.18345

UHE neutrinos

Sub-Eddington proton power

New extended jet model

Jet

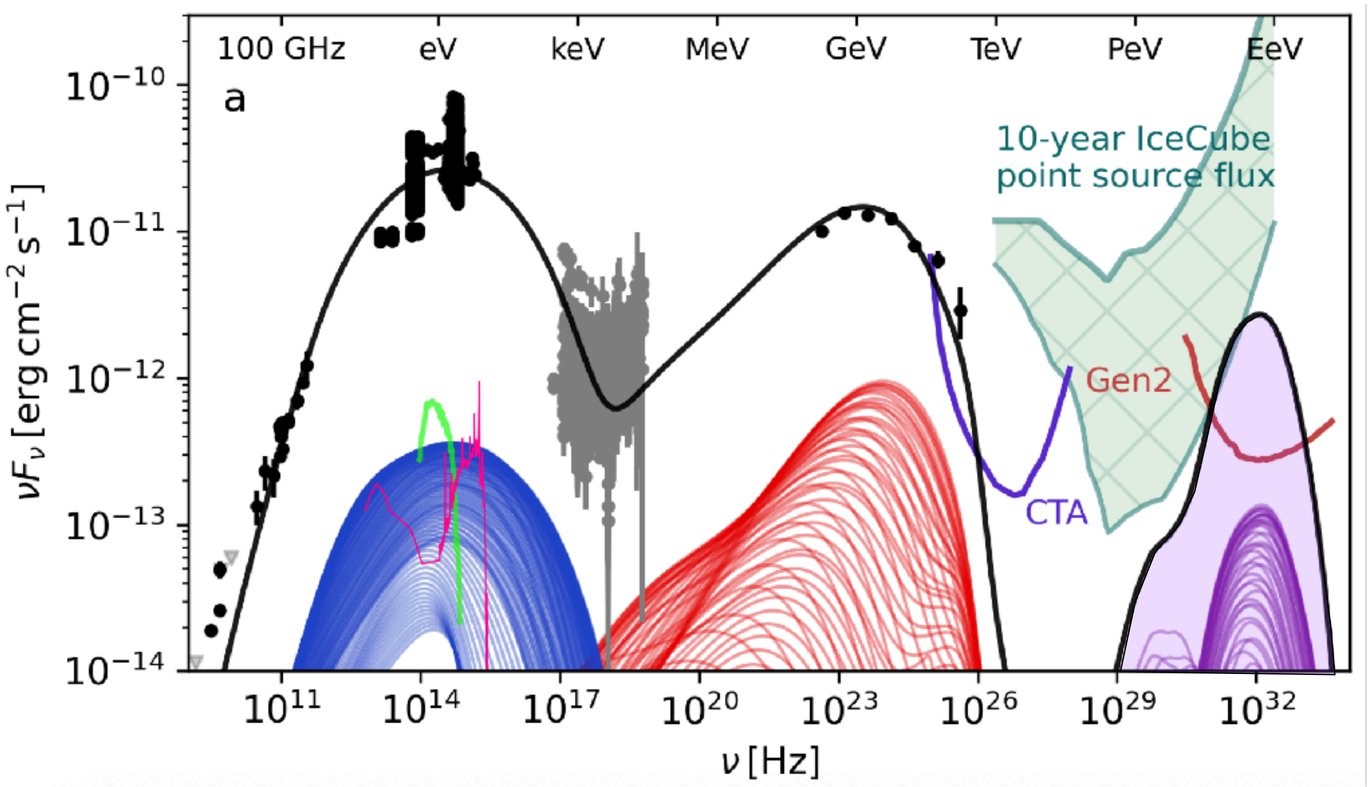
~30 mpc:
proton emission
(gammas, X-rays,
neutrinos)

~ pc:
optical

Gas
(BLR)

Dust

TXS 0506+056



XR, Rieger, Bohdan & Padovani (arXiv:2508.18345)

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proton emission
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~ pc:
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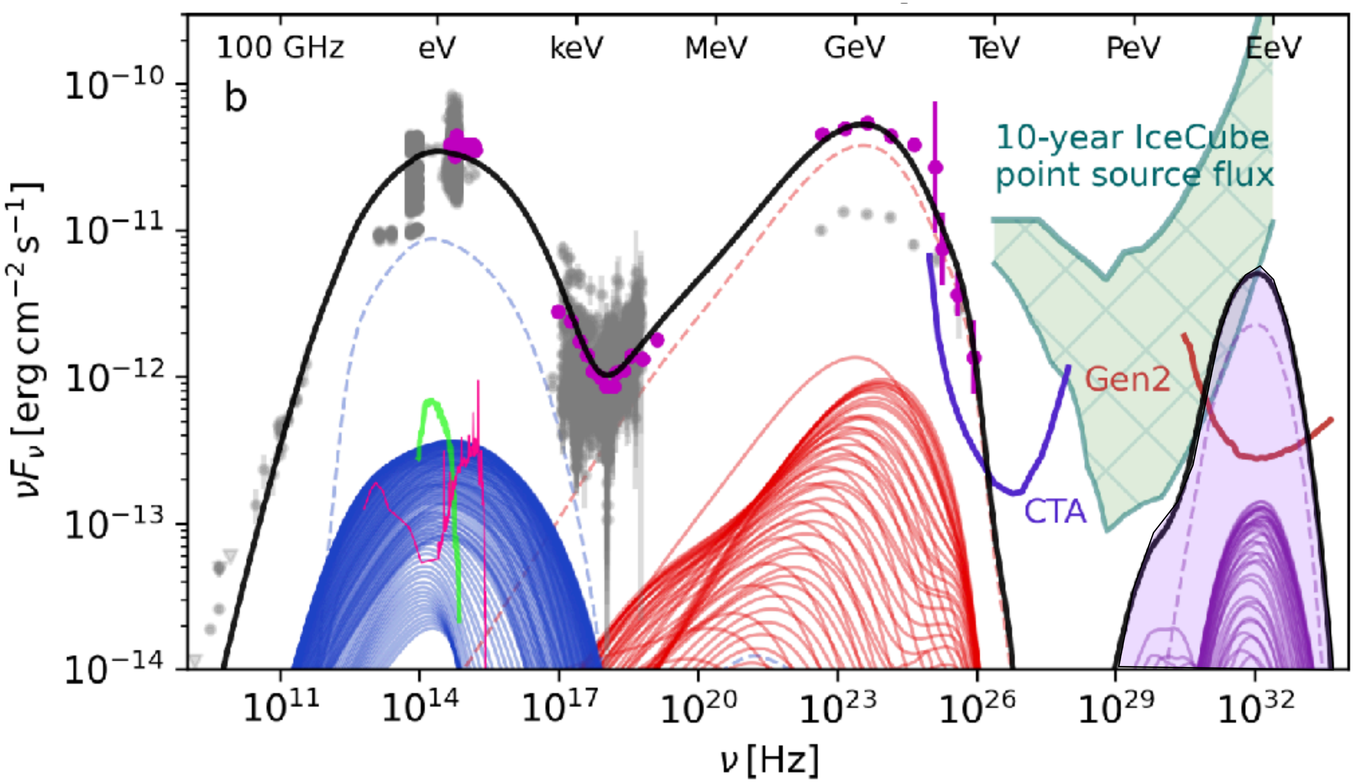
(BLR)

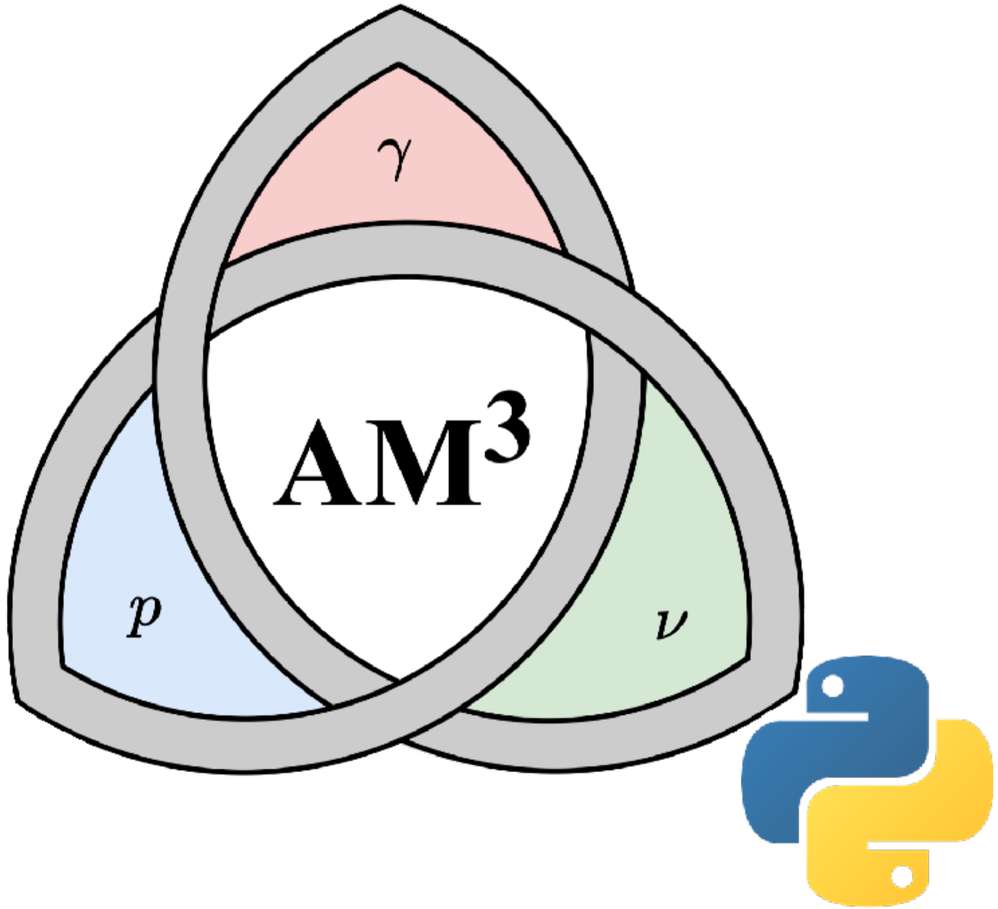
Dust

TXS 0506+056 (2017 flare)



XR, Rieger, Bohdan & Padovani (arXiv:2508.18345)

Open-source Python software for numerical source modeling

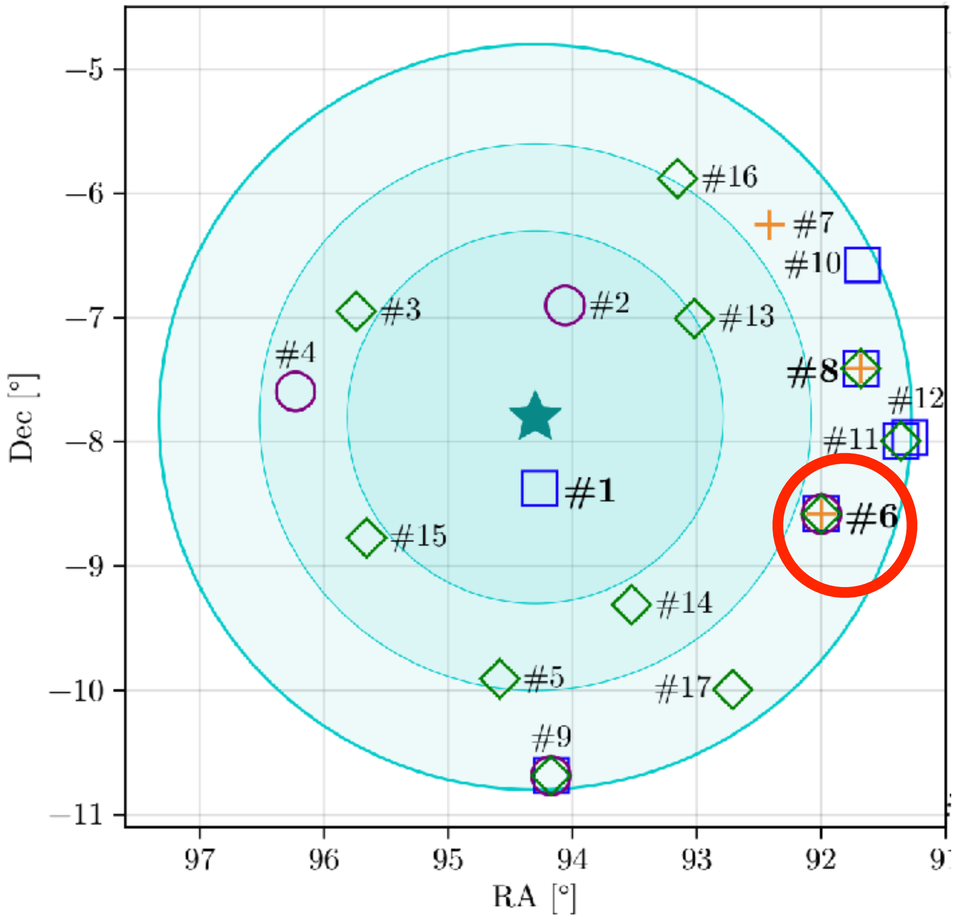


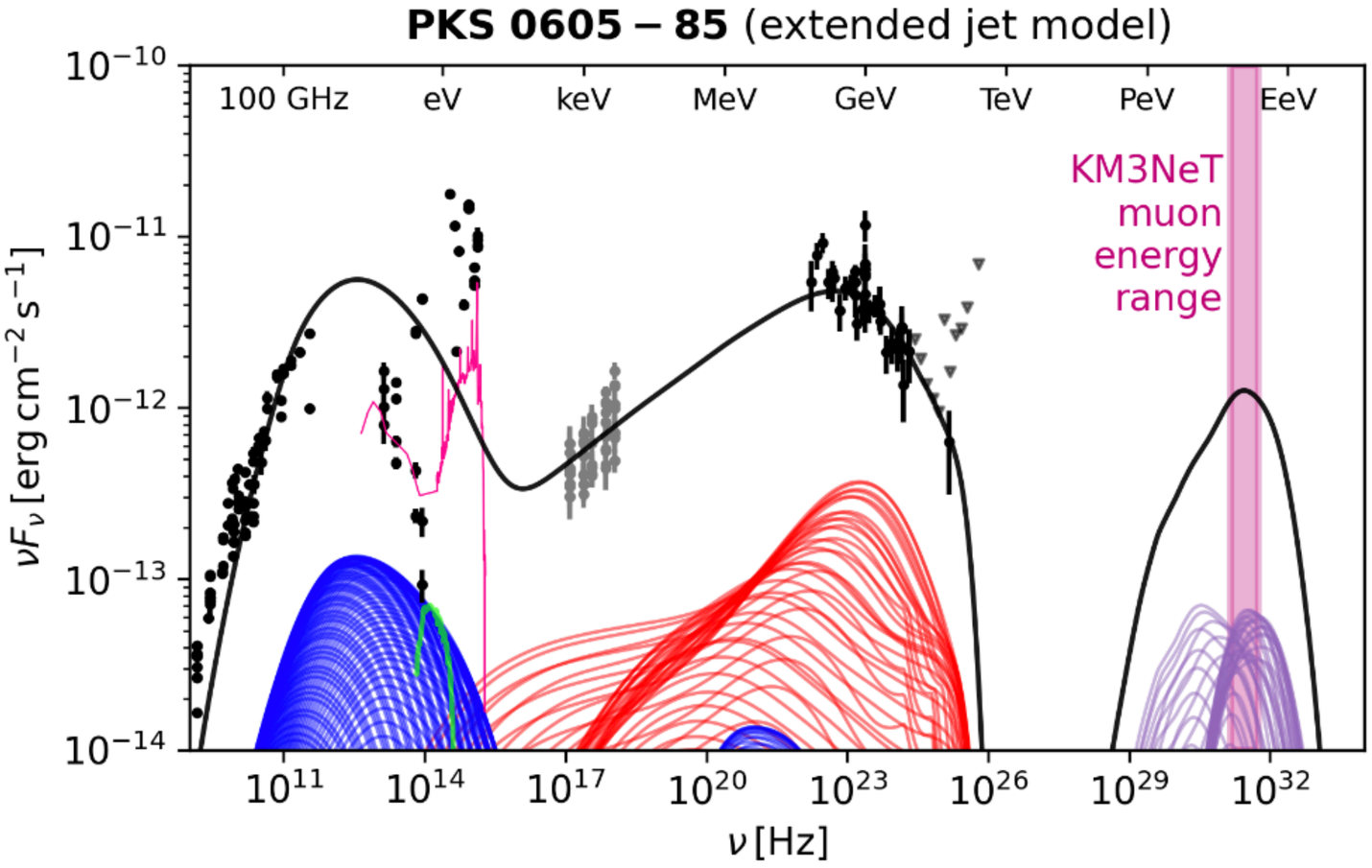

```
$ conda install -c conda-forge am3
```

am3.readthedocs.io

Klinger, Rudolph, XR, et al. 2024, ApJS 275

KM3NeT event KM3-230213A

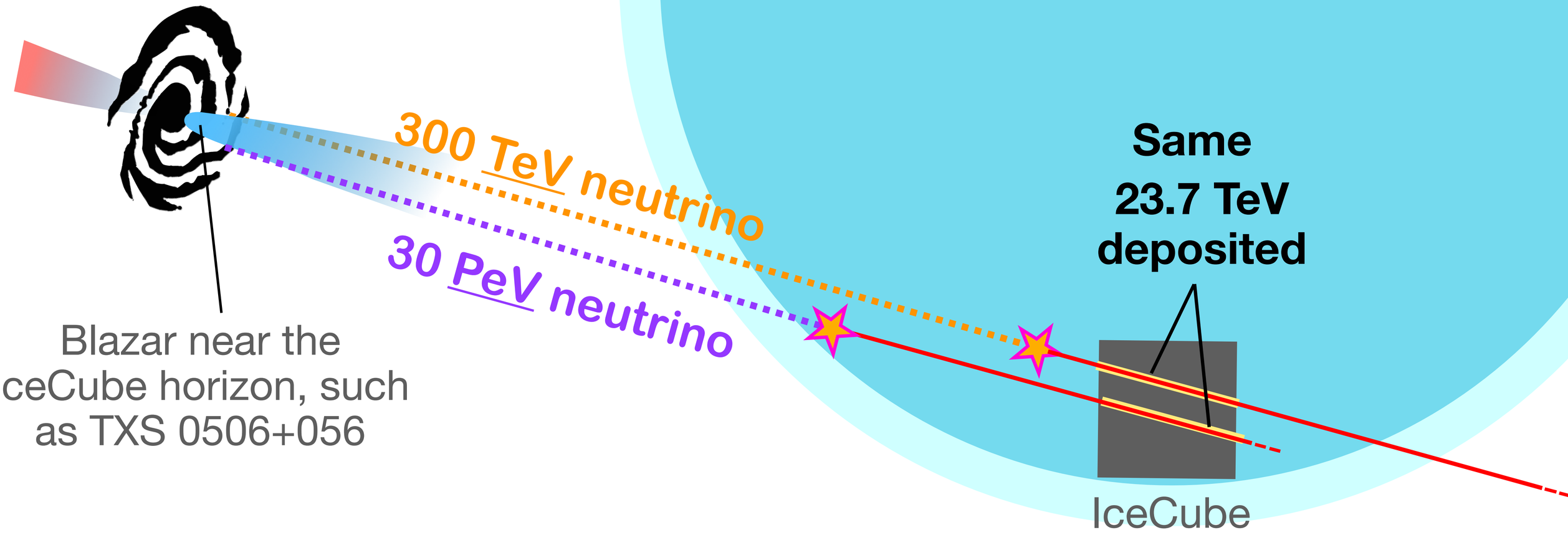




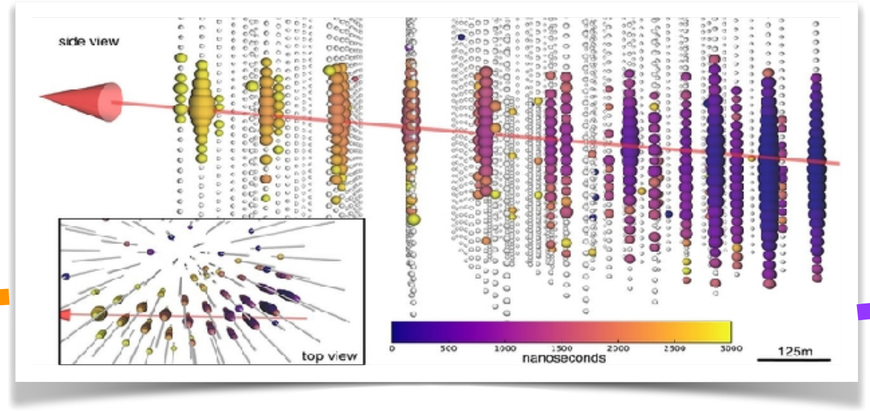
Adriani et al. 2025

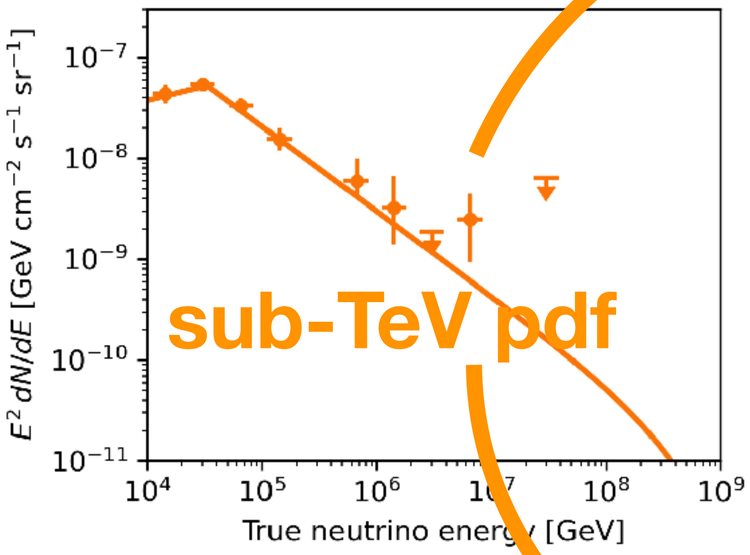
For more details see
XR, Rieger, Bohdan & Padovani (arXiv:2508.18345)

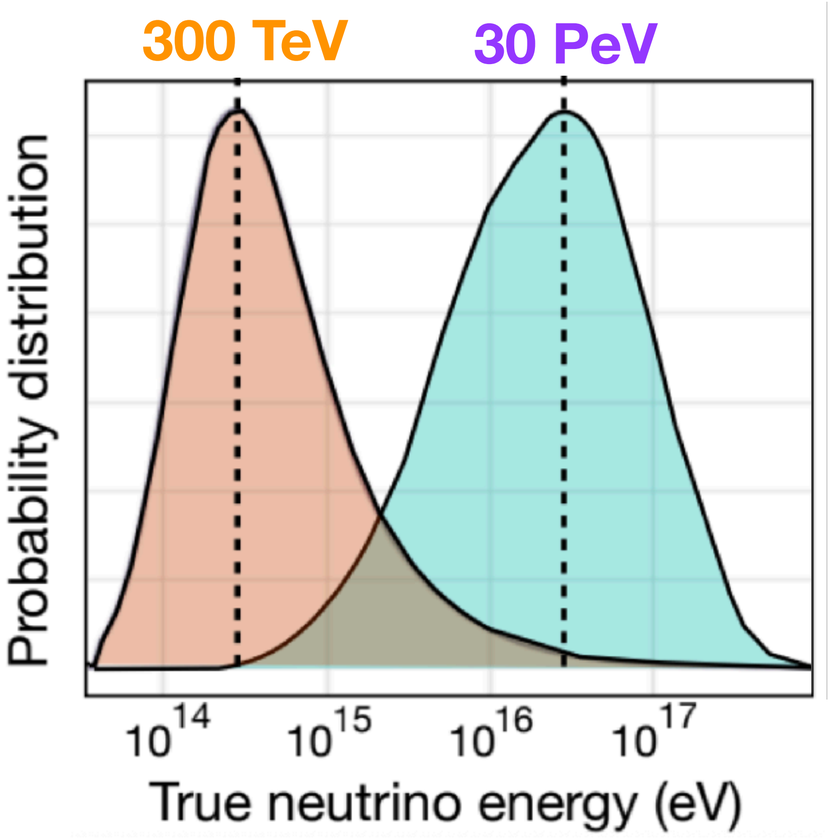
Sub-PeV vs UHE scenario

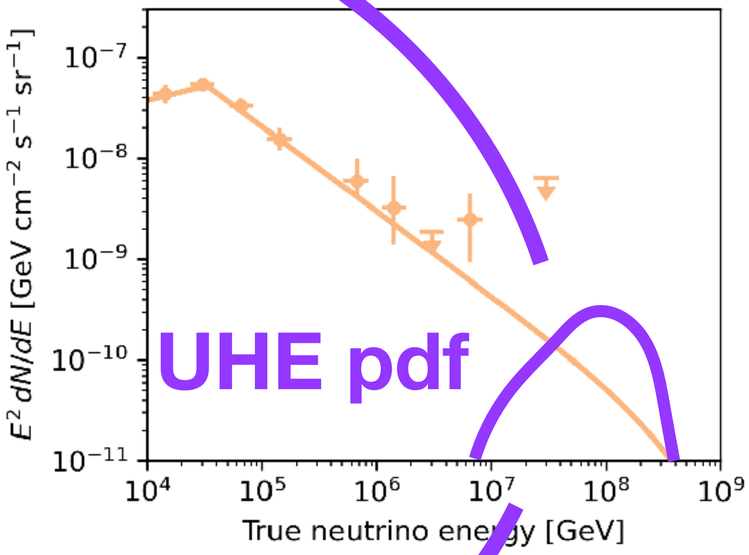


What is the energy of IceCube events from blazars?



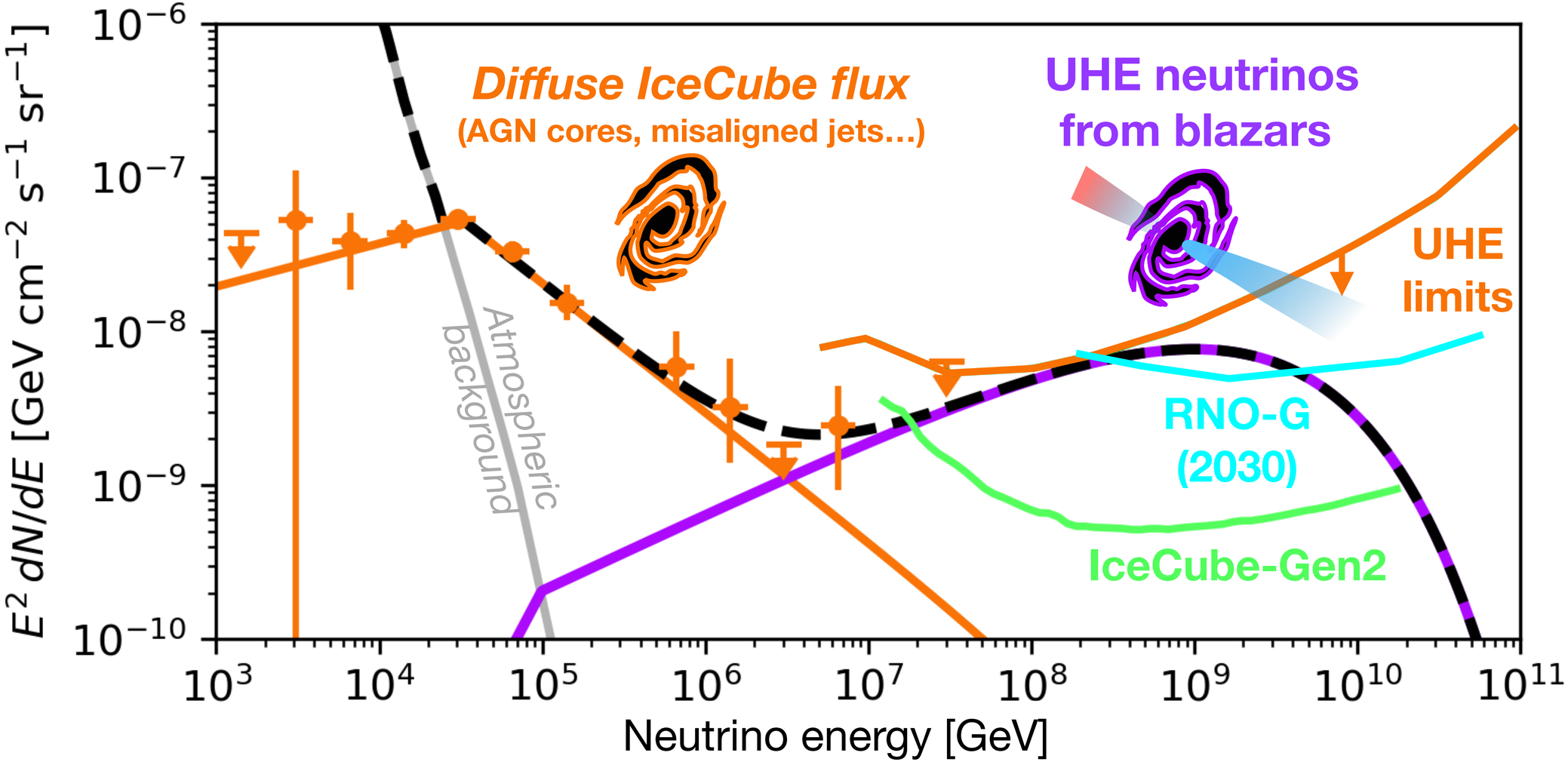






cf. Kuhlmann & Capel
2503.04632

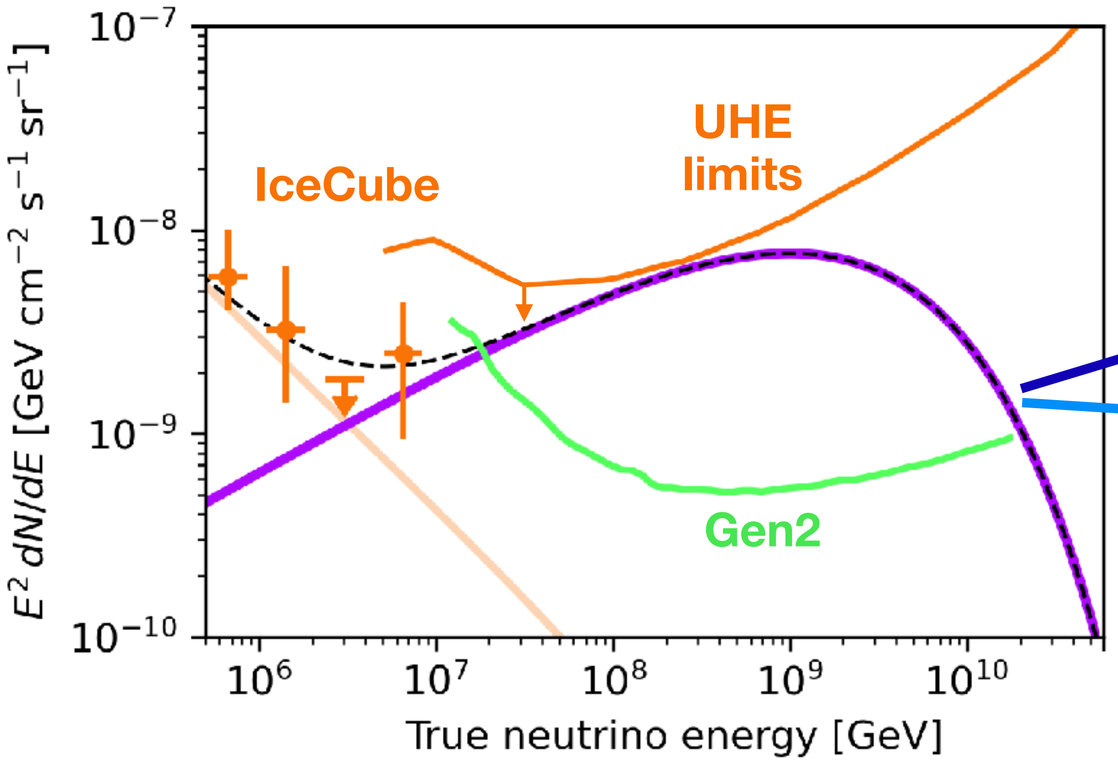
UHE blazar neutrinos are within our reach



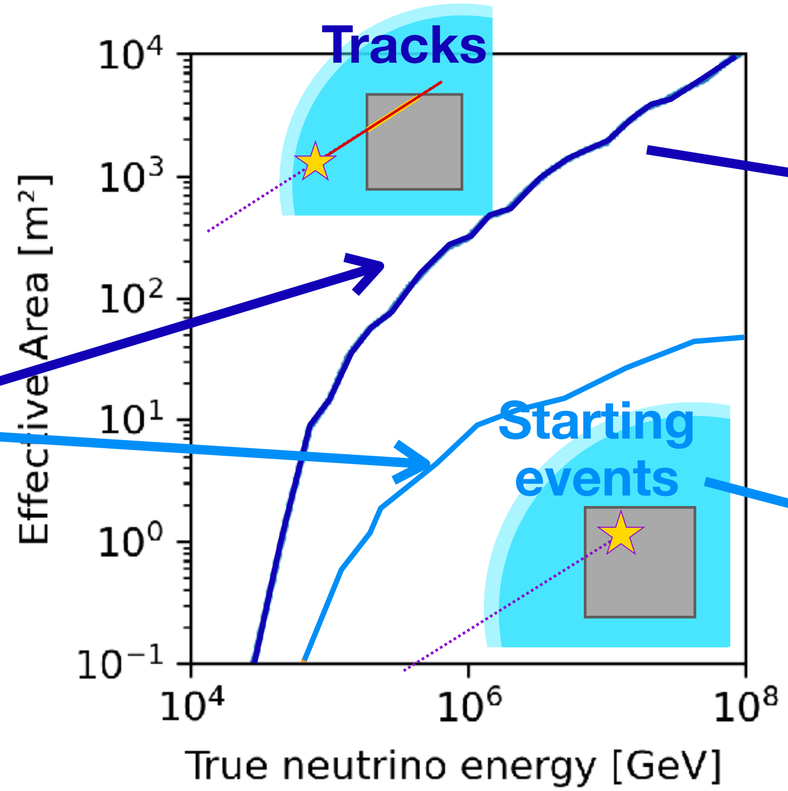
Consistent with Fermi + Auger:

XR, Heinze, Palladino, van Vliet & Winter, PRL 126 (2021)

How many events have blazars produced in IceCube?



Effective area near the horizon



Number of >PeV events in 10 years

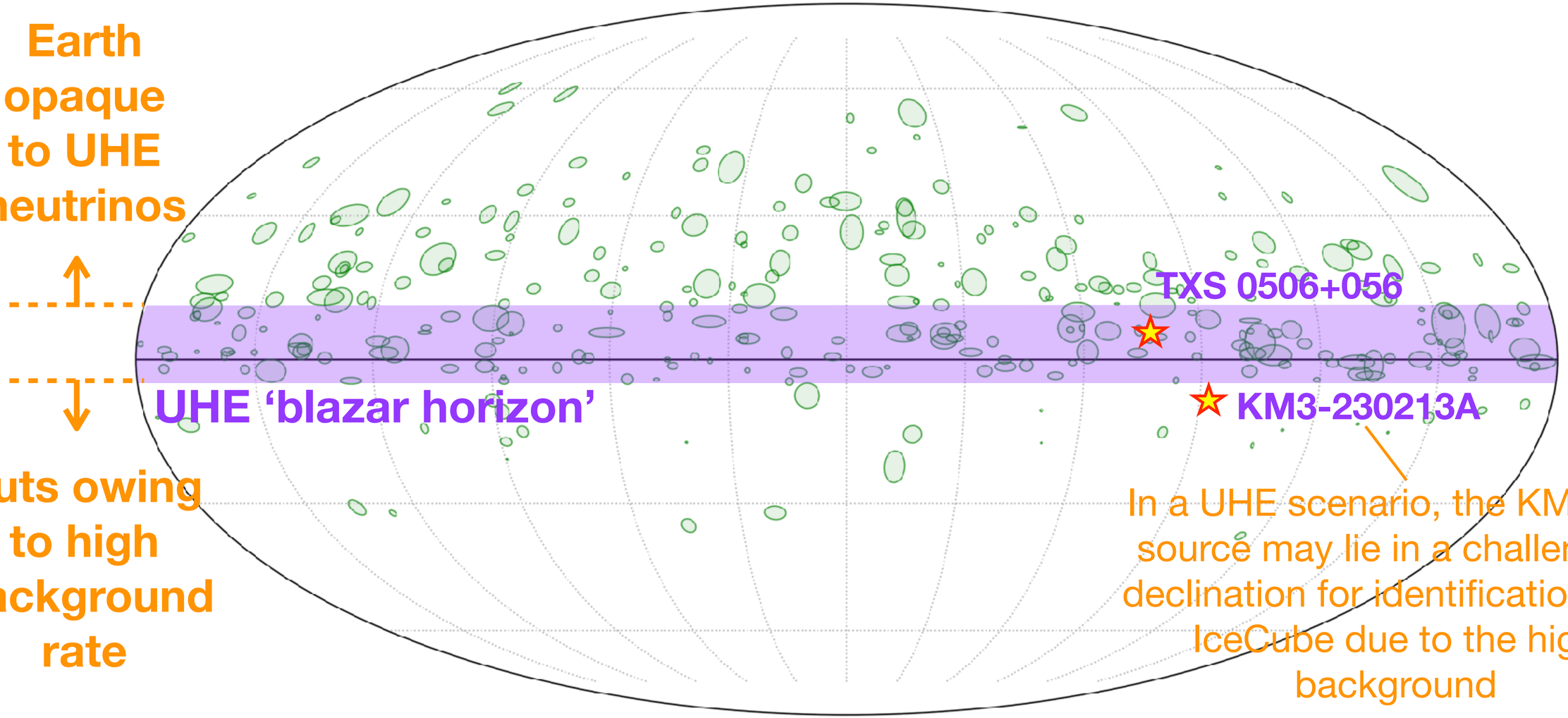
~50
(likely among the ~300 alert events)

~0.3
(consistent with zero)

~300 alert events in 10 years of IceCube

(Abbasi+2023 → see update by G. Sommani tomorrow

Earth opaque to UHE neutrinos



cuts owing to high background rate

In a UHE scenario, the KM3NeT source may lie in a challenging declination for identification with IceCube due to the high background