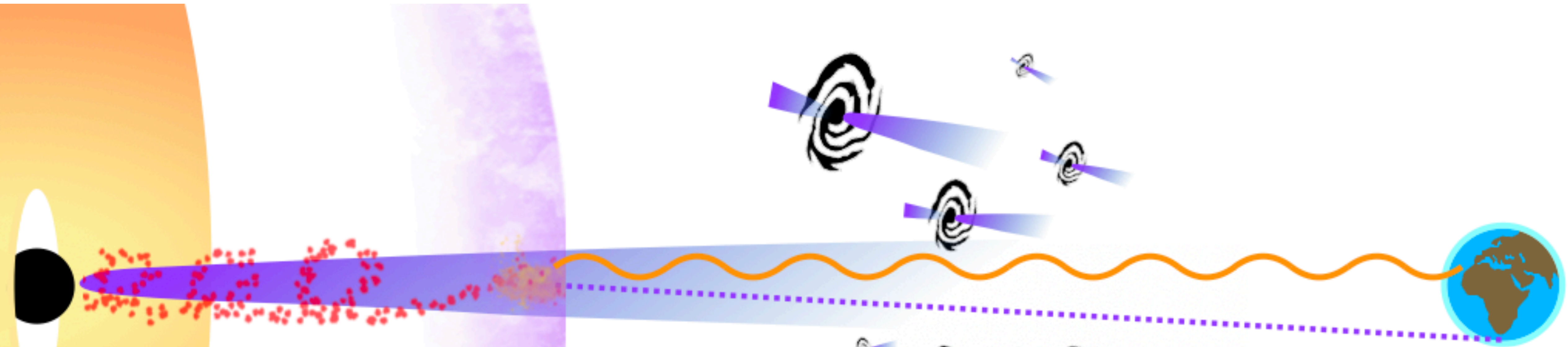


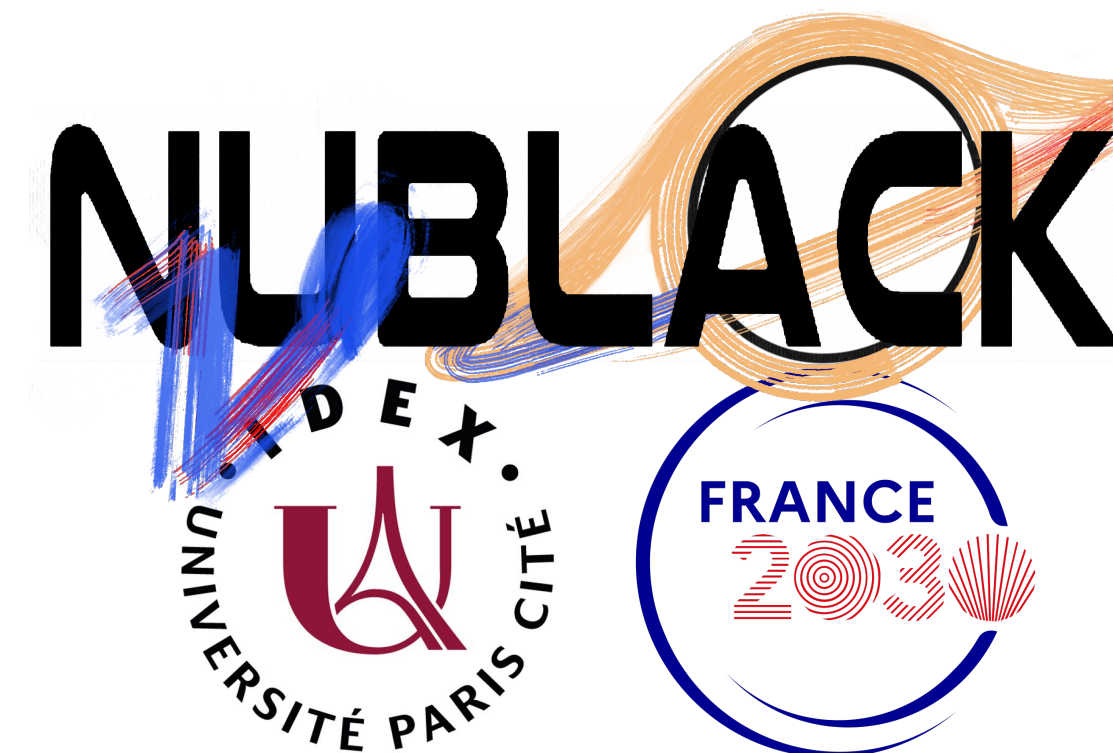
Uniting optical, gamma-ray, and neutrino data a decade after the first neutrino blazar



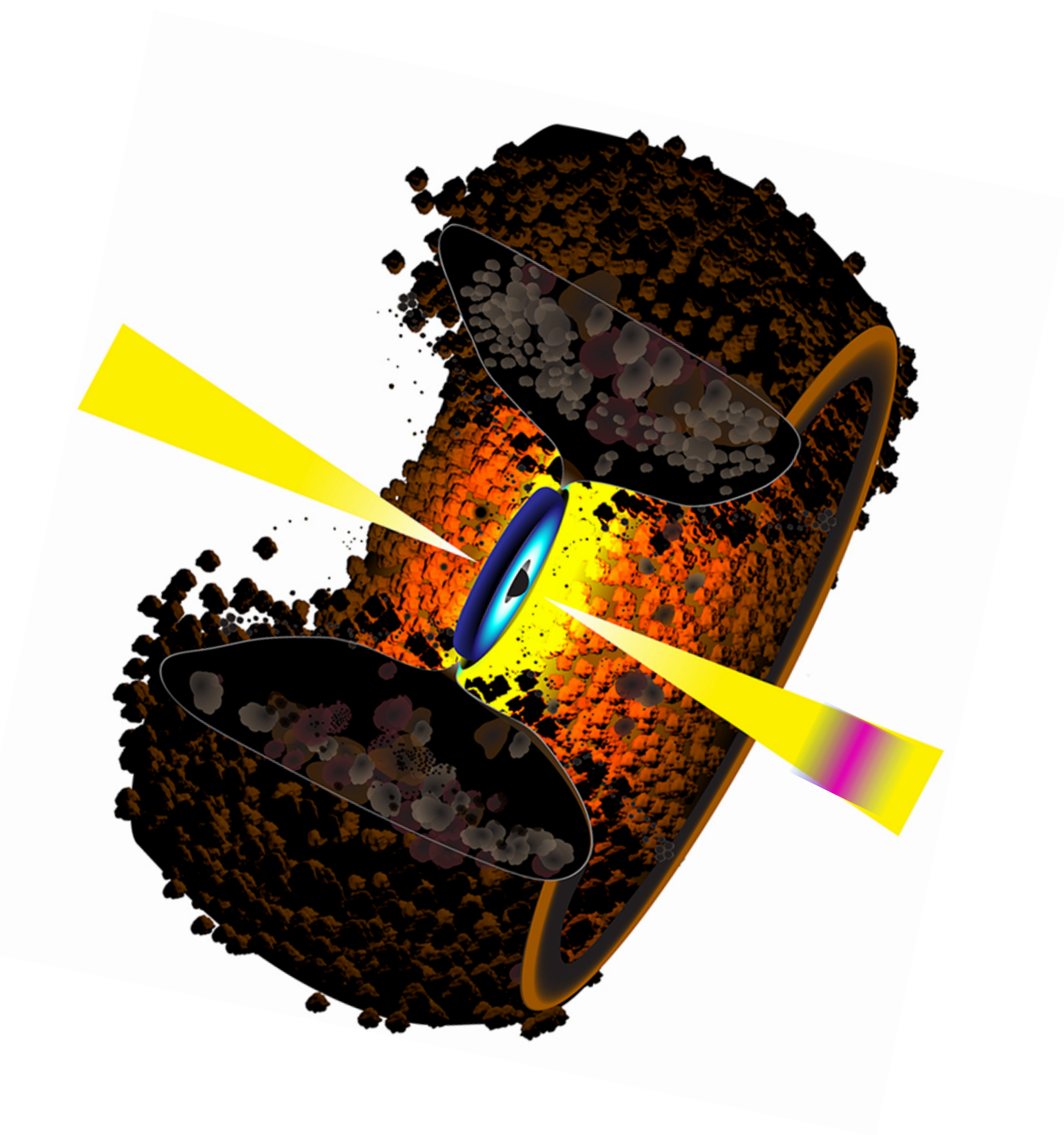
Xavier Rodrigues (APC, Paris)

**Illuminating the Active Universe
(and celebrating Paolo Padovani!)**

ESO Garching, 16 September 2026



A decade after the first neutrino blazar: what do we know?



Science

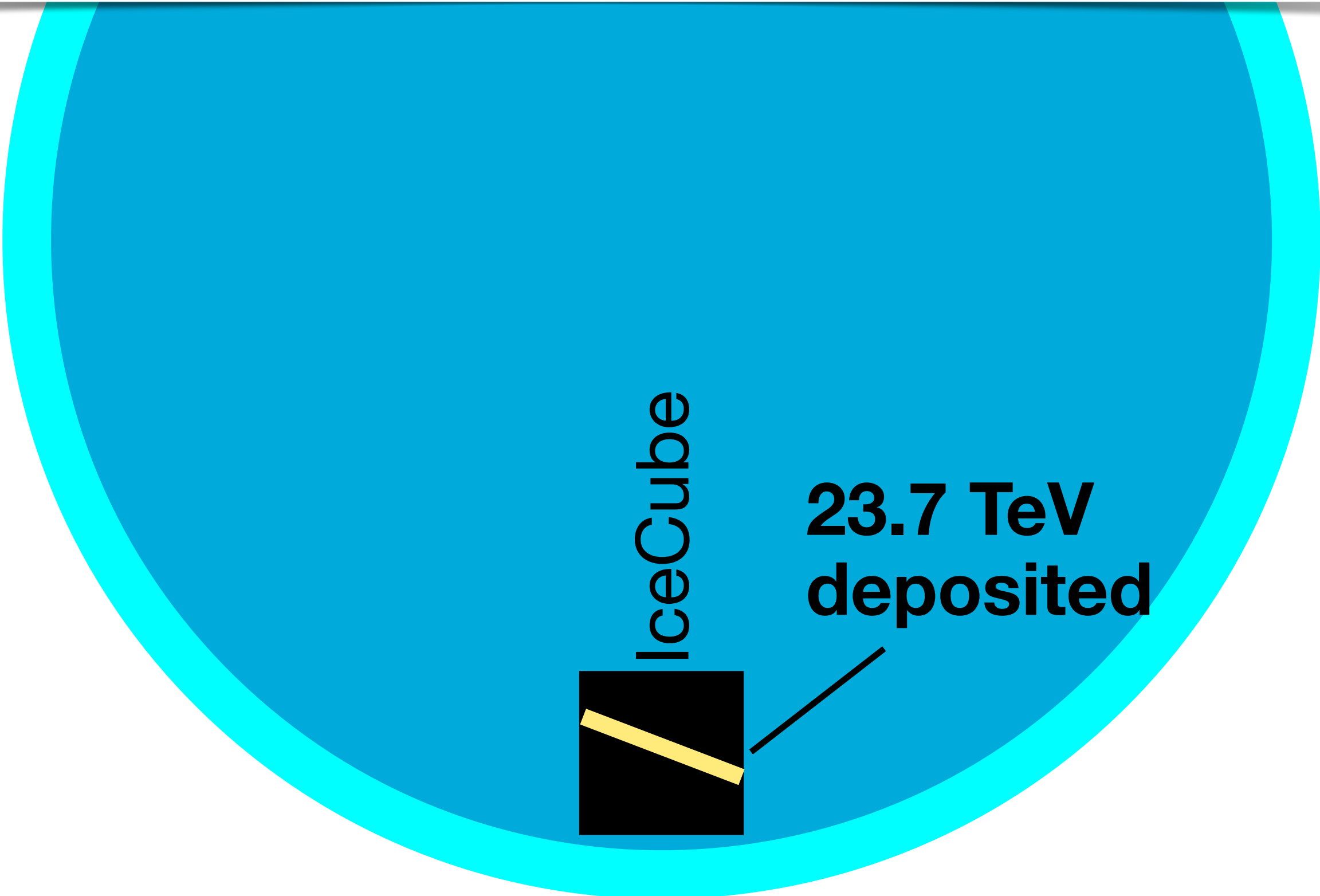
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Multimessenger observations of a flaring blazar coincident with high-energy neutrino IceCube-170922A



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Science

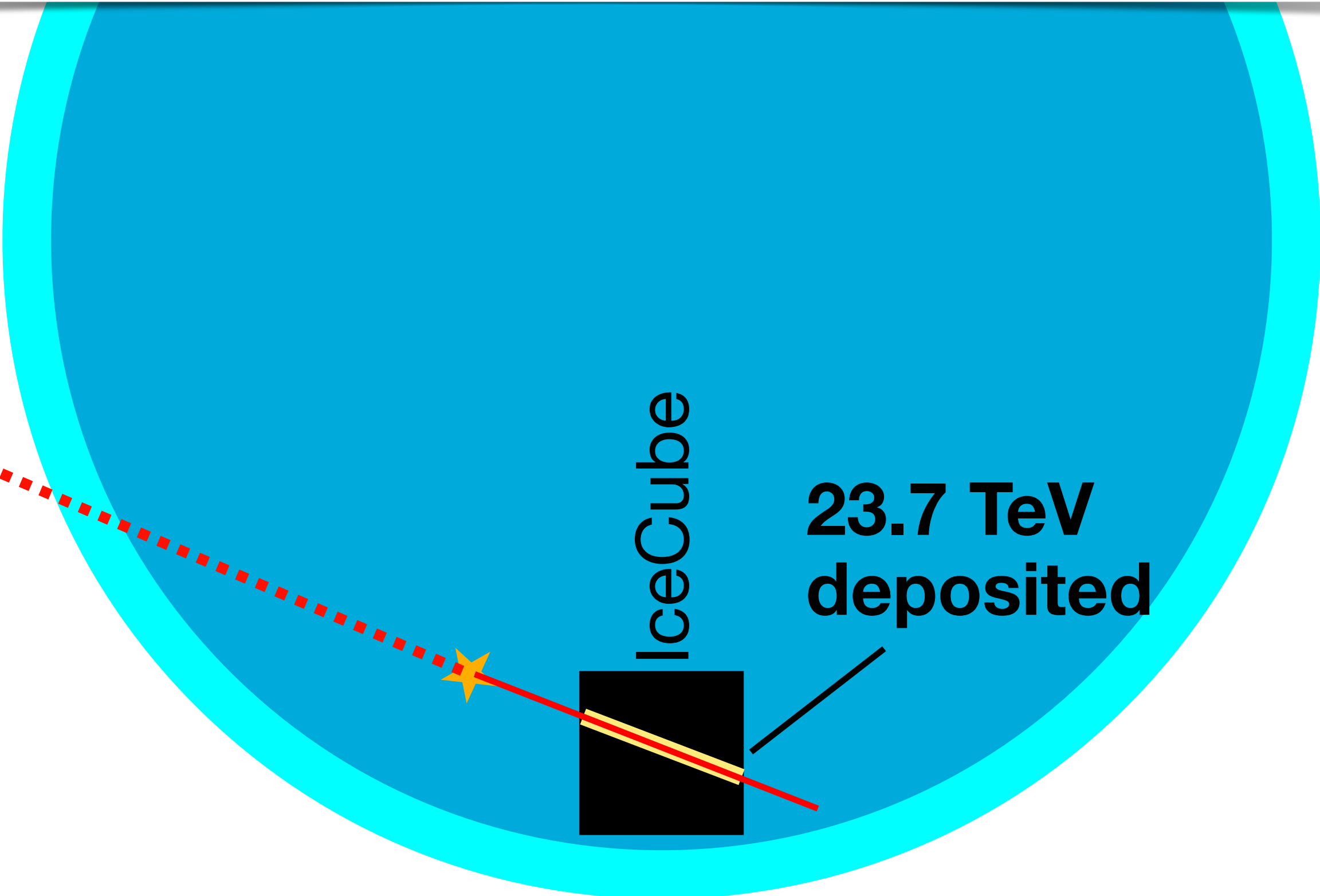
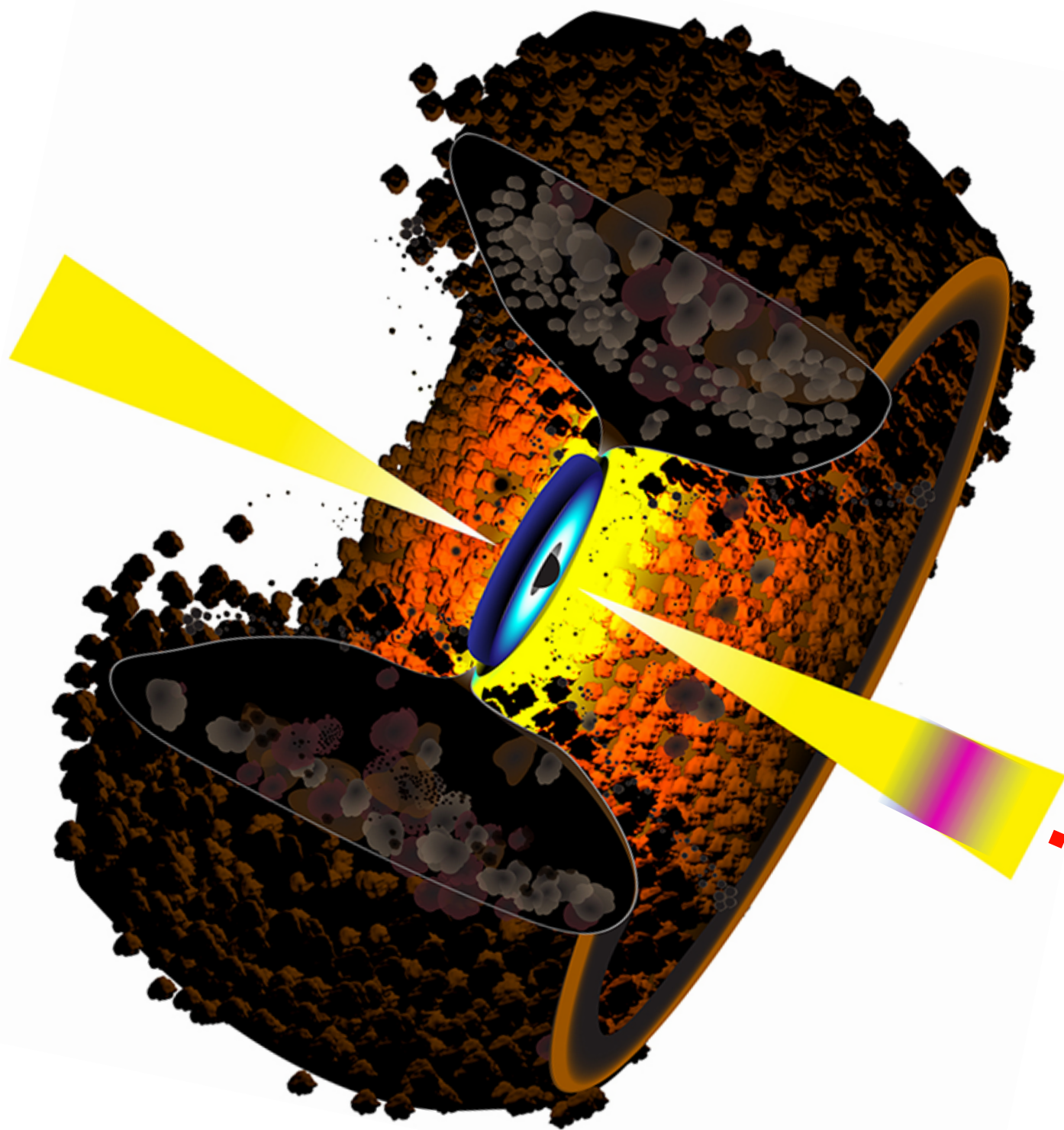
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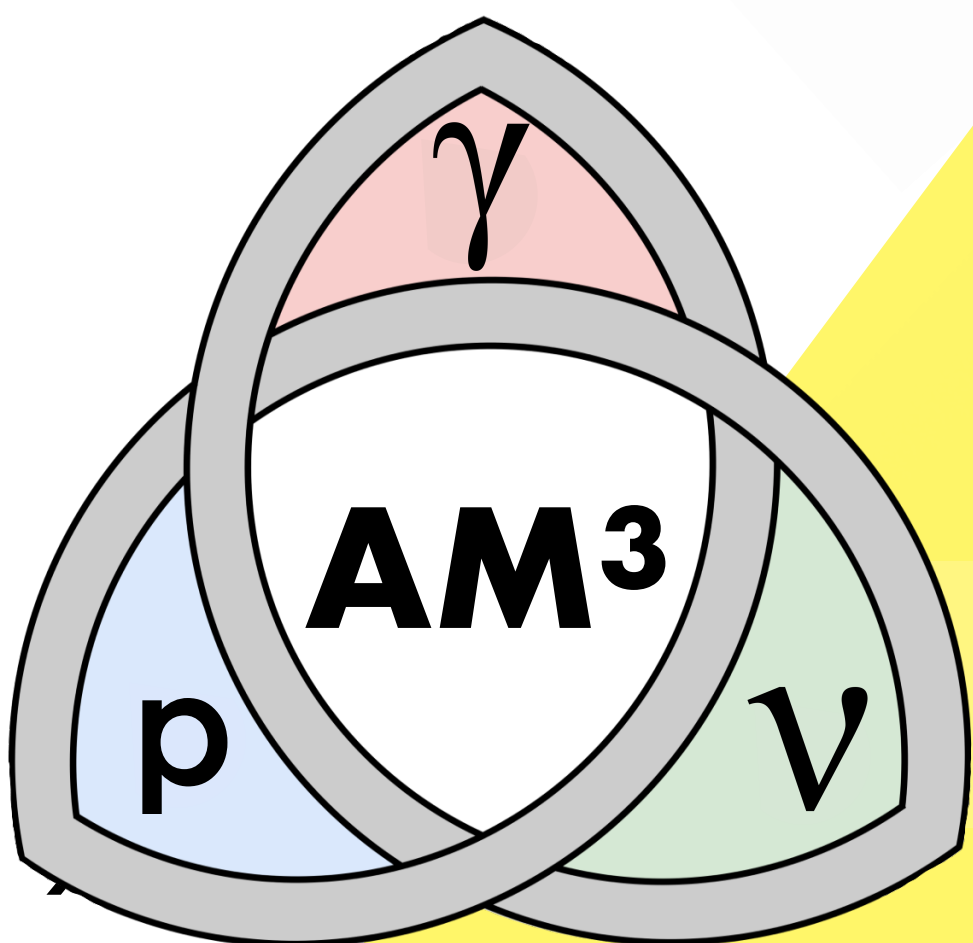
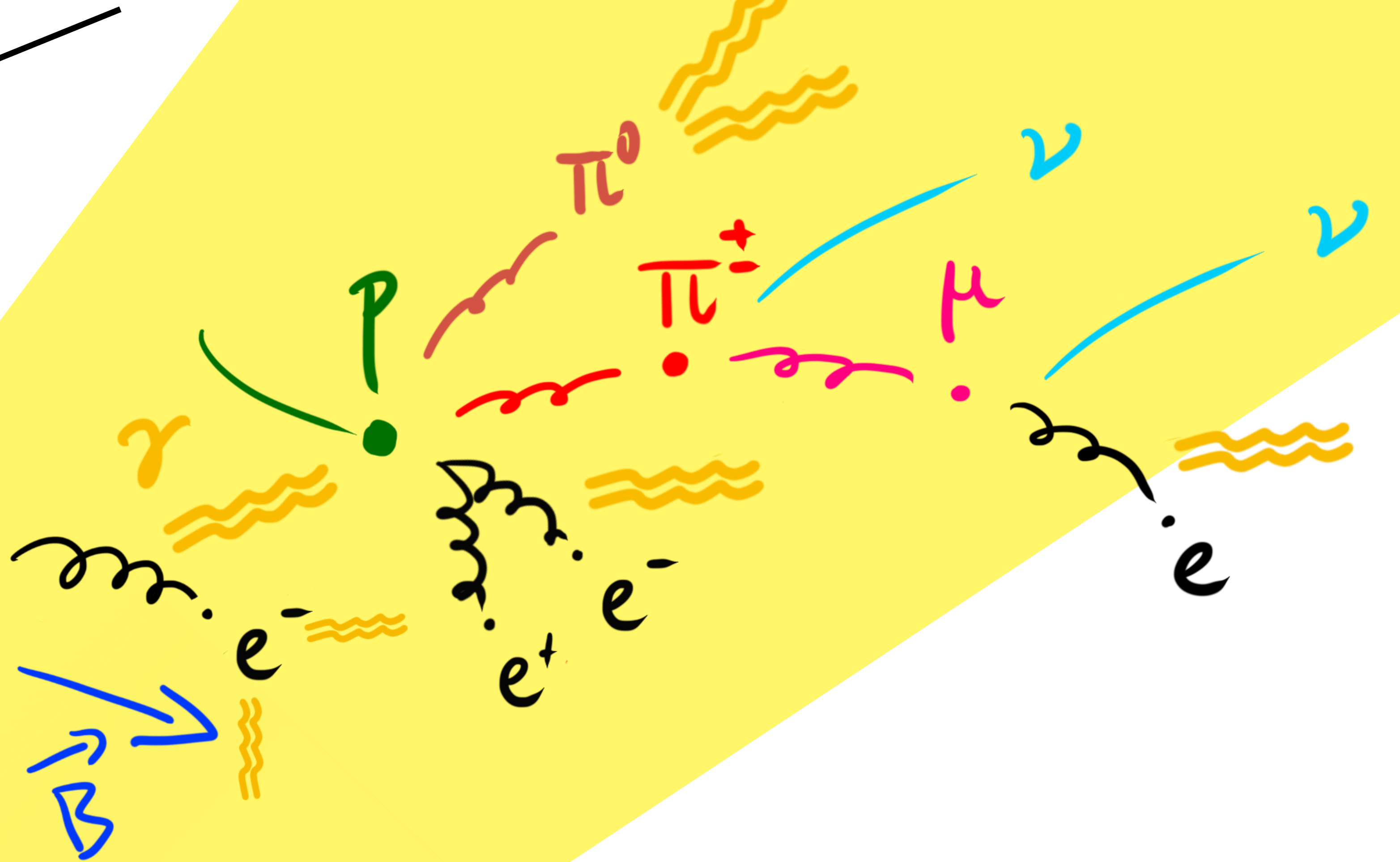
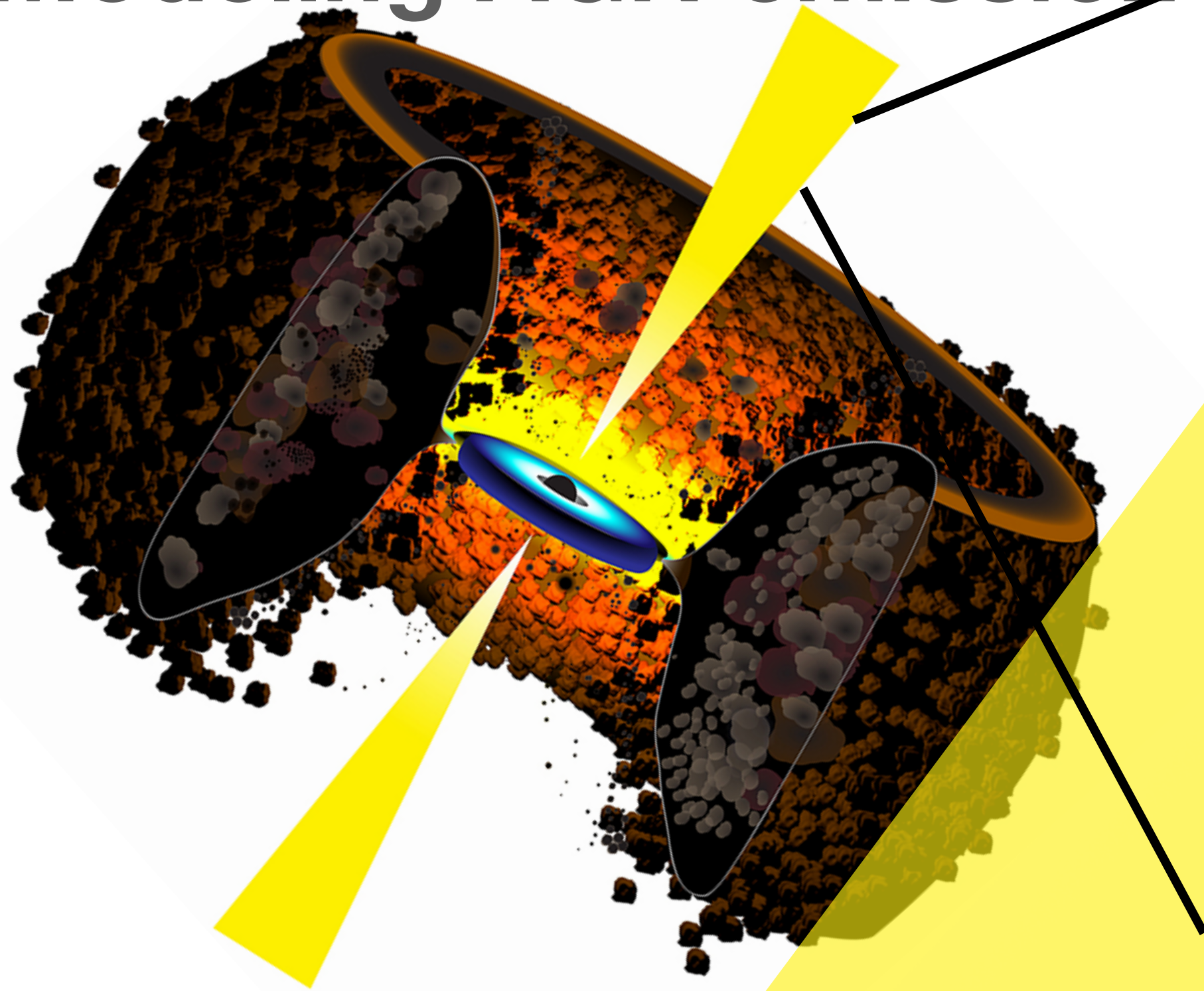
RESEARCH ARTICLE

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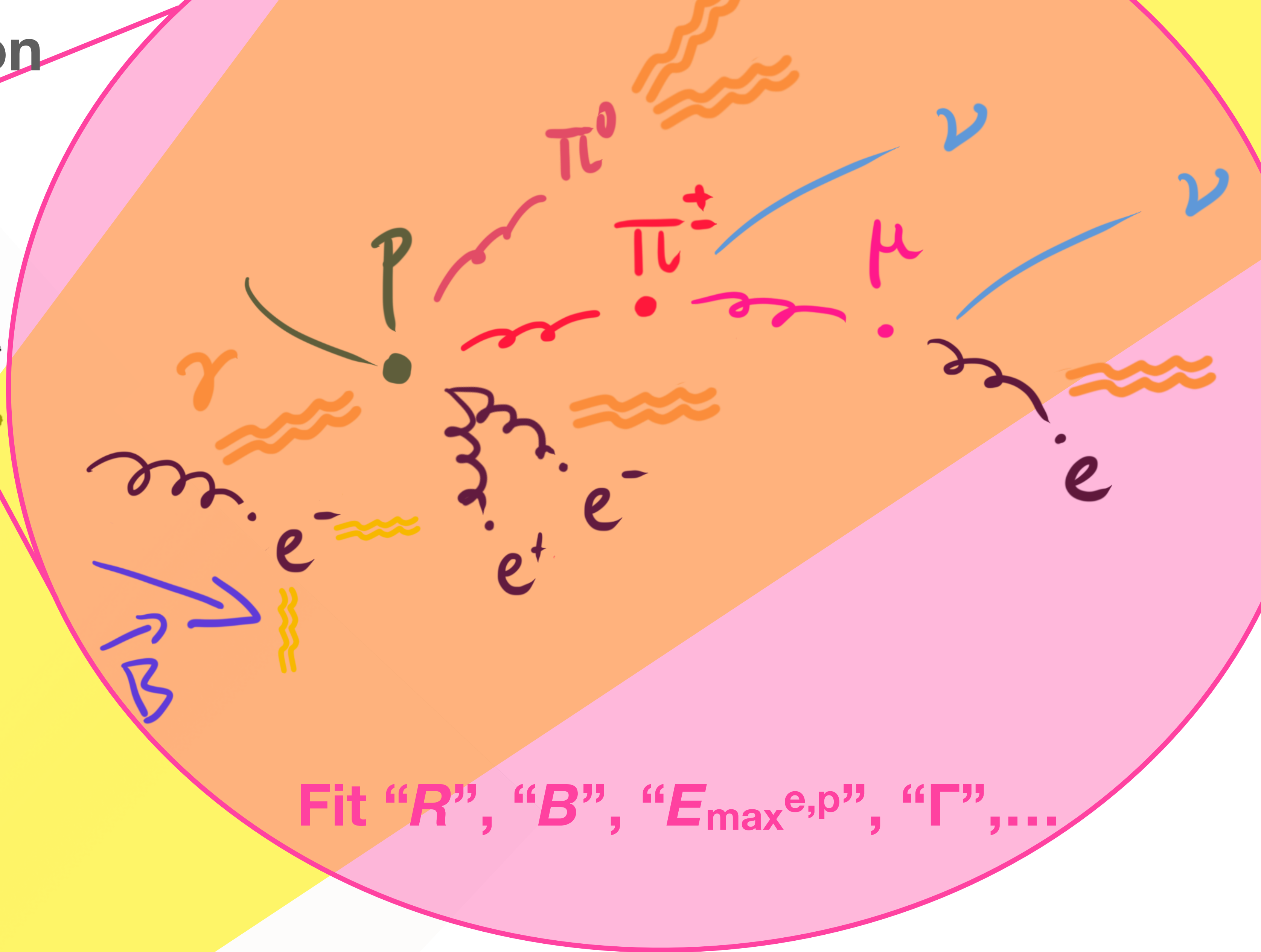
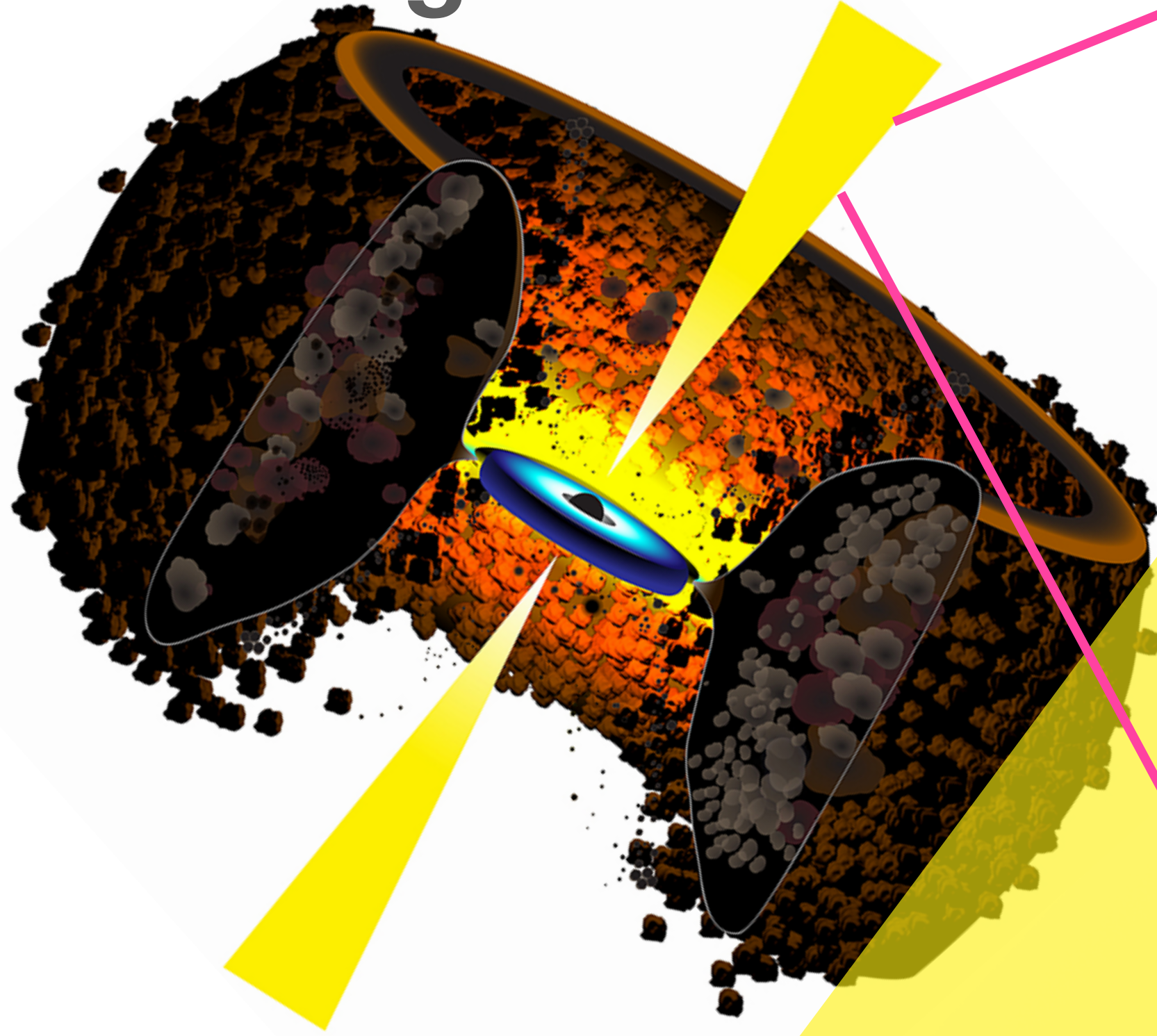


Modeling AGN emission

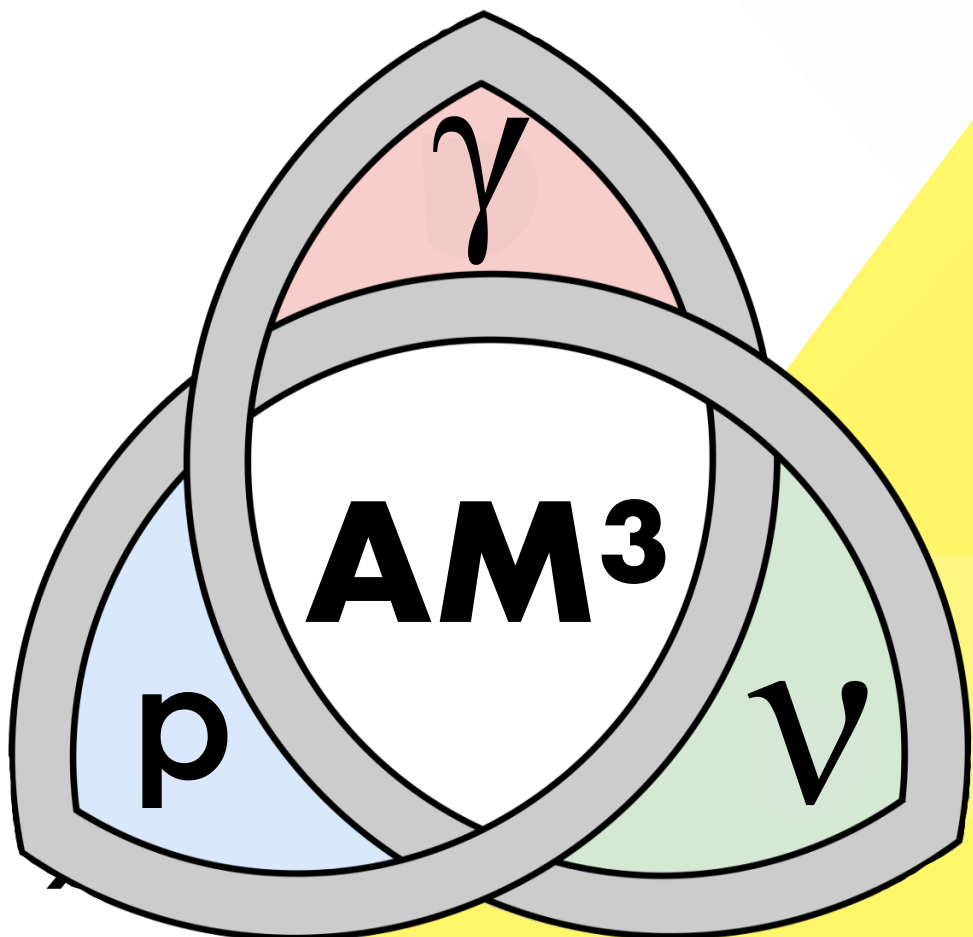


am3.readthedocs.io

Modeling AGN emission

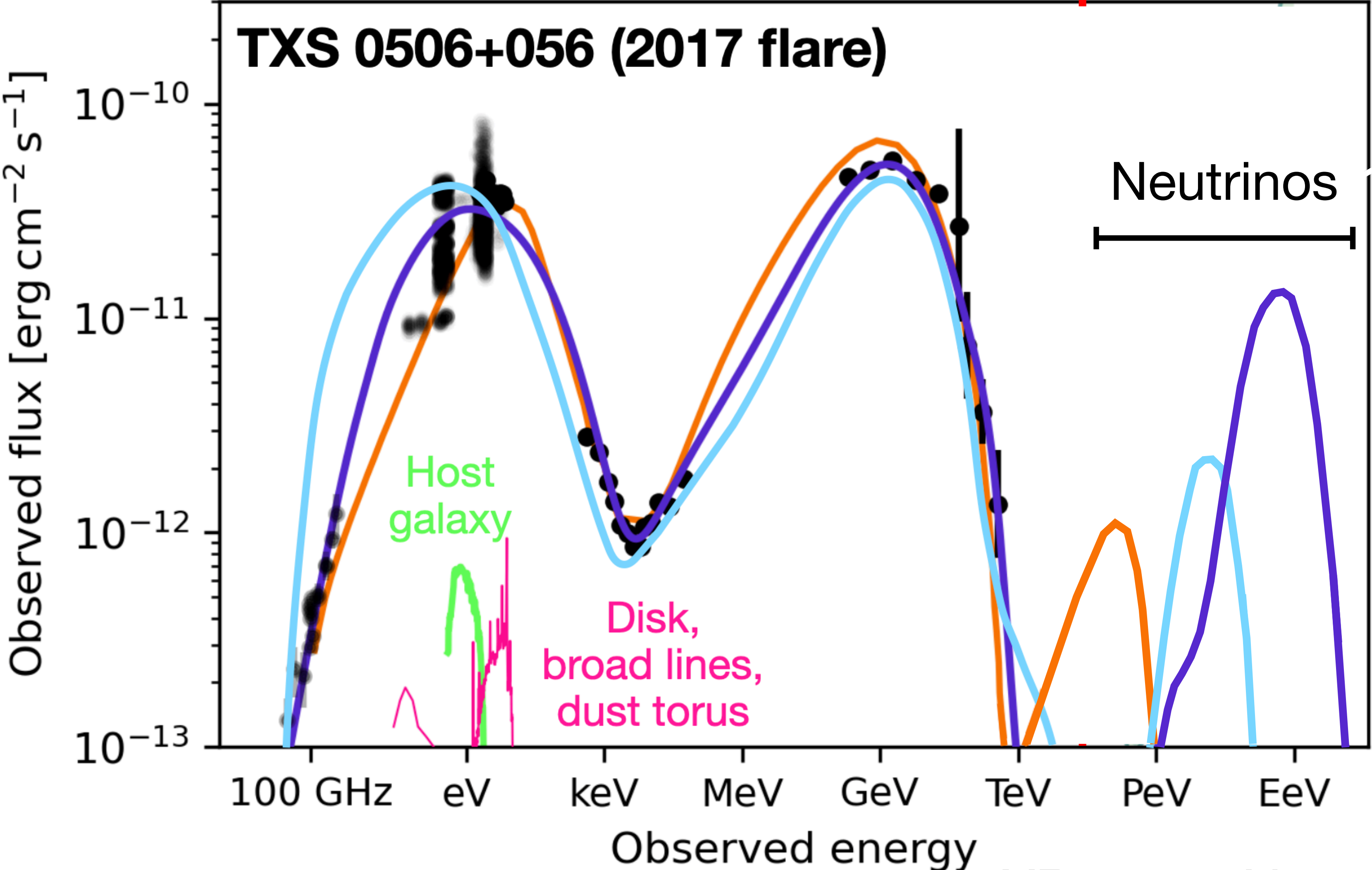


Fit “ R ”, “ B ”, “ $E_{\max}^{e,p}$ ”, “ Γ ”, ...

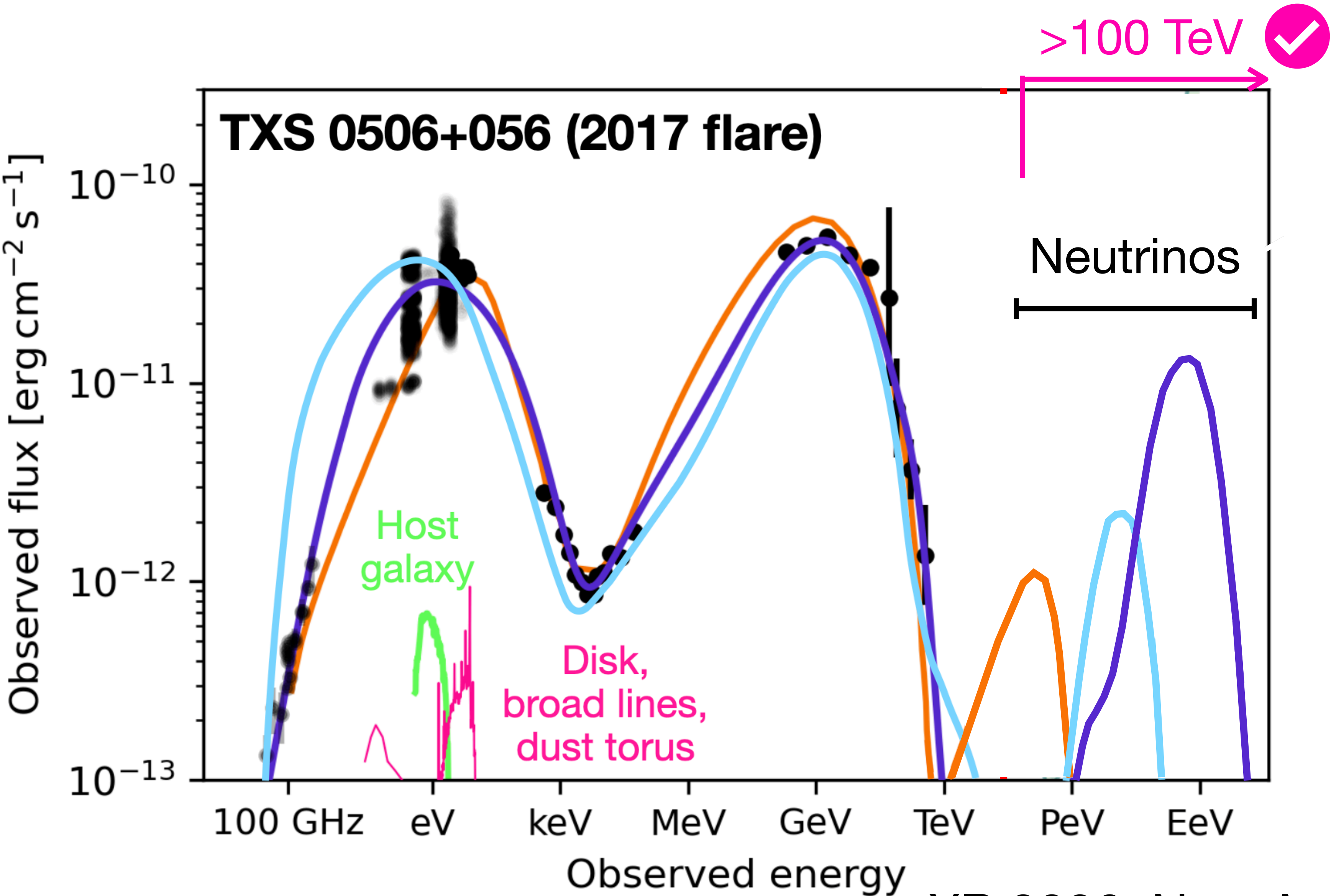


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End of the road for one-zone models?

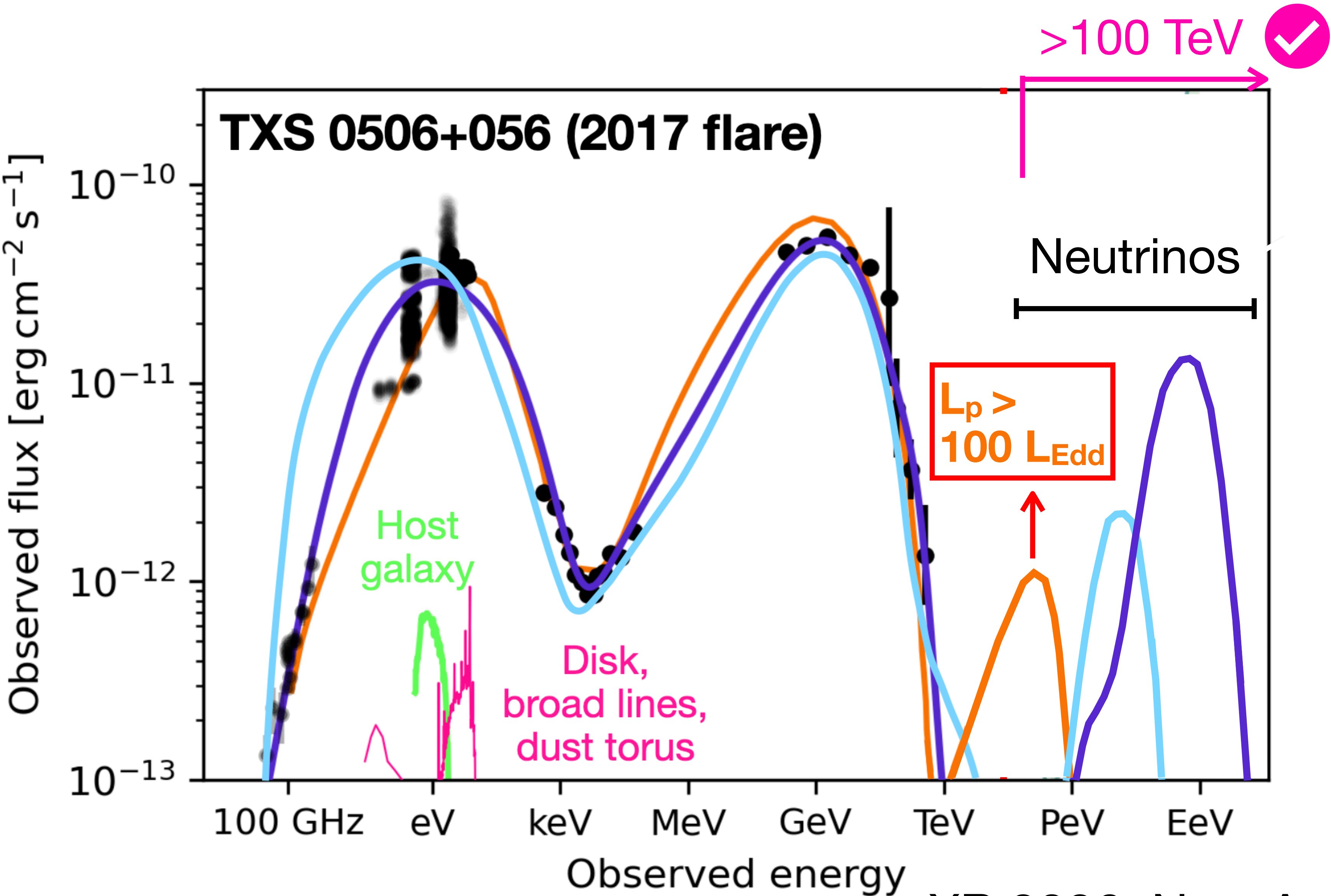


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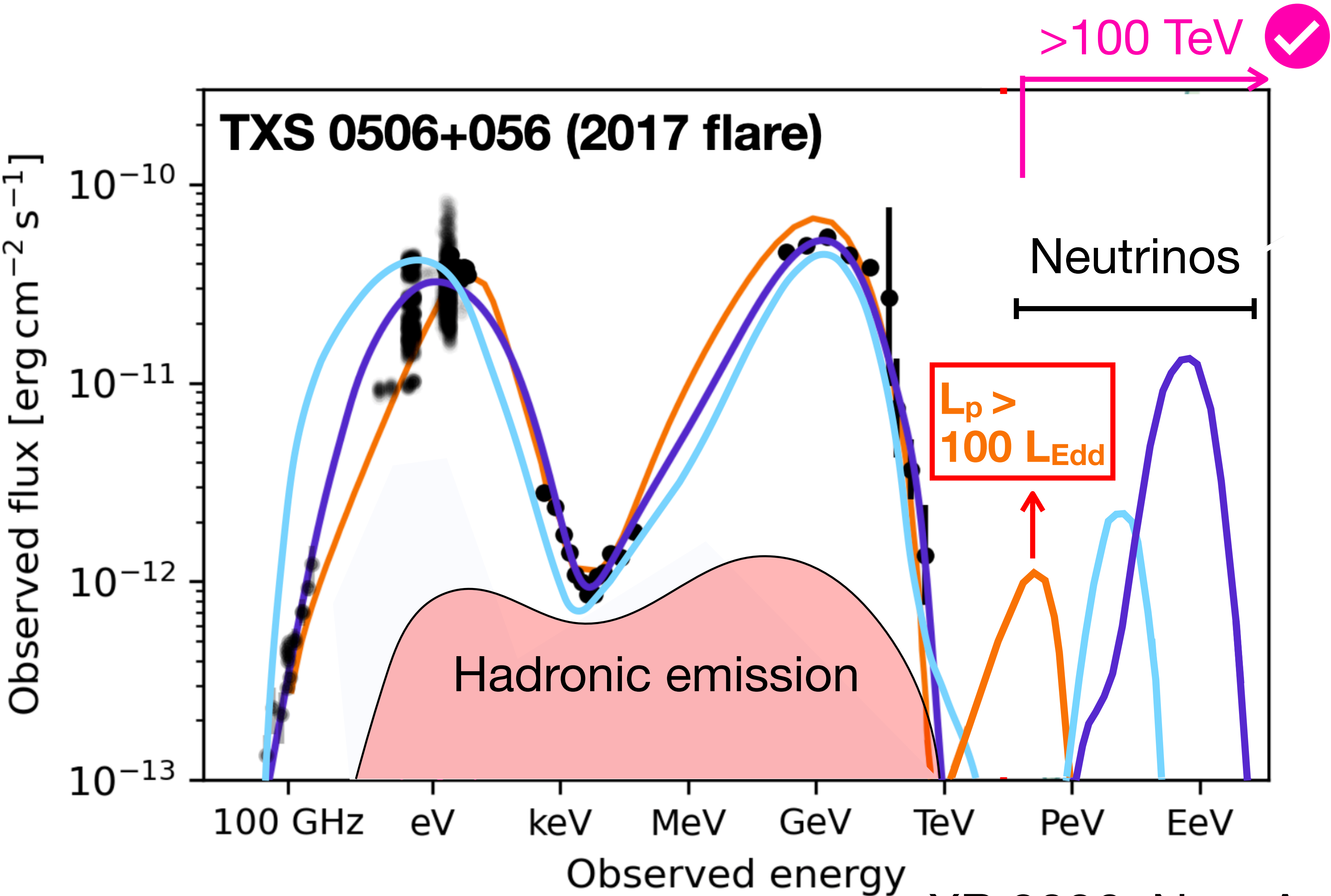
XR 2026, New Astron. Rev. 102

End of the road for one-zone models?



XR 2026, New Astron. Rev. 102

End of the road for one-zone models?



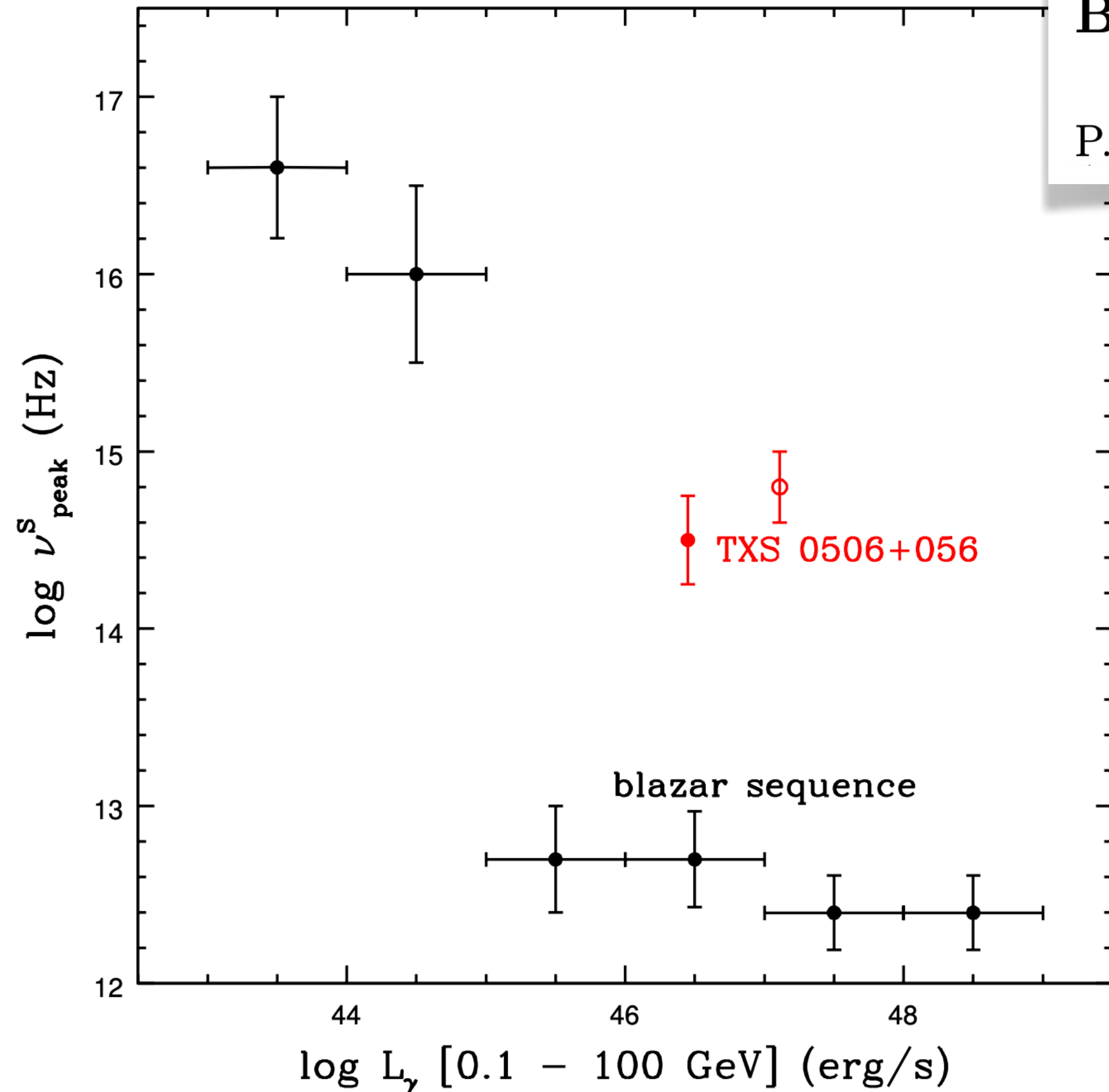
XR 2026, New Astron. Rev. 102

Dissecting the region around IceCube-170922A: the blazar TXS 0506+056 as the first cosmic neutrino source

P. Padovani¹, P. Giommi^{2,3,4}, E. Resconi⁵, T. Glauch⁵, B. Arsioli^{6,7}, N. Sahakyan⁸, M. Huber⁵

TXS 0506+056, the first cosmic neutrino source, is not a BL Lac

P. Padovani^{1,2}★, F. Oikonomou¹, M. Petropoulou³, P. Giommi^{4,5,6}, E. Resconi⁷

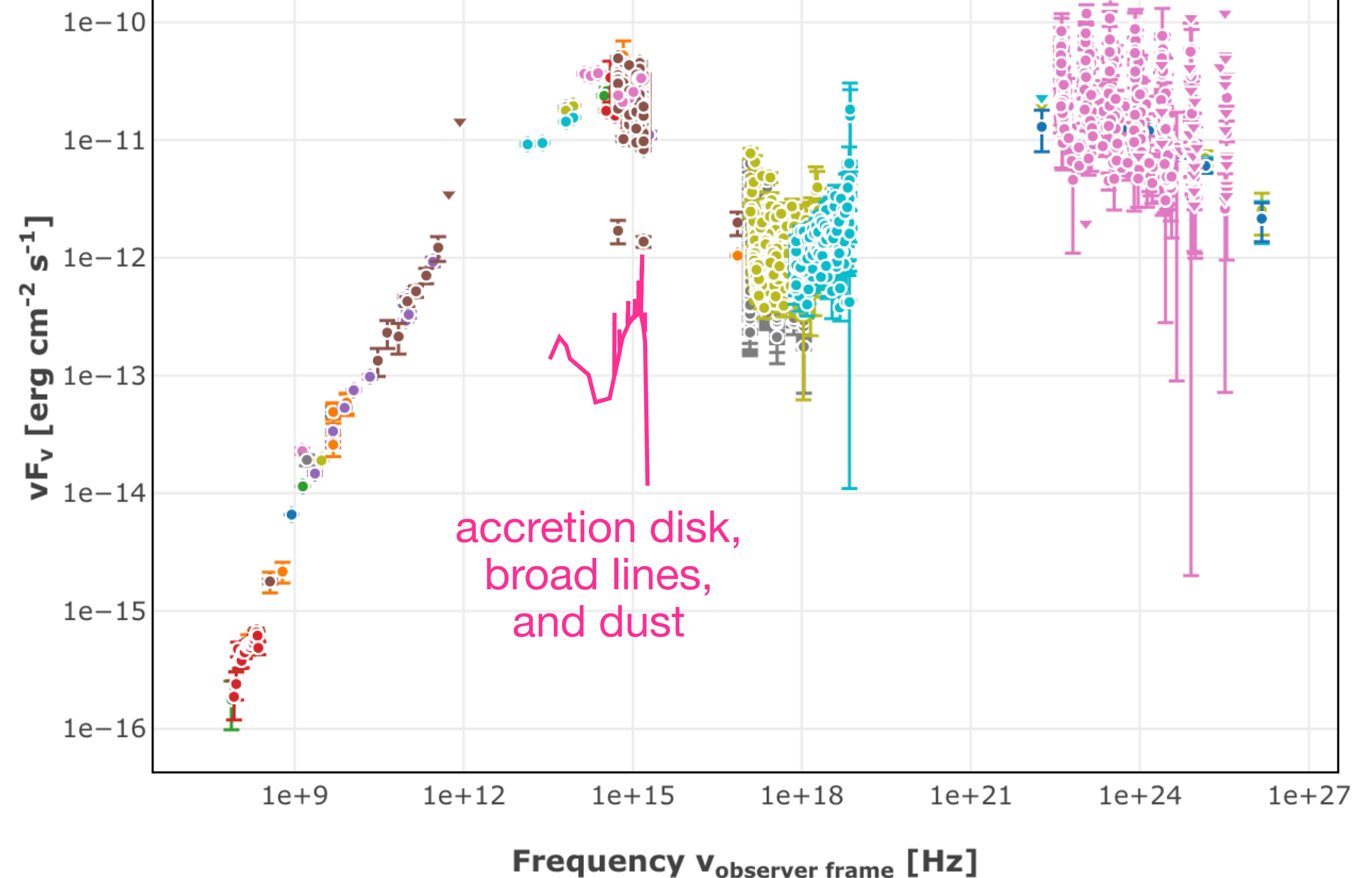
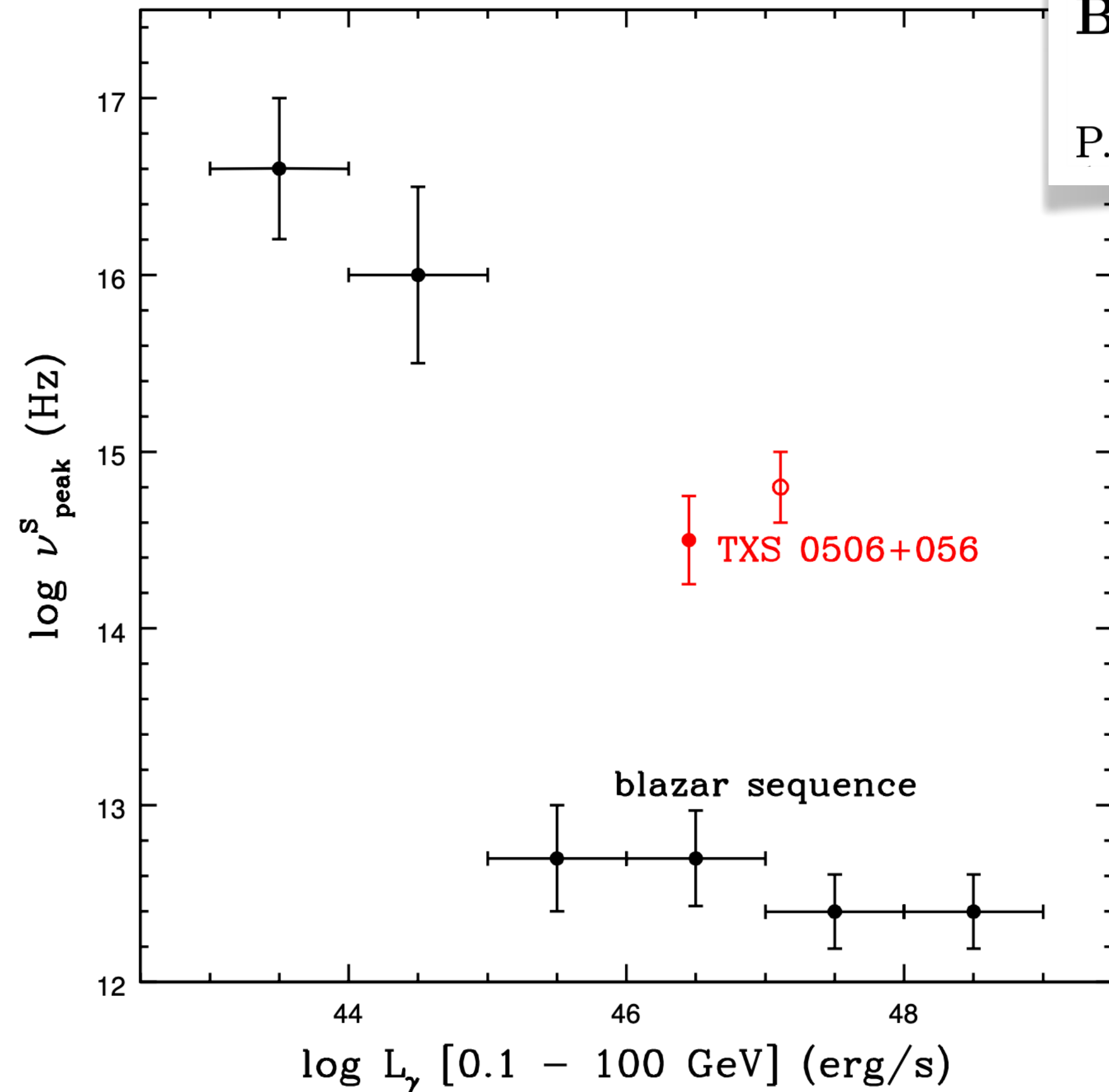


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The spectra of IceCube neutrino candidate sources - I. Optical spectroscopy of blazars

Simona Paiano^{1,2,3}★, Renato Falomo⁴, Aldo Treves^{5,6}, Paolo Padovani^{7,8}, Paolo Giommi^{9,10,11}, Riccardo Scarpa^{12,13}

The Spectra of IceCube Neutrino (SIN) candidate sources - II. Source Characterisation

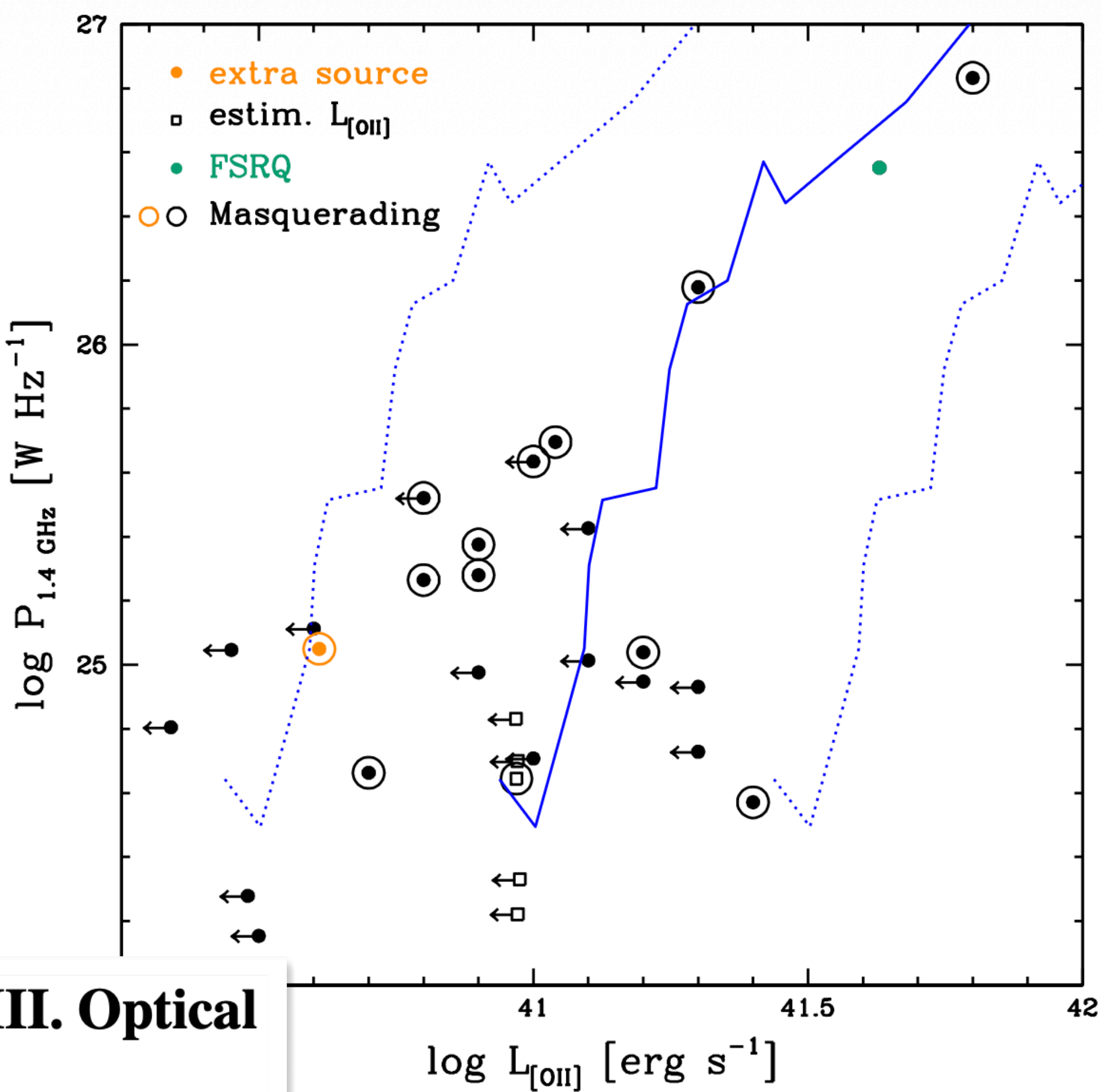
P. Padovani^{1,2}★, P. Giommi^{3,4,5}, R. Falomo⁶, F. Oikonomou⁷, M. Petropoulou⁸†, T. Glauch⁹, E. Resconi⁹, A. Treves^{10,11}, S. Paiano^{12,13,14}

The spectra of IceCube Neutrino (SIN) candidate sources - III. Optical spectroscopy and source characterization of the full sample

Simona Paiano^{1,2}★, Renato Falomo³, Aldo Treves^{4,5}, Paolo Padovani^{6,7}, Paolo Giommi^{8,9,10}, Riccardo Scarpa^{11,12}, Susanna Bisogni², Ester Marini¹³

The spectra of IceCube Neutrino (SIN) candidate sources – IV. Spectral energy distributions and multiwavelength variability

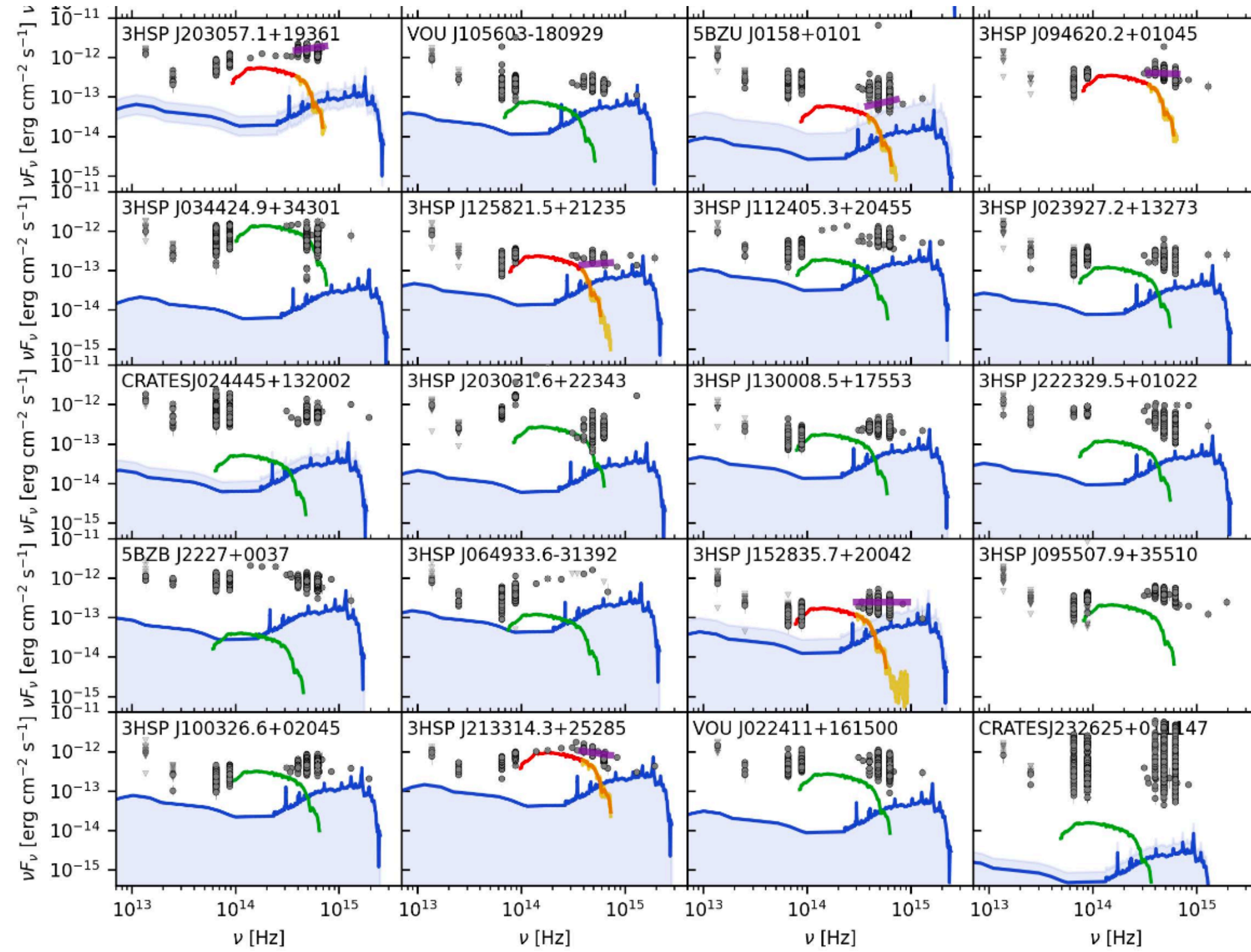
Martina Karl , ^{1,2}★ Paolo Padovani ^{2,3} and Paolo Giommi ^{4,5,6}



The Spectra of IceCube Neutrino (SIN) candidate sources

V. Modeling and interpretation of multiwavelength and neutrino data

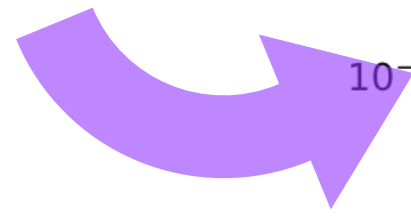
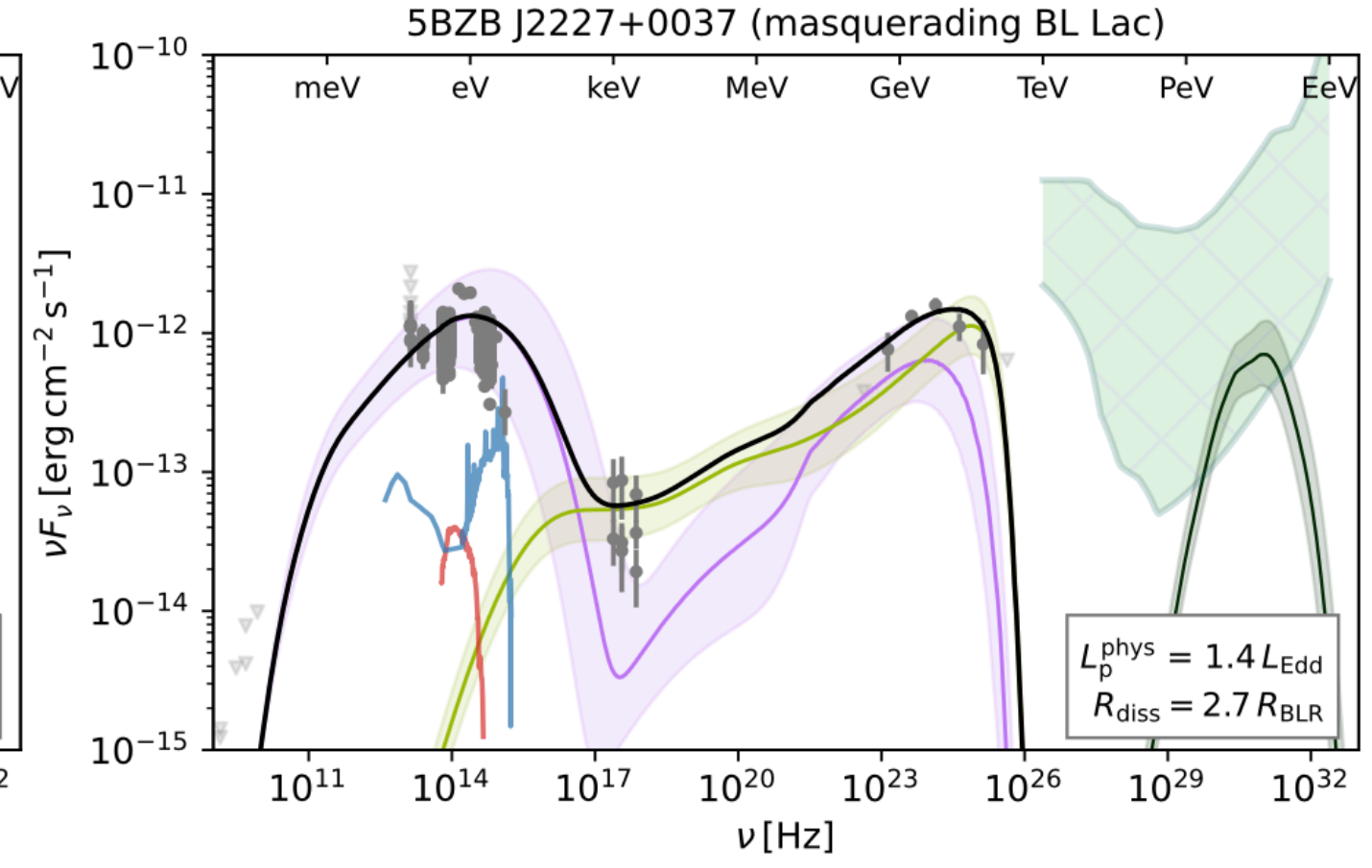
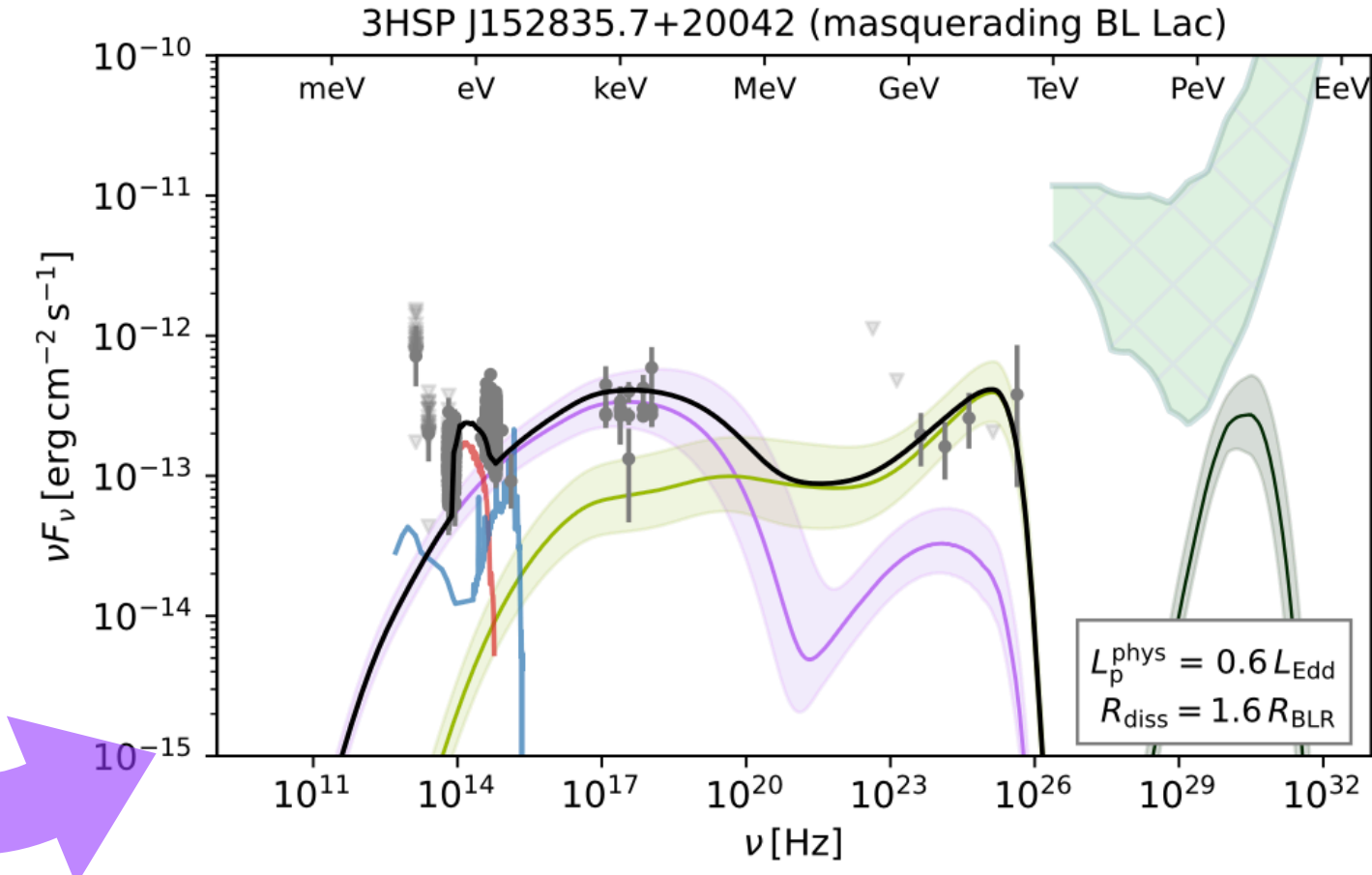
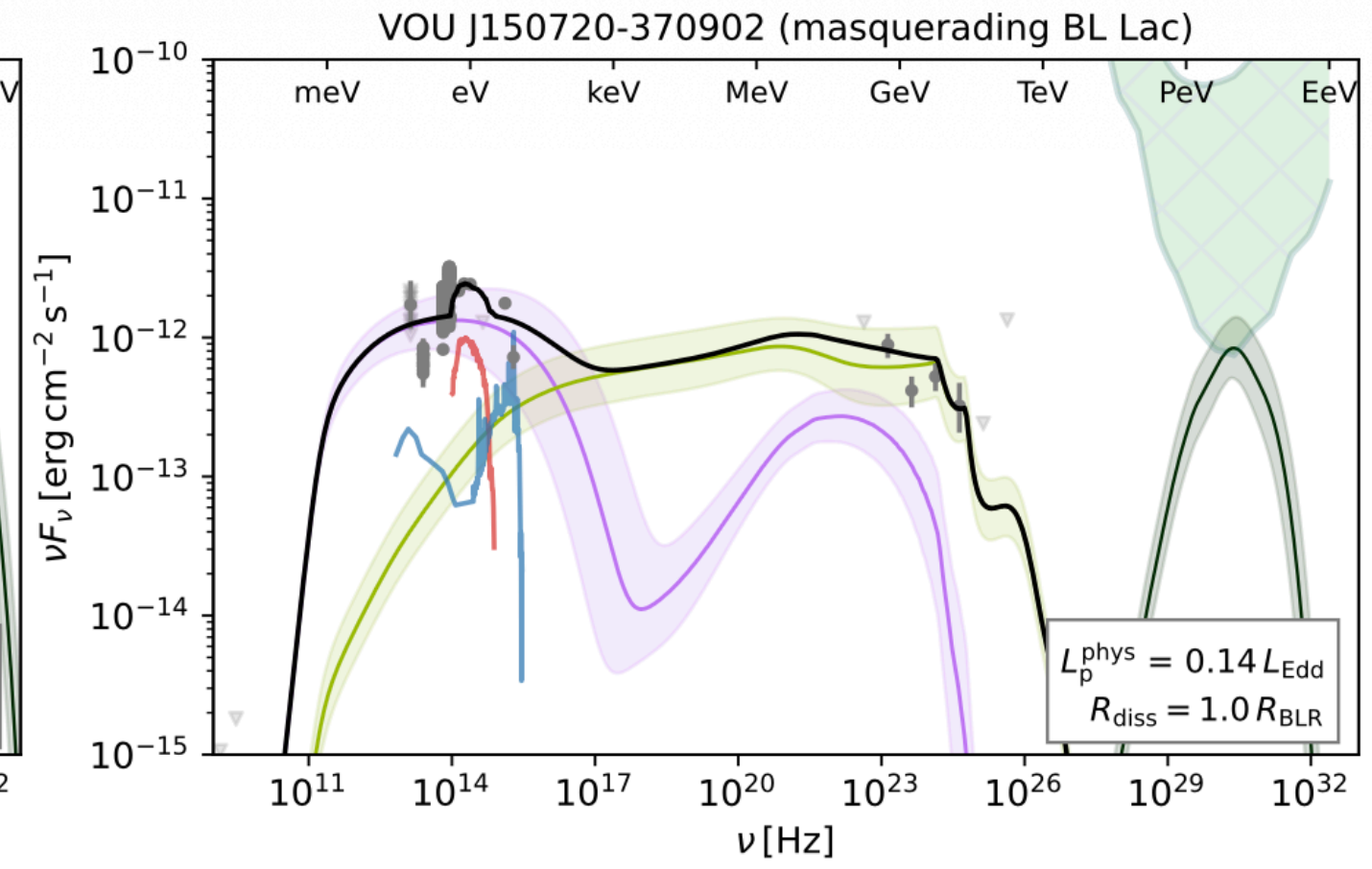
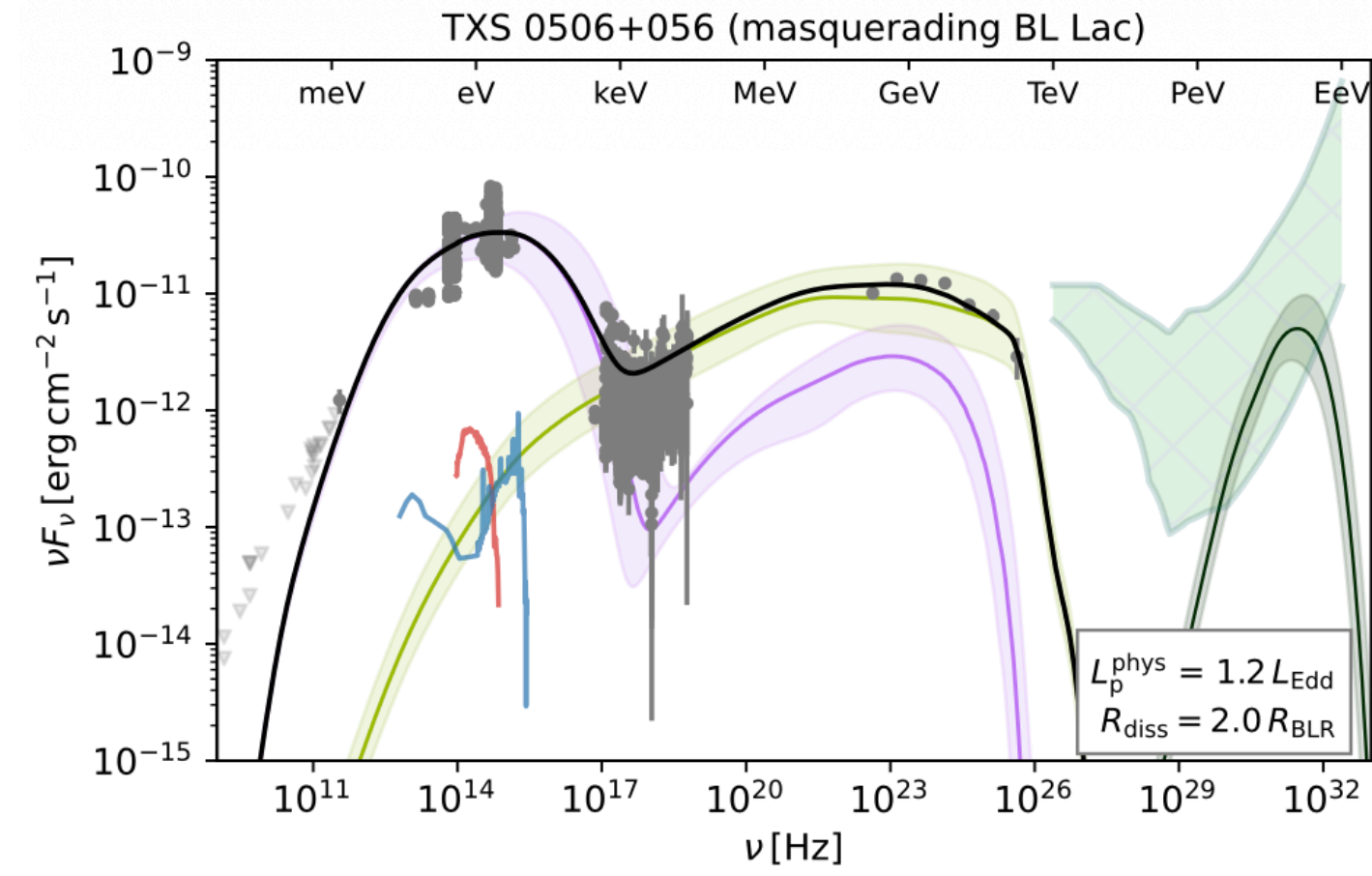
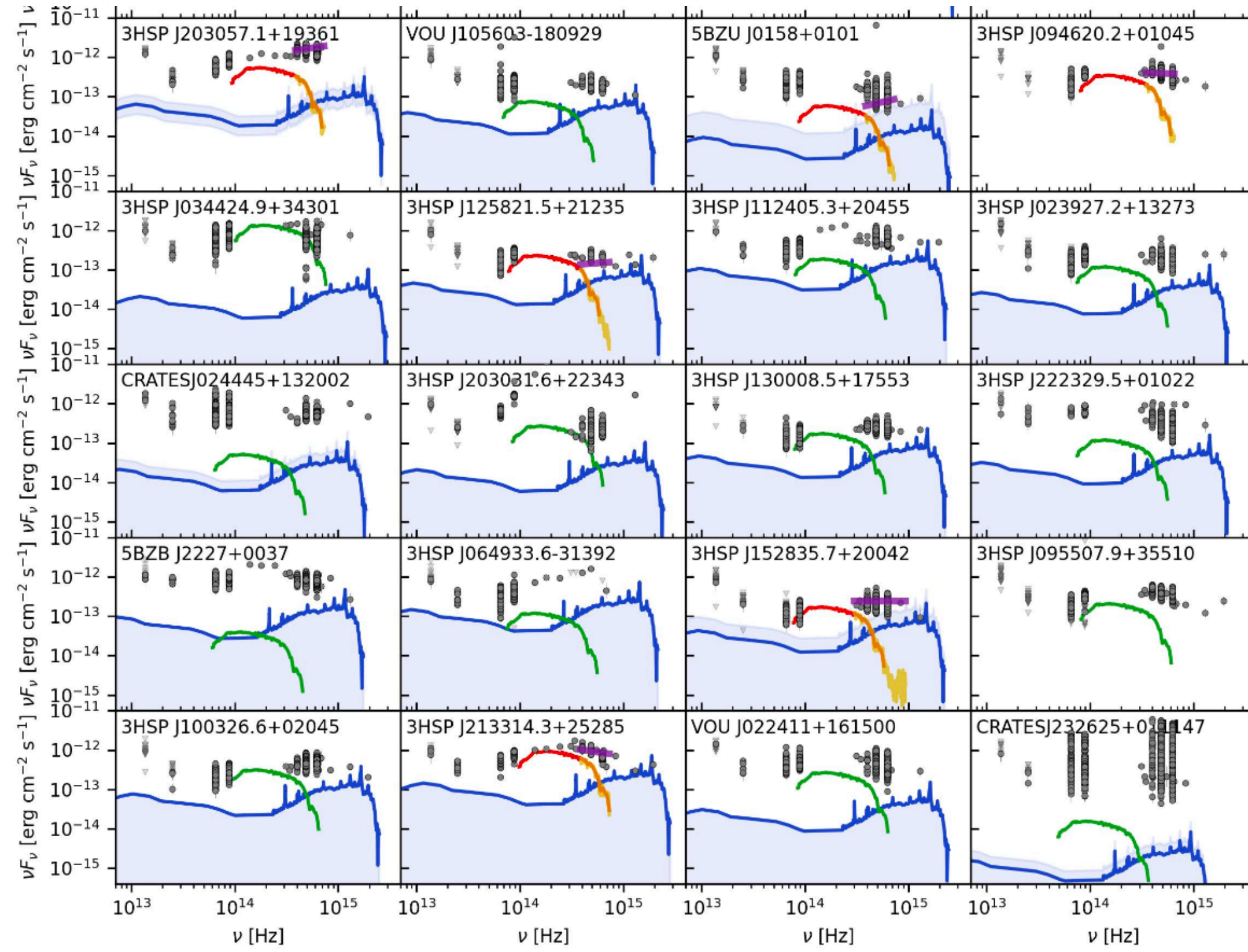
X. Rodrigues^{1,2,★}, M. Karl^{3,1}, P. Padovani¹, P. Giommi^{4,5,6}, S. Paiano^{7,8}, R. Falomo⁹,
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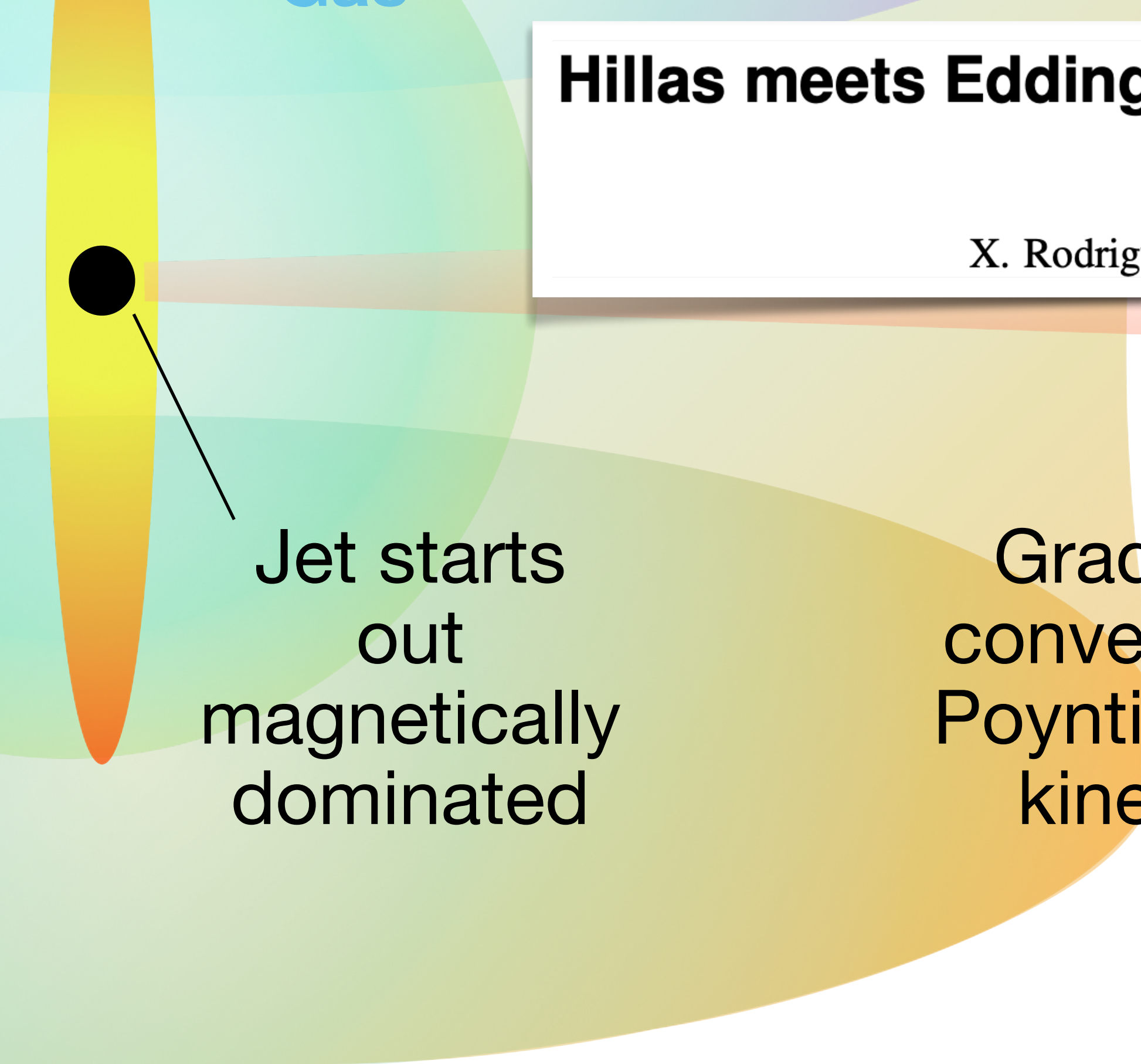
Hillas meets Eddington: The case for blazars as ultra-high-energy neutrino sources

X. Rodrigues^{1,2},, F. Rieger^{3,4}, A. Bohdan³, and P. Padovani¹



Hillas meets Eddington: The case for blazars as ultra-high-energy neutrino sources

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Jet starts
out
magnetically
dominated

Gradual
conversion
 $Poynting \gg$
kinetic

Small fraction of the
particles in the medium
are continuously
accelerated by turbulence

Hillas meets Eddington: The case for blazars as ultra-high-energy neutrino sources

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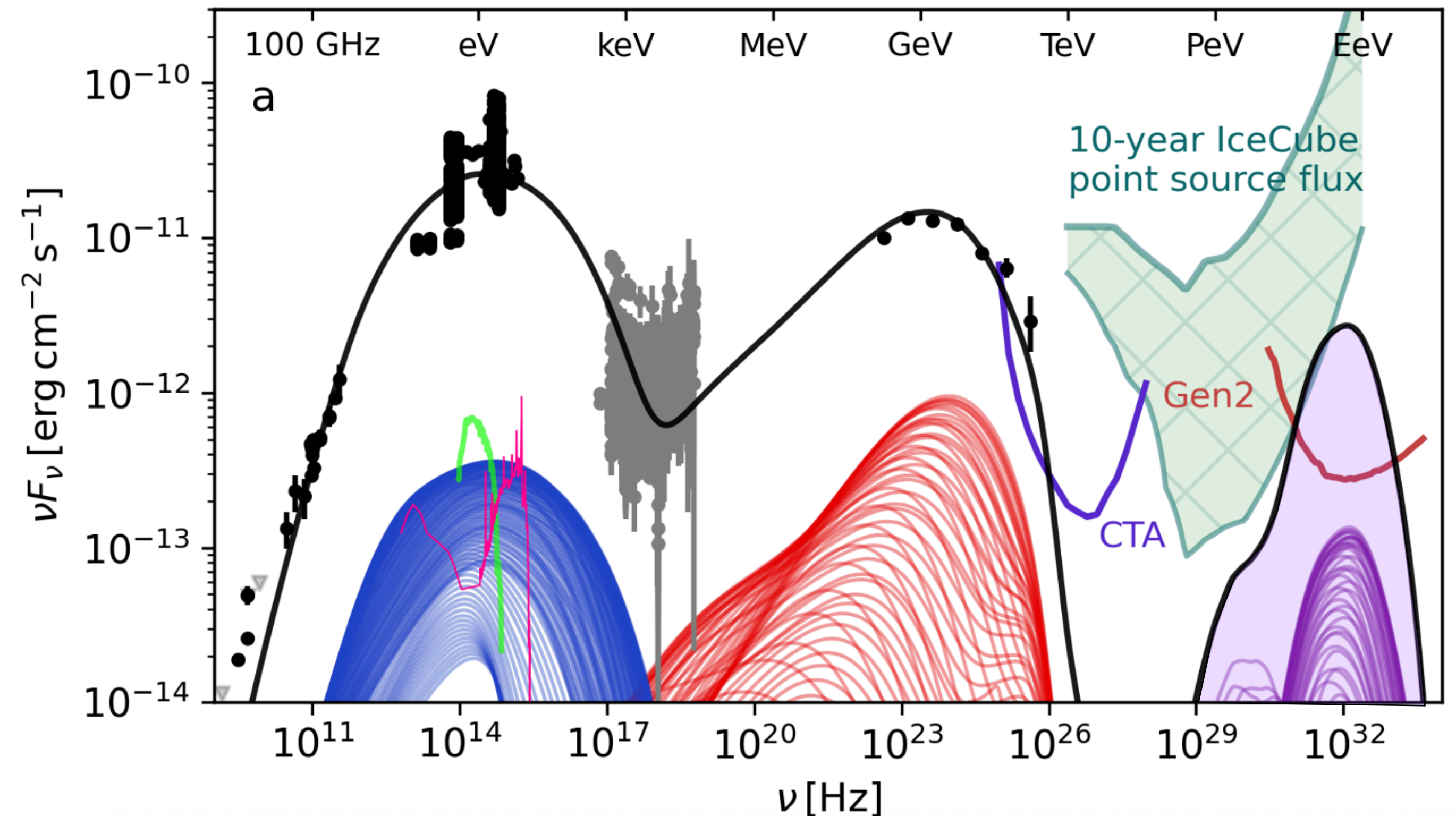


~30 mpc:
proton emission
(gammas, X-rays,
neutrinos)

~ 0.1-1 pc:
optical

~ 1-10 pc:
radio

TXS 0506+056 (quiescent)



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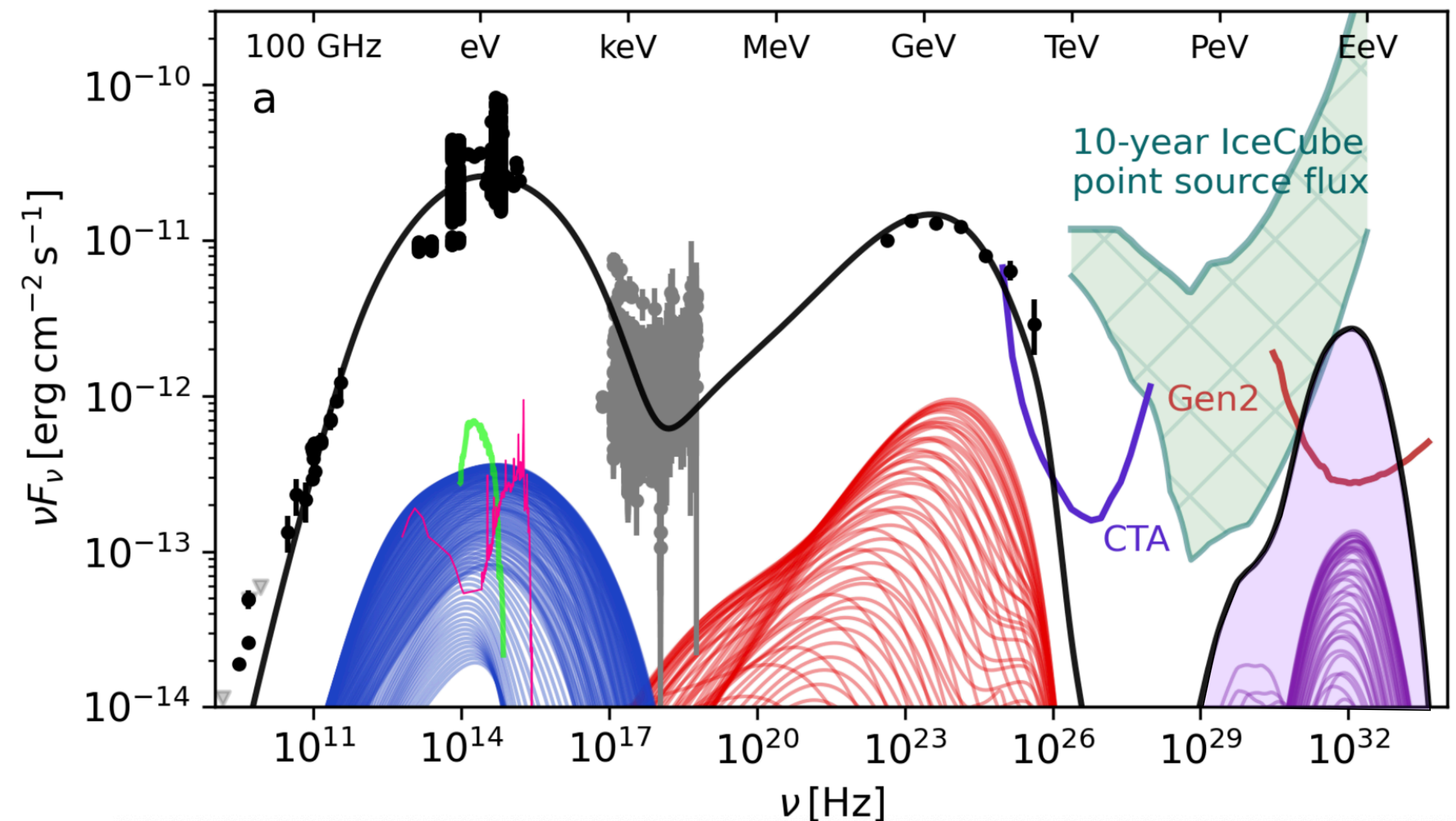
Single-zone models

Extended jet models

Pheno parameters
B-field, ad hoc particle
energies,...

Physics parameters
Jet power, turbulence,
density, diffusion...

TXS 0506+056 (quiescent)



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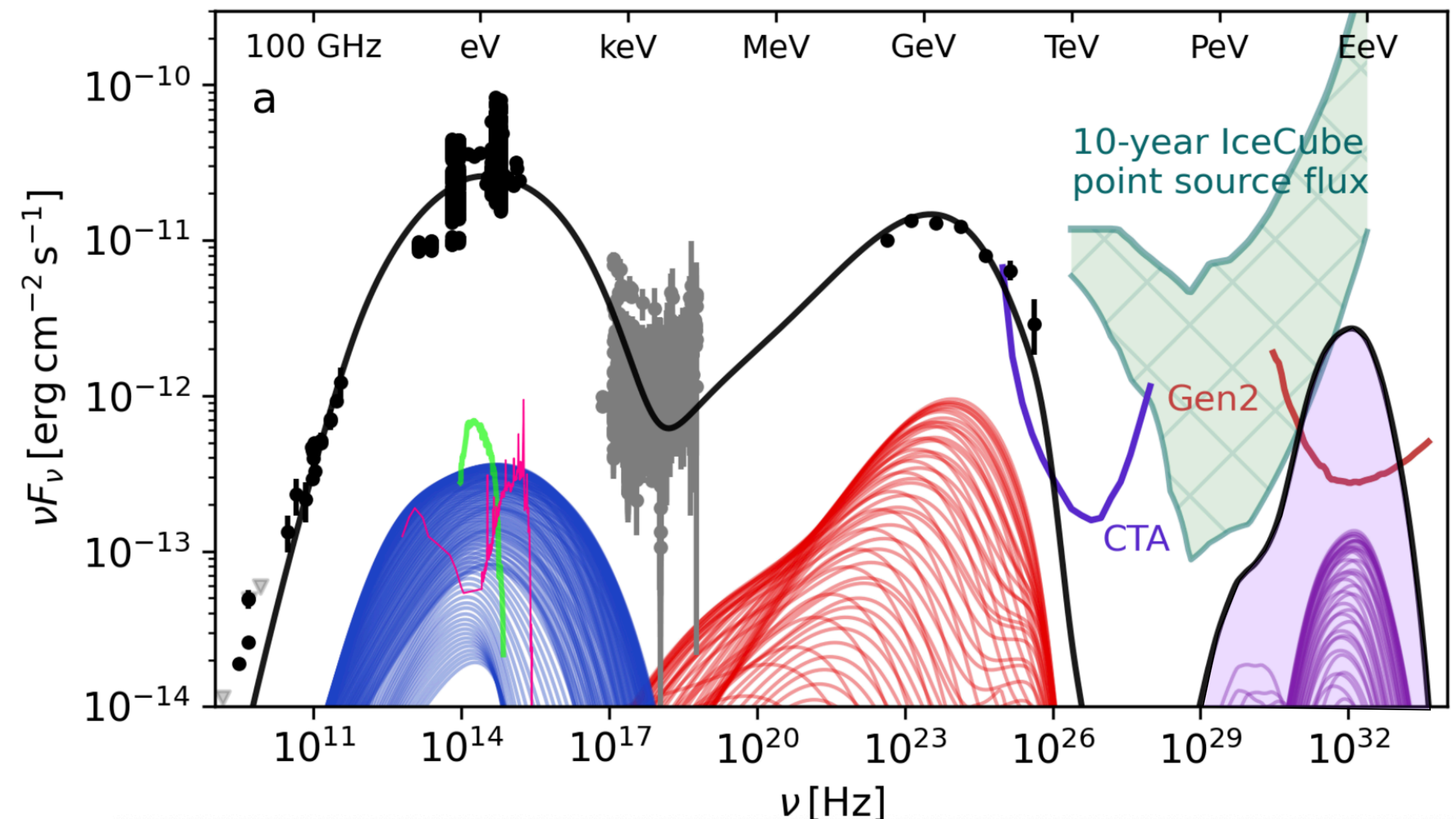
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Access to hidden
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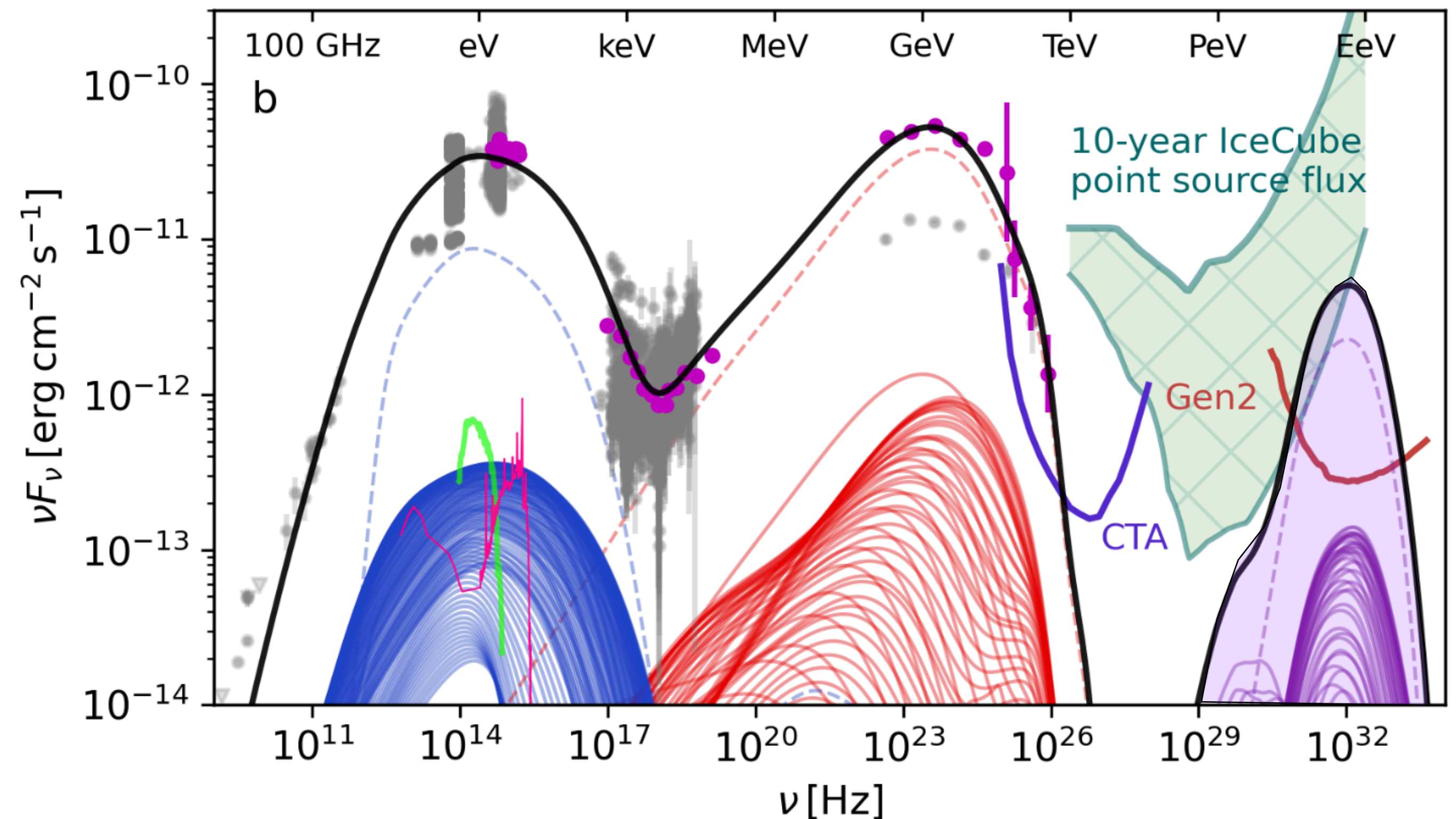
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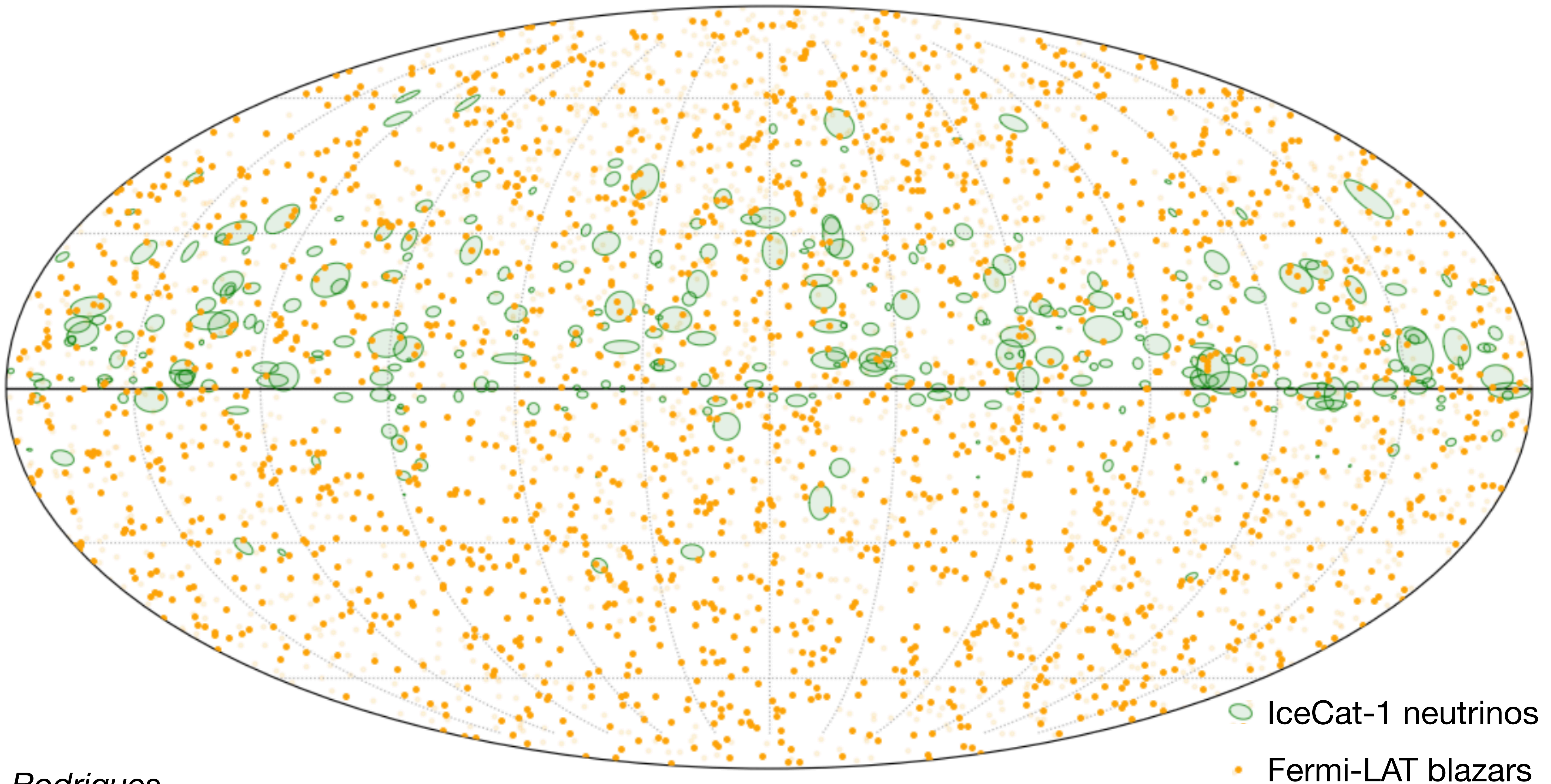
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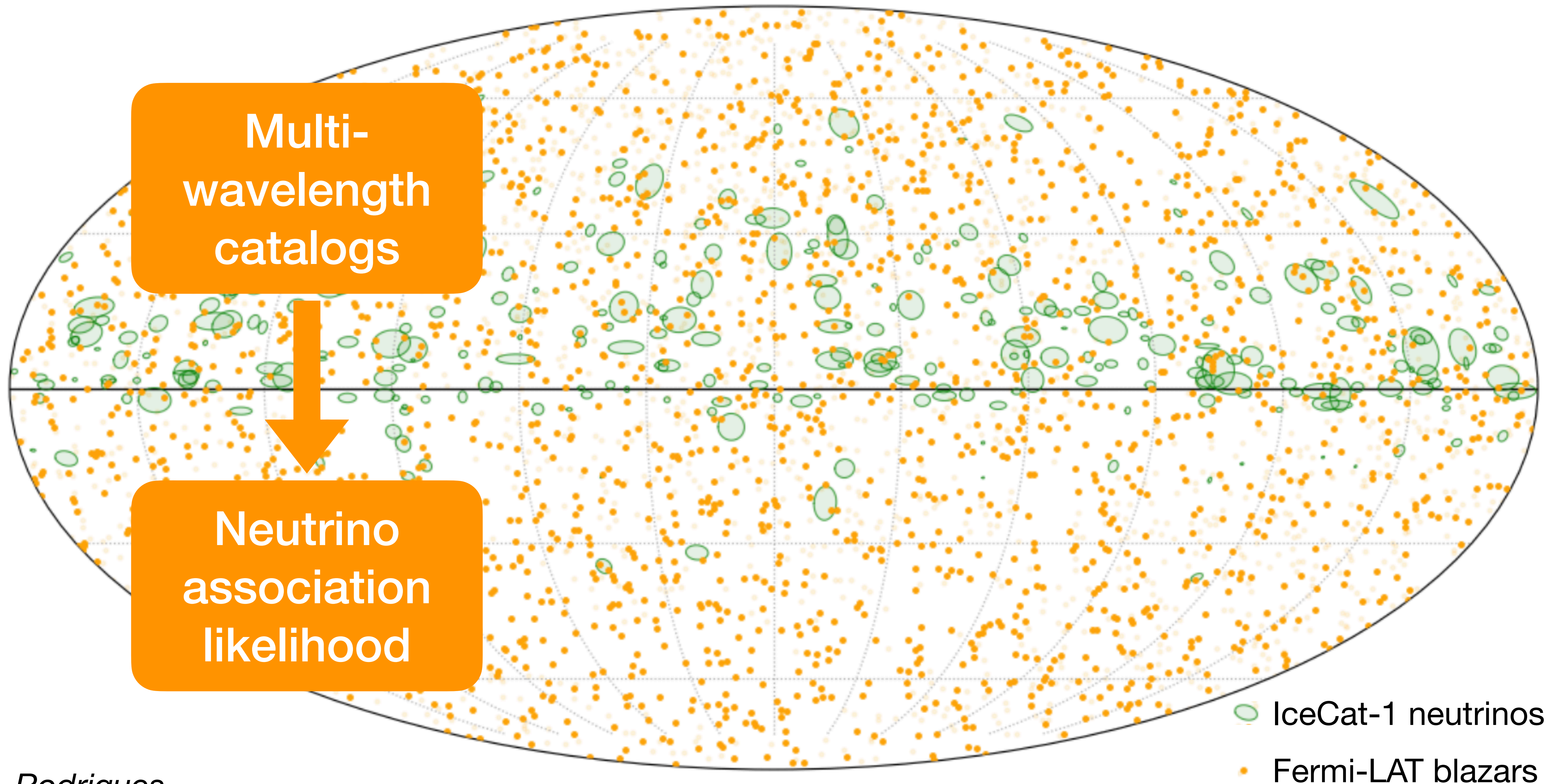
TXS 0506+056 (2017 flare)



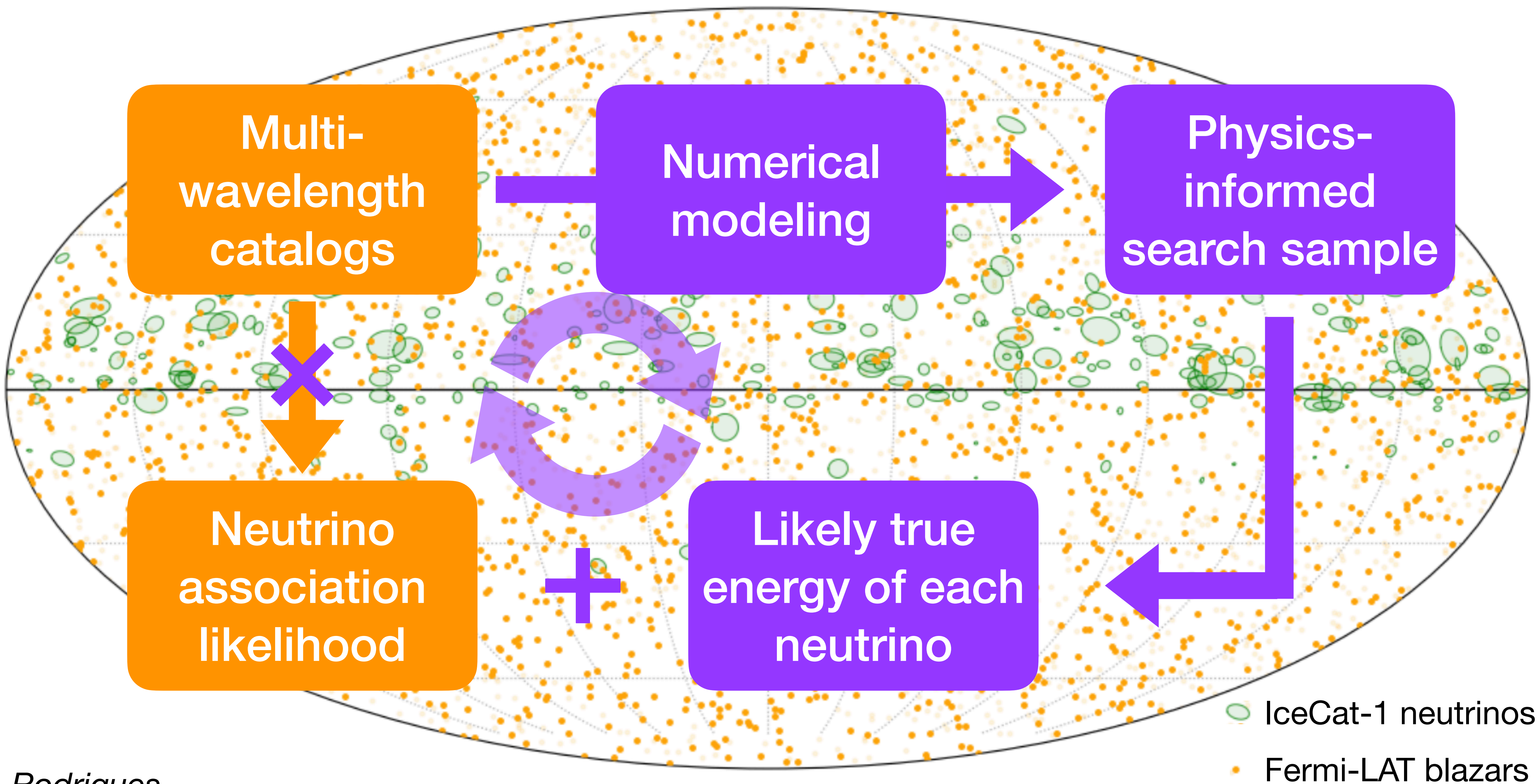
Two decade after the first neutrino blazar: what will we know?



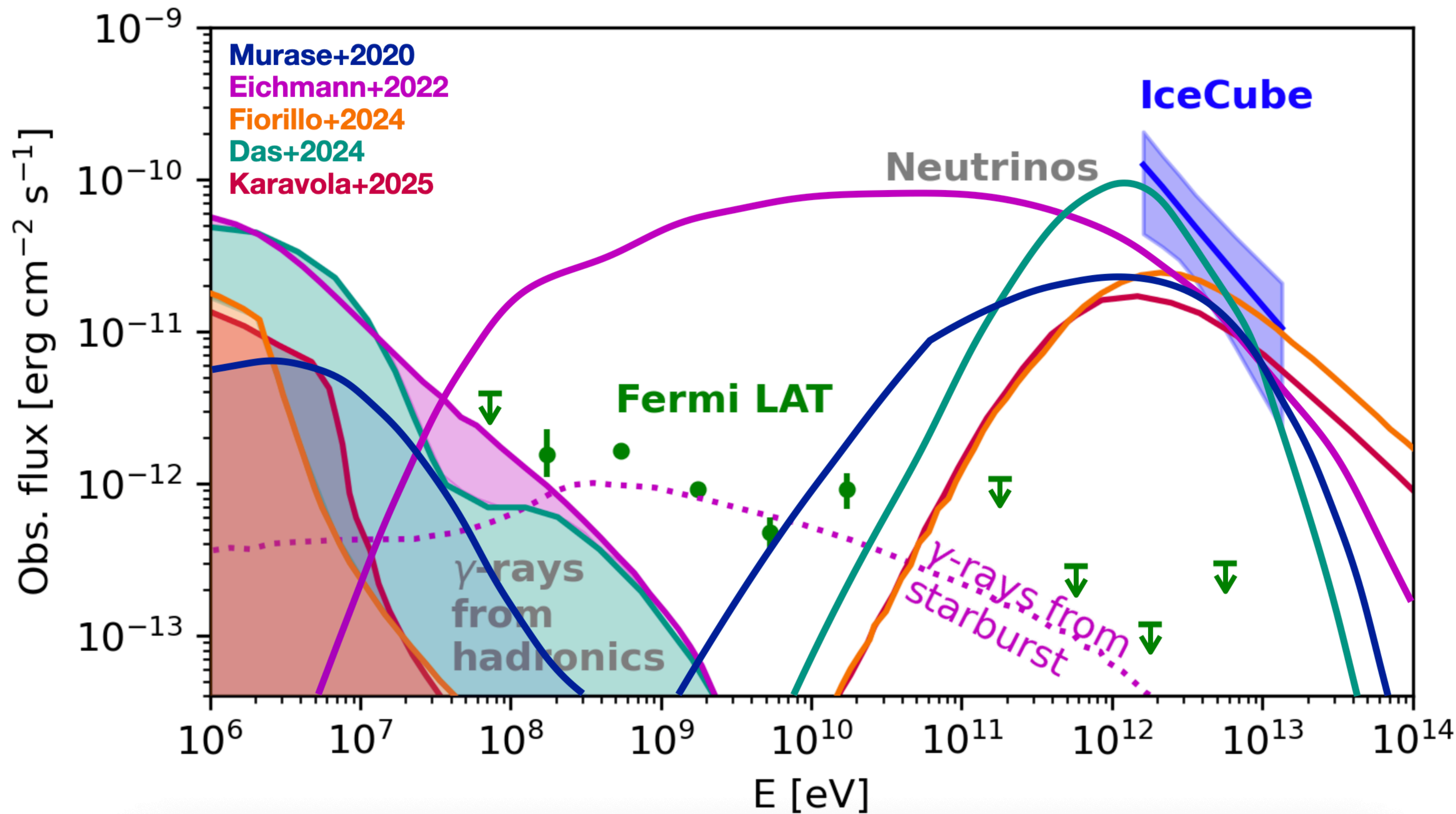
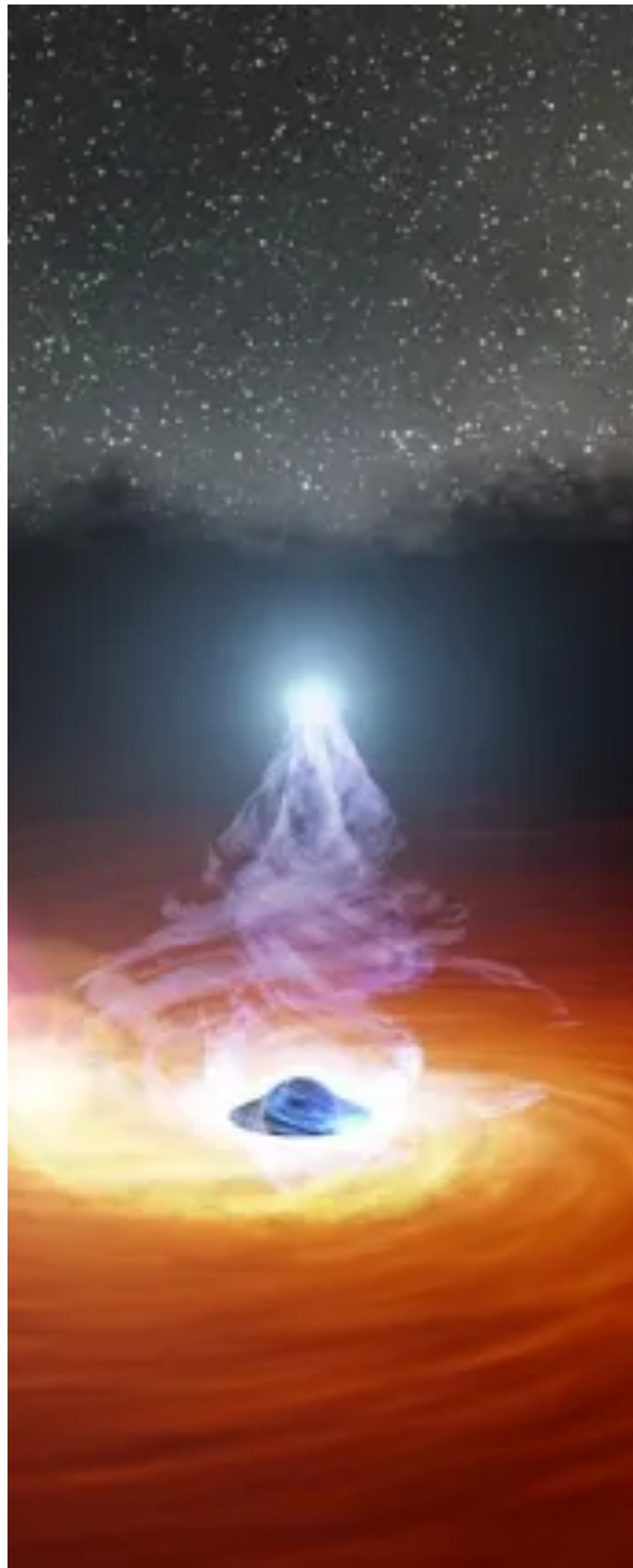
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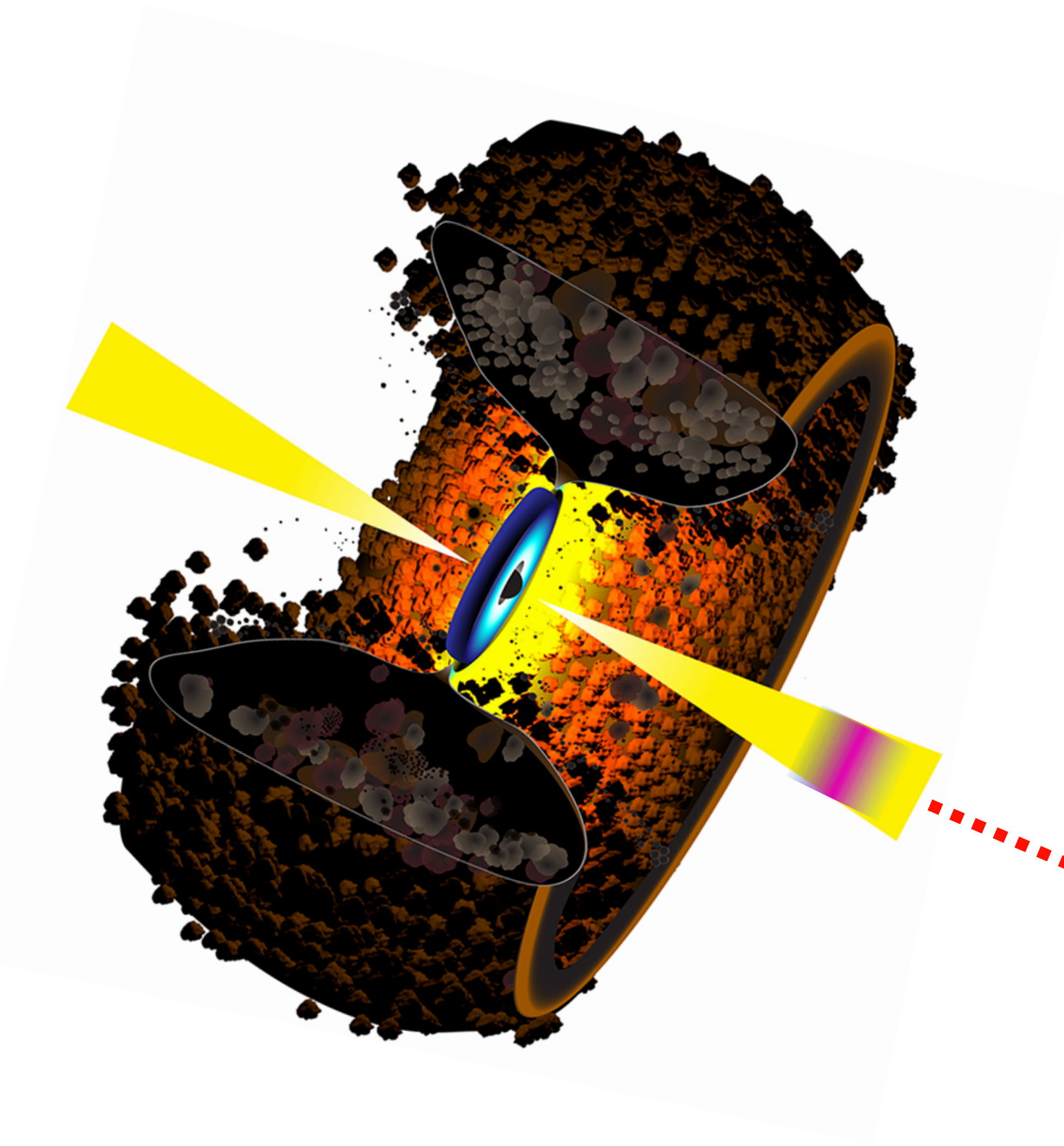
Two decade after the first neutrino blazar: what will we know?



NGC 1068



TXS 0506+056, a decade on: what do we know?



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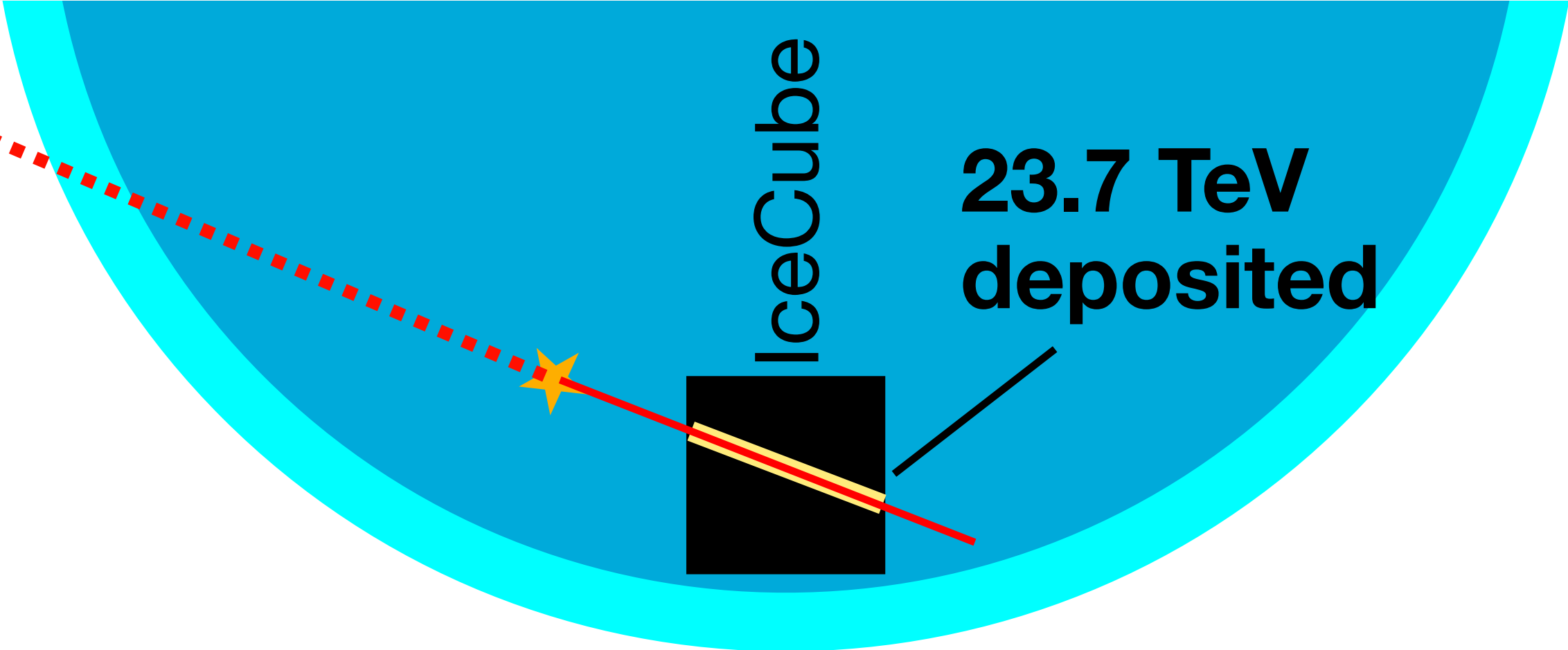
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RESEARCH ARTICLE

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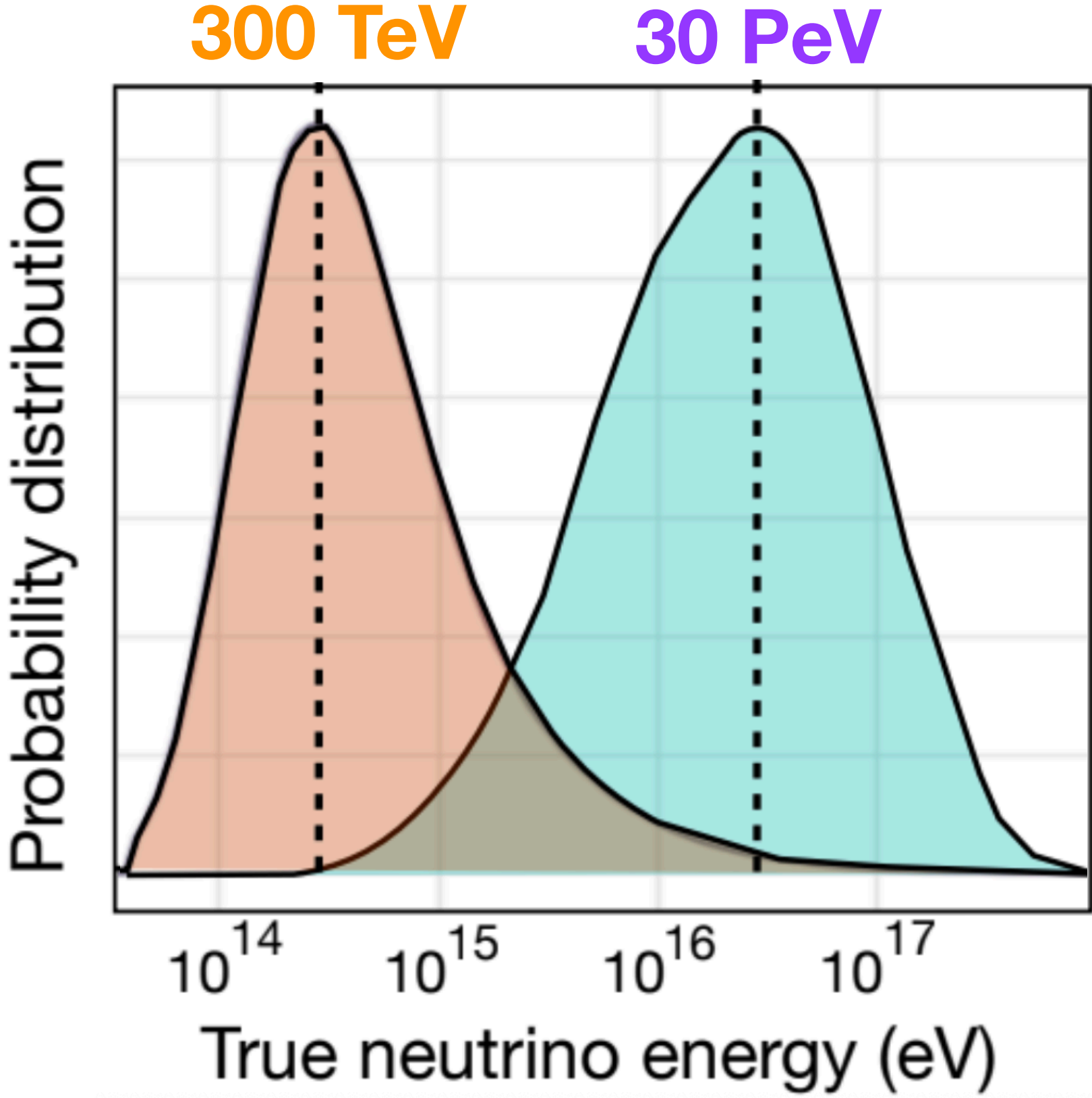
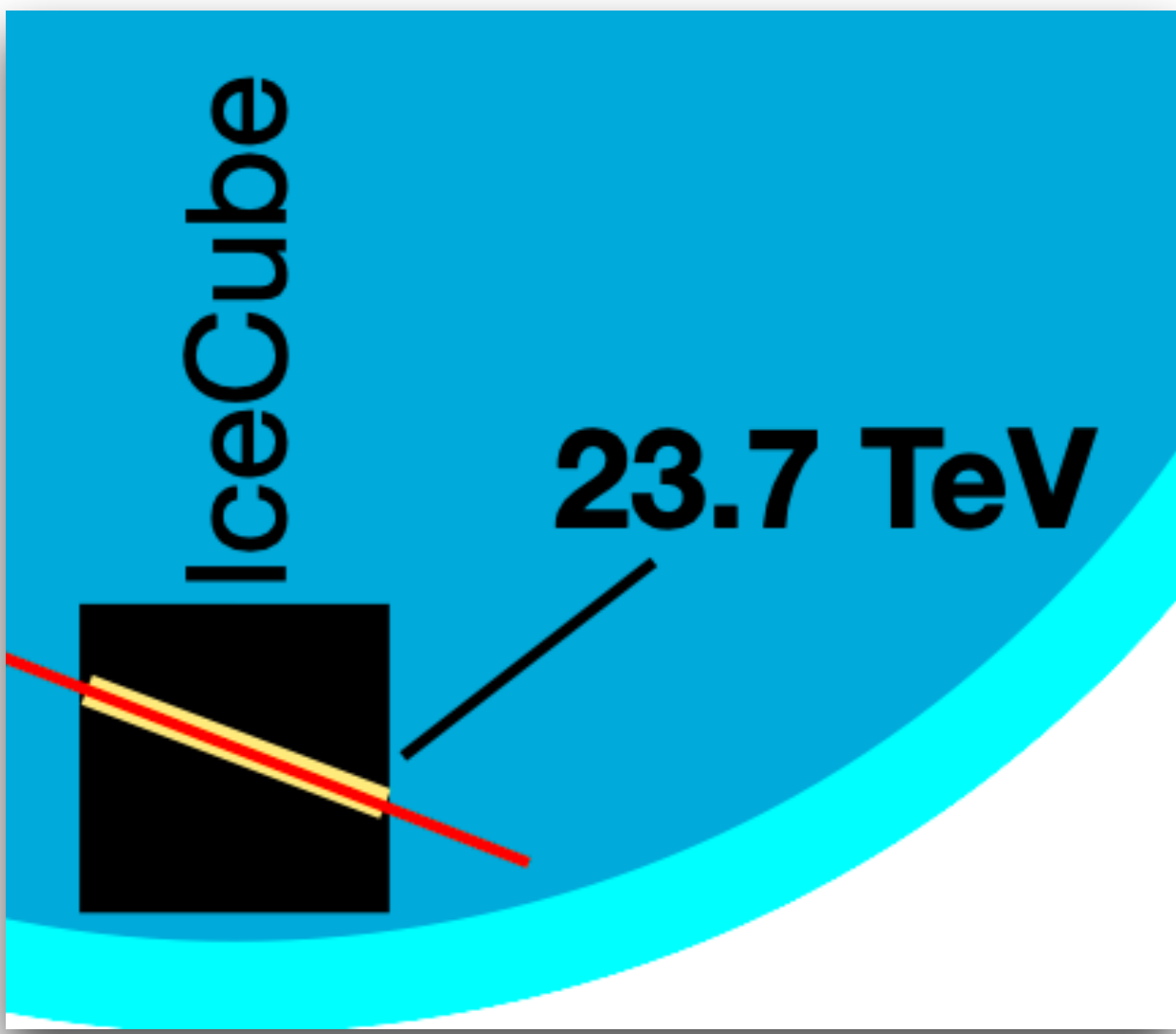
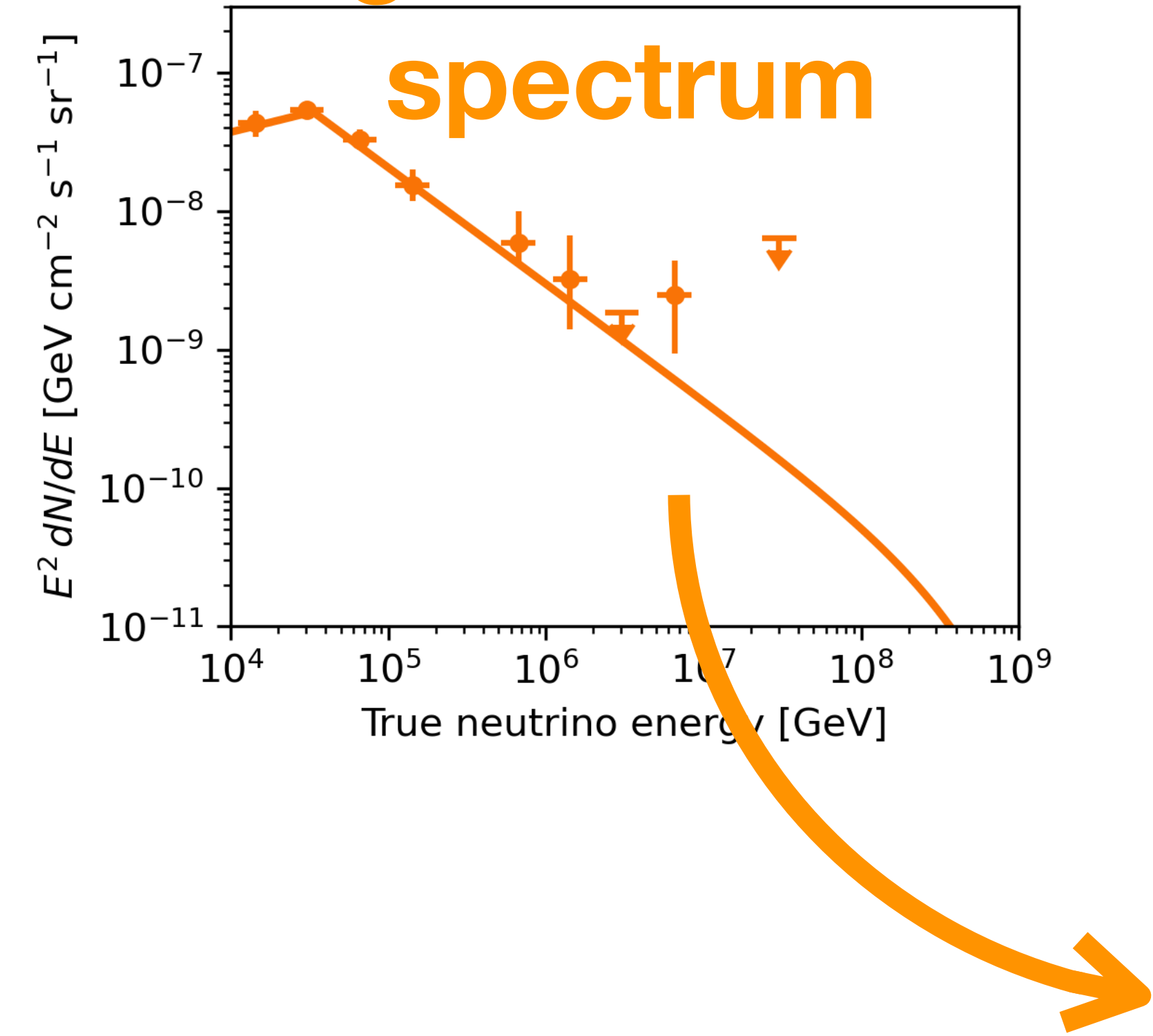
Multimessenger observations of a flaring blazar coincident with high-energy neutrino IceCube-170922A

generate high-energy neutrinos and γ -rays, which are produced when the cosmic rays accelerated in the jet interact with nearby gas or photons. On 22 September 2017, the cubic-kilometer IceCube Neutrino Observatory detected a **~290-TeV** neutrino from a direction consistent with the flaring γ -ray blazar TXS 0506+056. We report the details of this observation and the results of a multiwavelength follow-

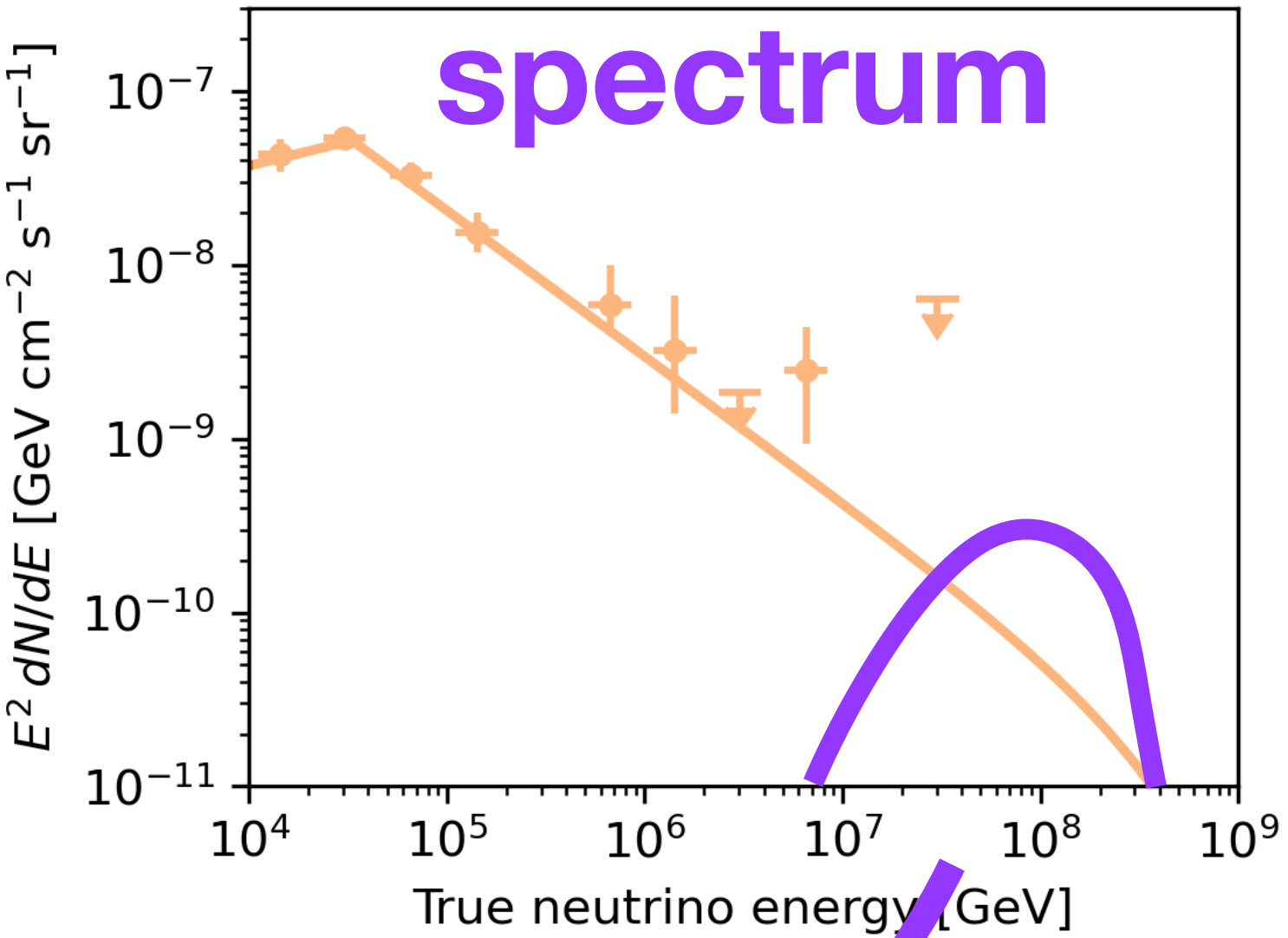


What is the energy of the IceCube alert events?

Assumption:
signal is a soft
spectrum



Assumption:
signal is a hard
spectrum



cf. Kuhlmann & Capel
2025, ApJ 994

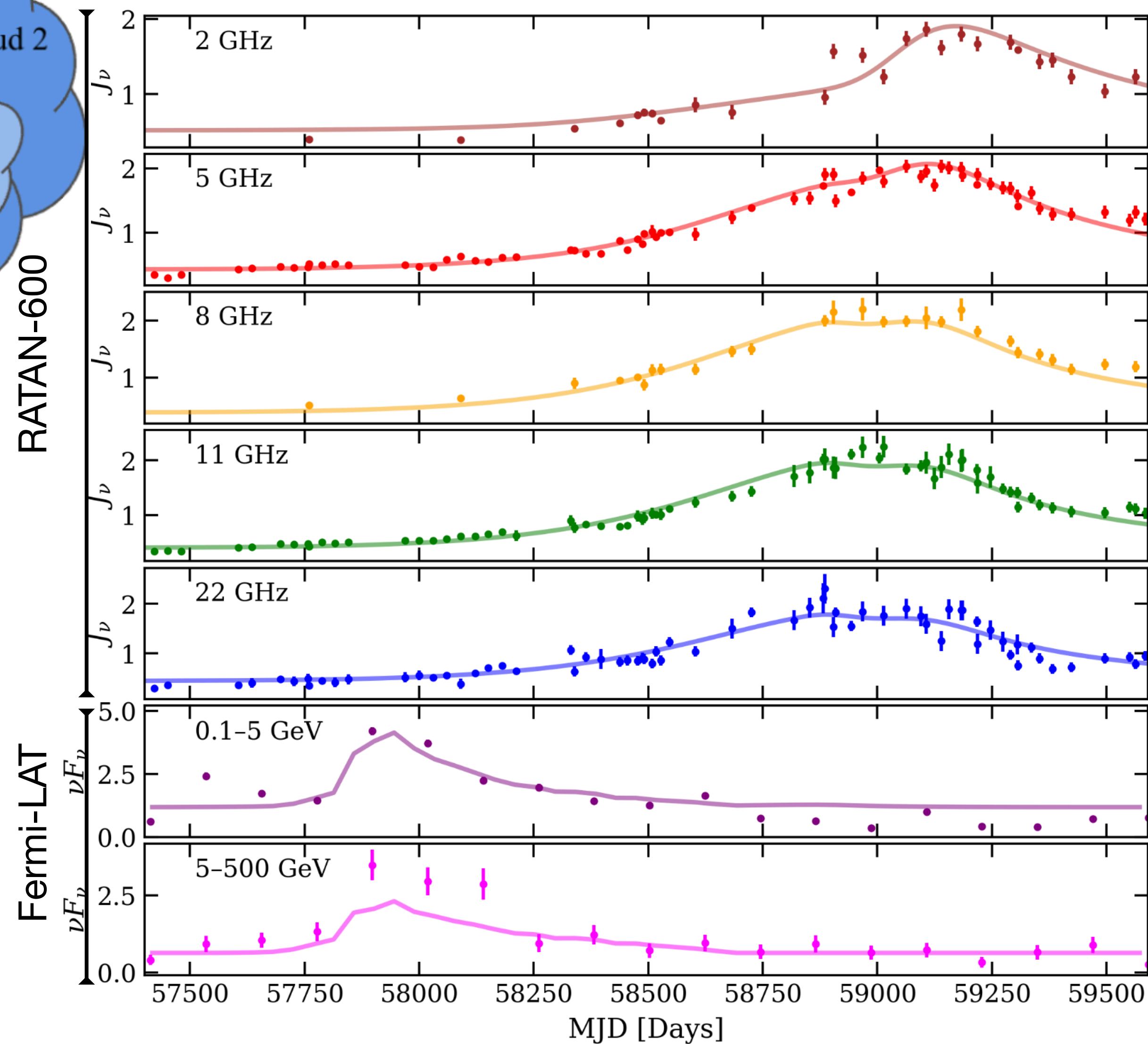
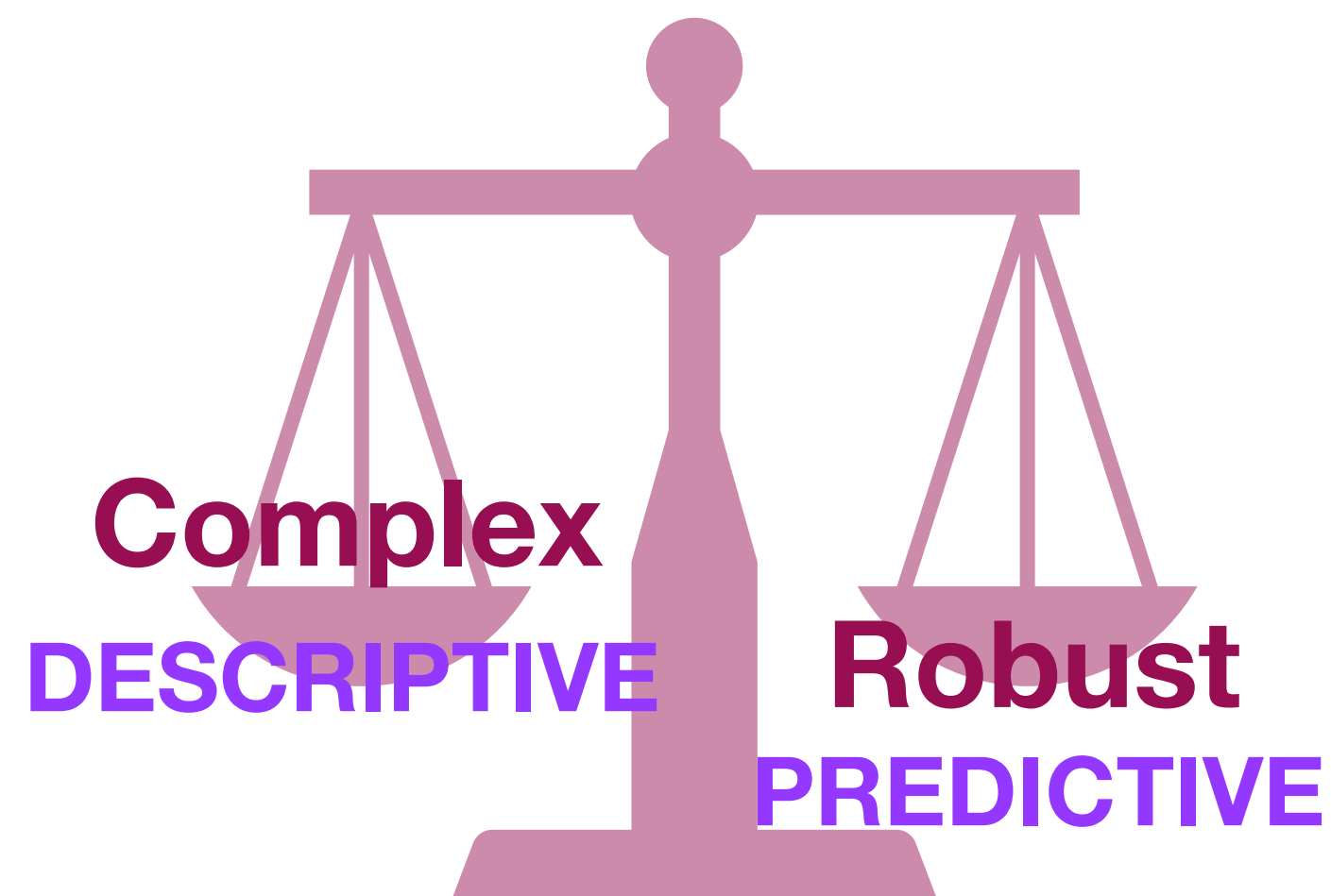
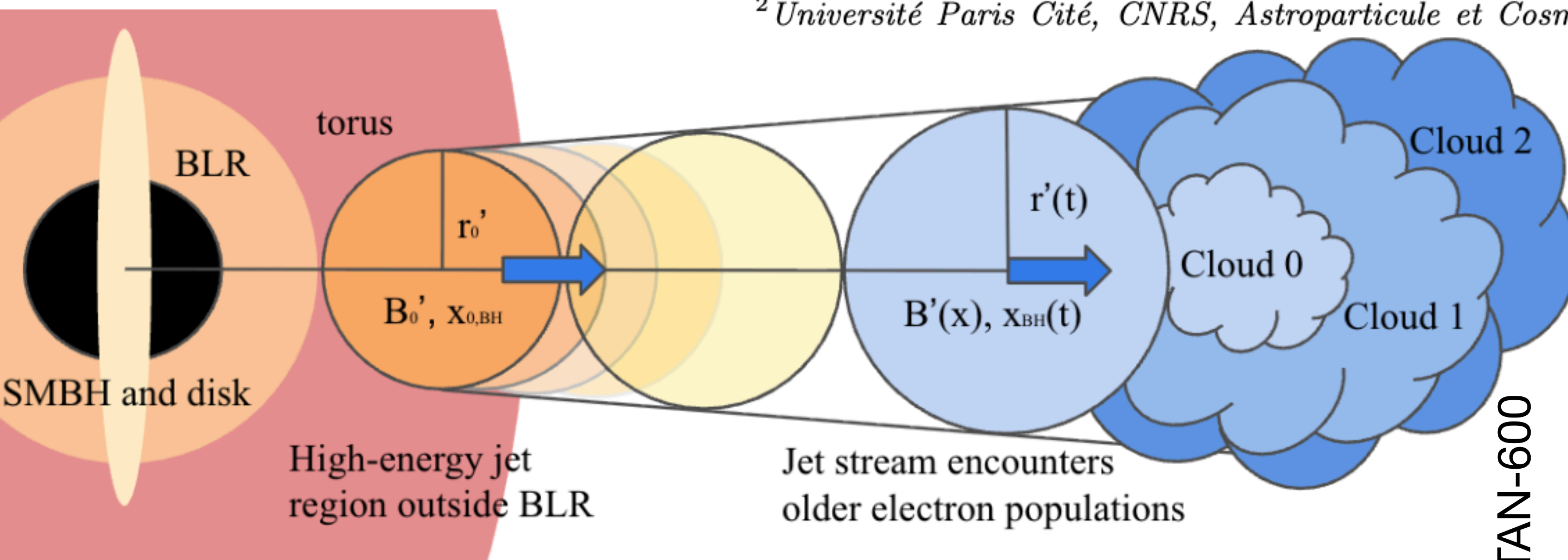
An Evolving Leptonic Jet Model for Delayed Radio Flares in Neutrino Blazars

arXiv:2608.12696
submitted to PRD

Alina Kochocki,¹ Xavier Rodrigues,² and Nathan Whitehorn¹

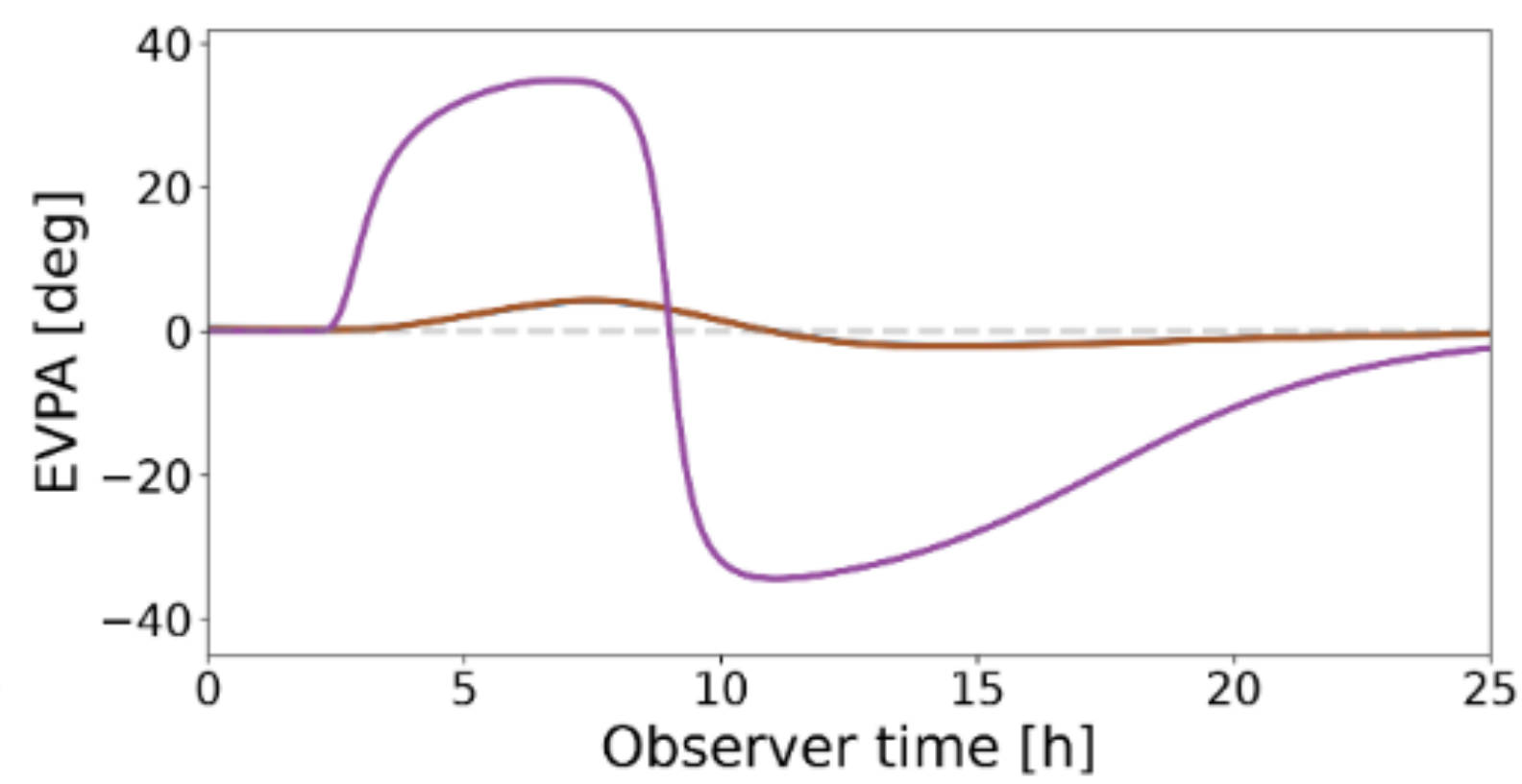
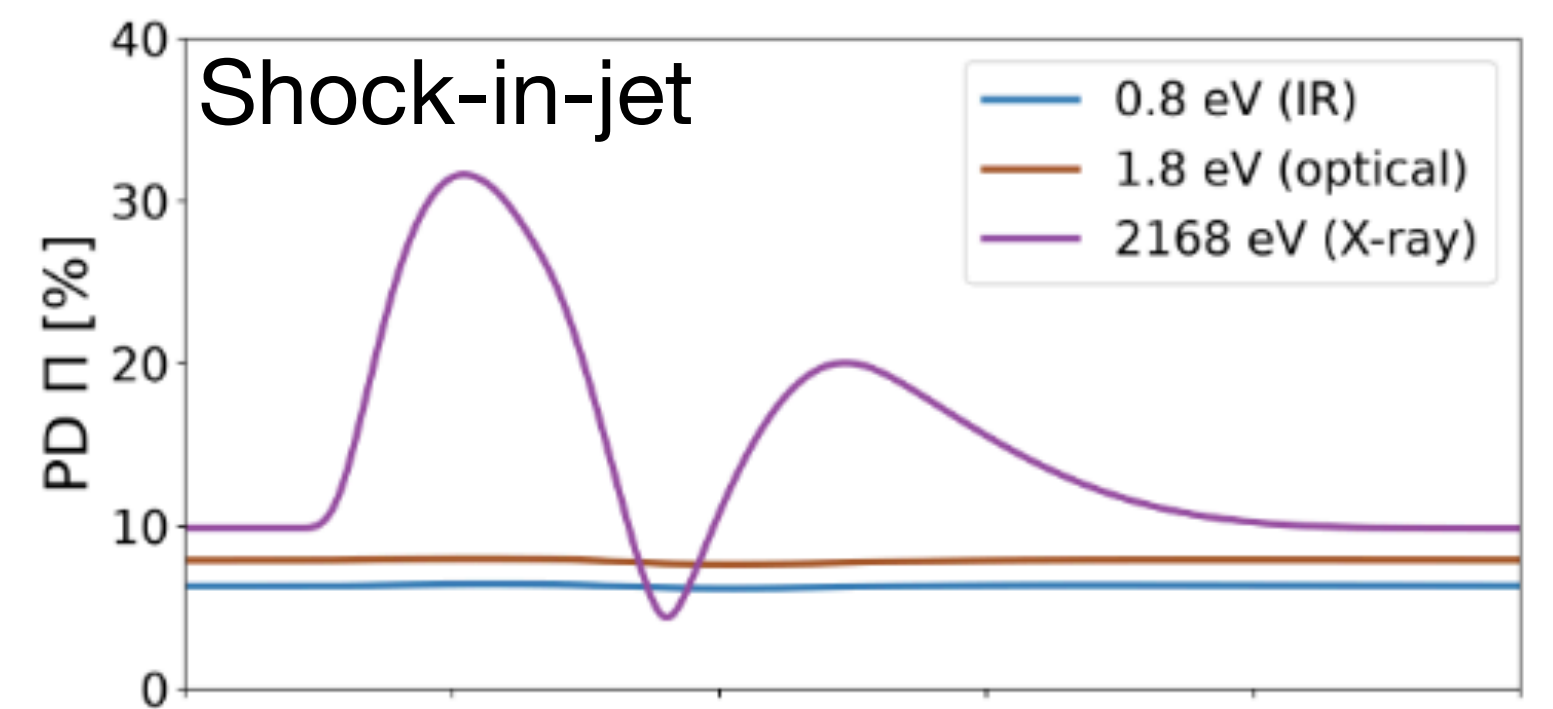
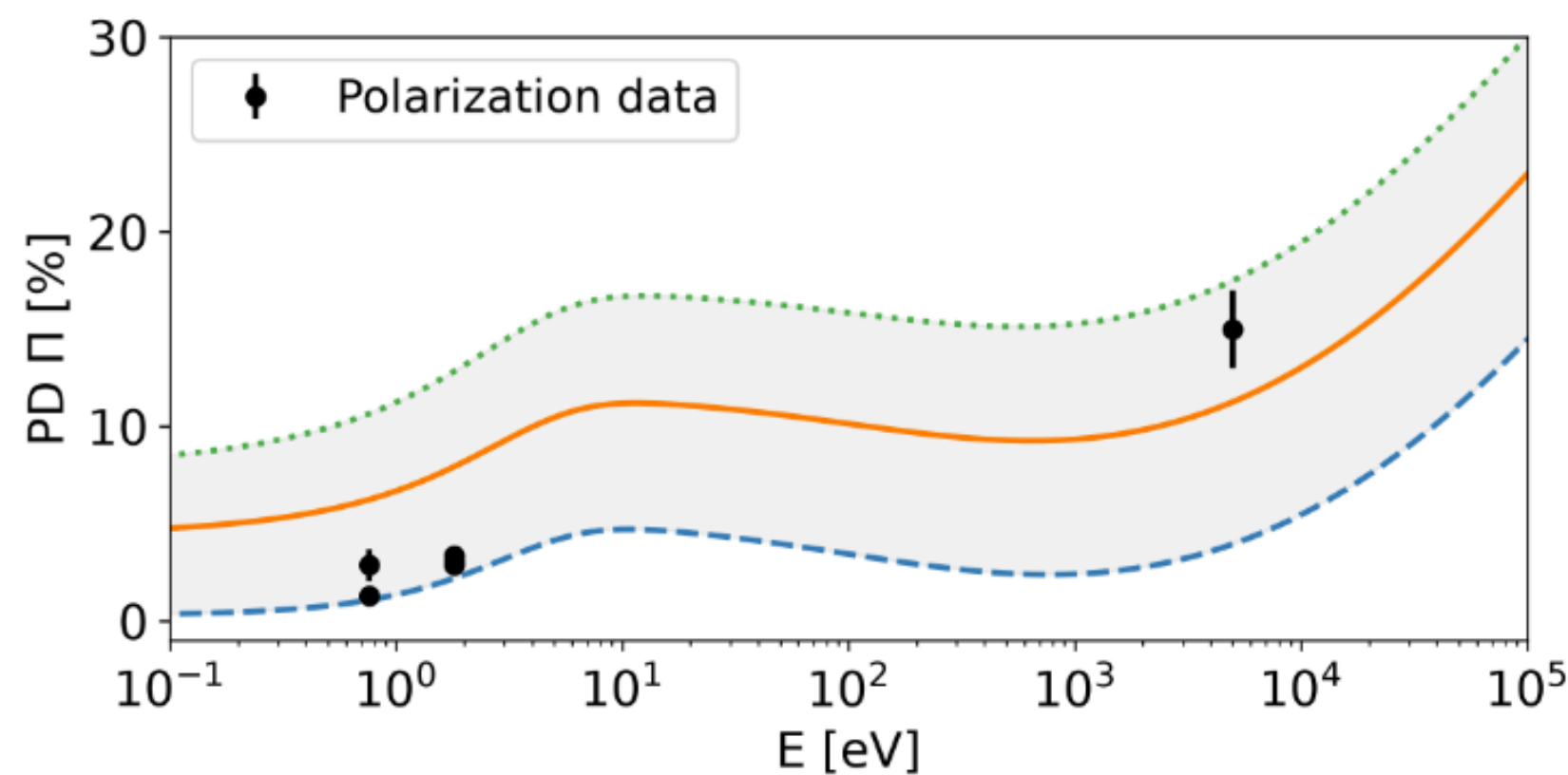
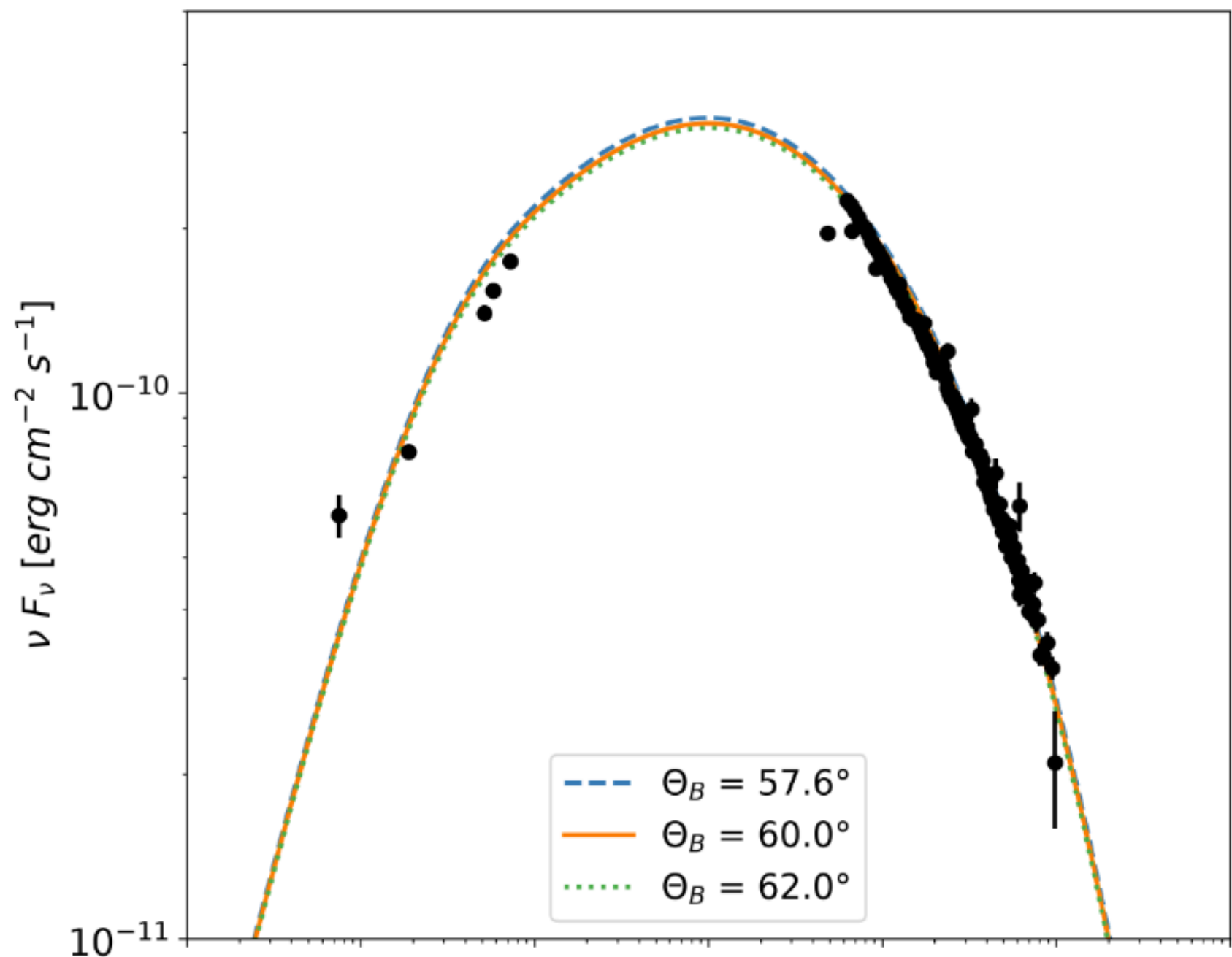
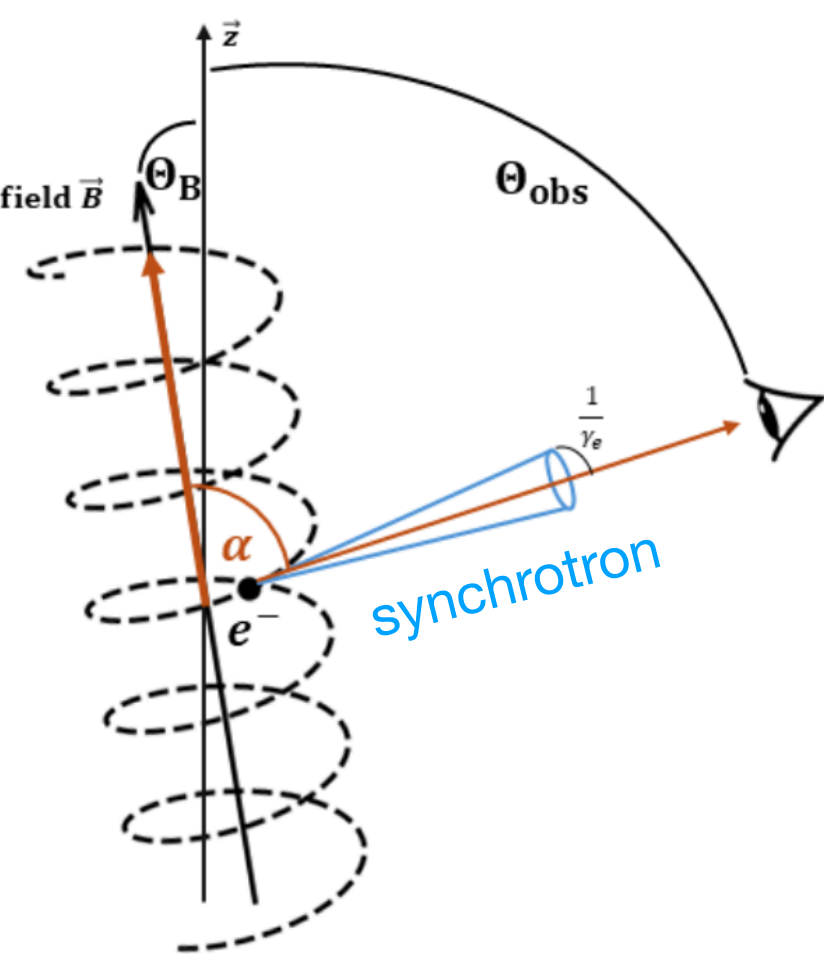
¹Department of Physics and Astronomy, MSU, East Lansing, MI 48823, USA

²Université Paris Cité, CNRS, Astroparticule et Cosmologie, F-75013 Paris, France



Self-consistent modeling of energy-dependent synchrotron polarization in blazars with application to Mrk 421 in prep.

F. Apel¹, M. Tisang², V. Barbosa Martins^{3,1}, X. Rodrigues⁴, M. Böttcher², and A. Franckowiak^{1,5}



with
Frederike Apel
@Uni Bochum

New extended jet model

XR, Rieger, Bohdan & Padovani 2026, A&A 706



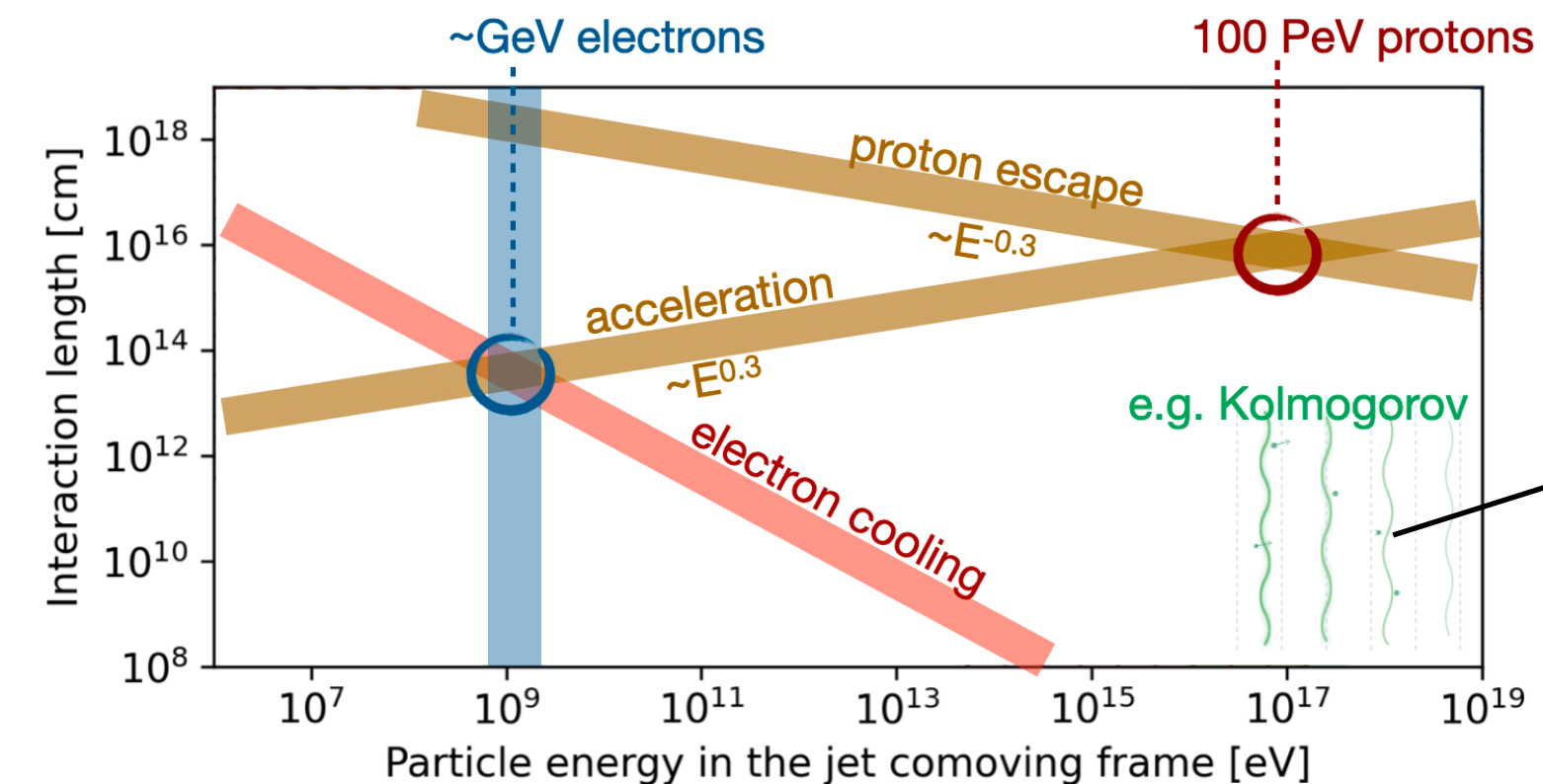
$$L_{\text{jet}} < L_{\text{Edd}}$$

Jet
magnetically
launched
near BH

$B \sim r^{-\alpha}$
Gradual
conversion
Poynting $\gg$
kinetic

$$\text{density} \sim r^{-\xi}$$

Small fraction of
medium particles
accelerated by
turbulence



diffusion
 δ

Maximum energy
based on diffusion

TXS 0506+056, a decade on: what do we know?

