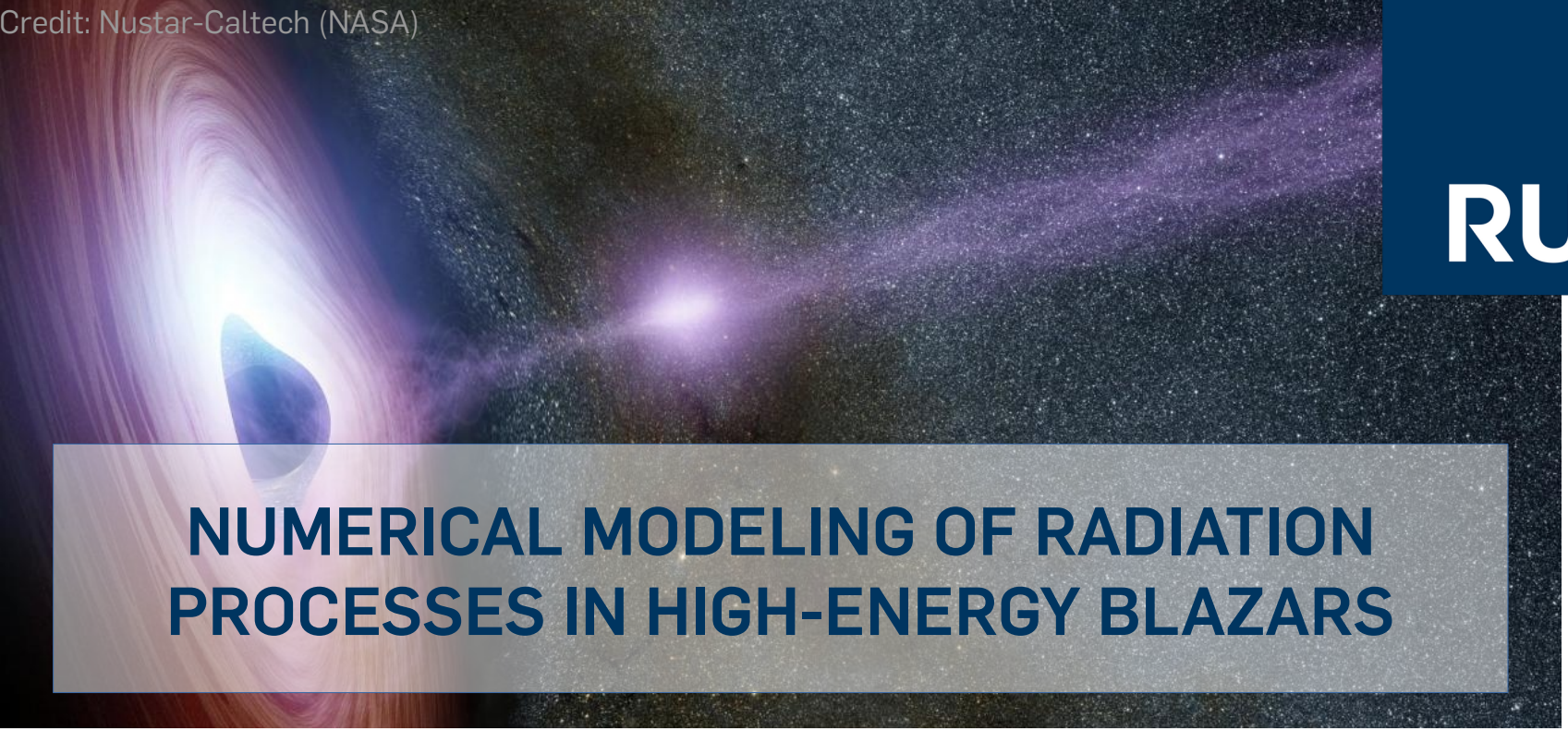

Credit: Nustar-Caltech (NASA)

NUMERICAL MODELING OF RADIATION PROCESSES IN HIGH-ENERGY BLAZARS

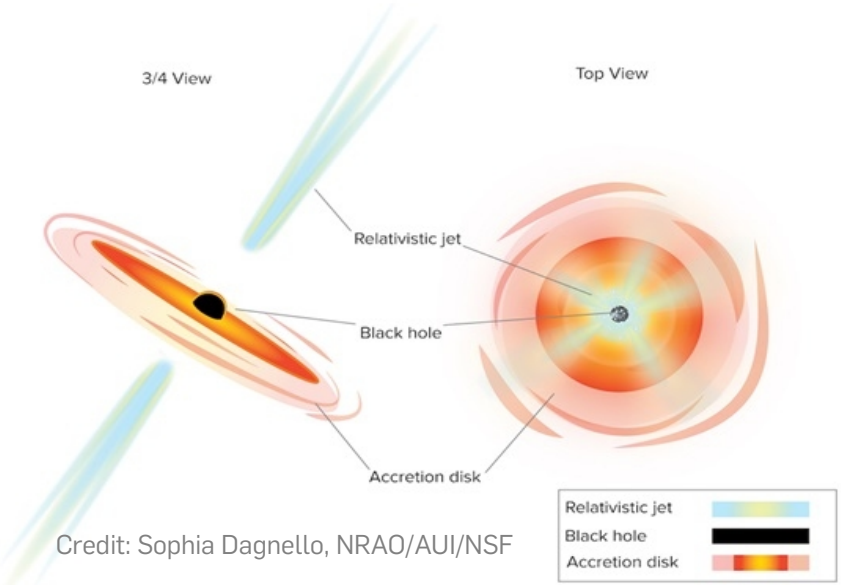
RUHR-UNIVERSITÄT BOCHUM

Anastasiia Omeliukh

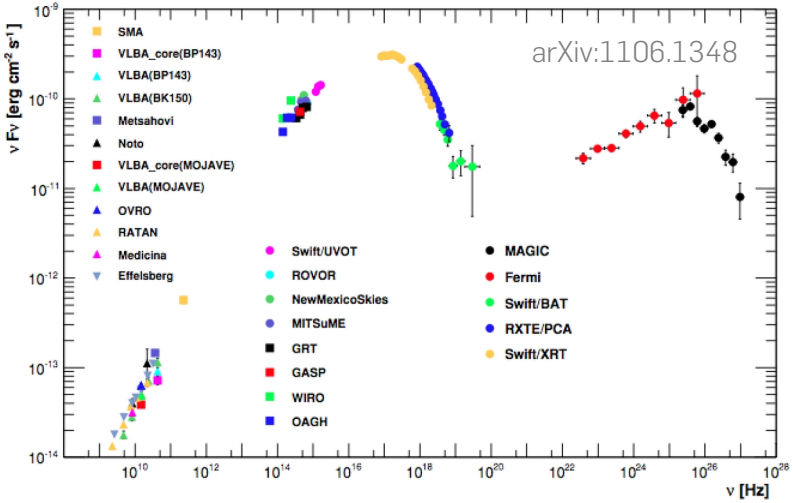
SFB 1491 Kick-Off Meeting Bochum | June 2, 2022

Blazars?

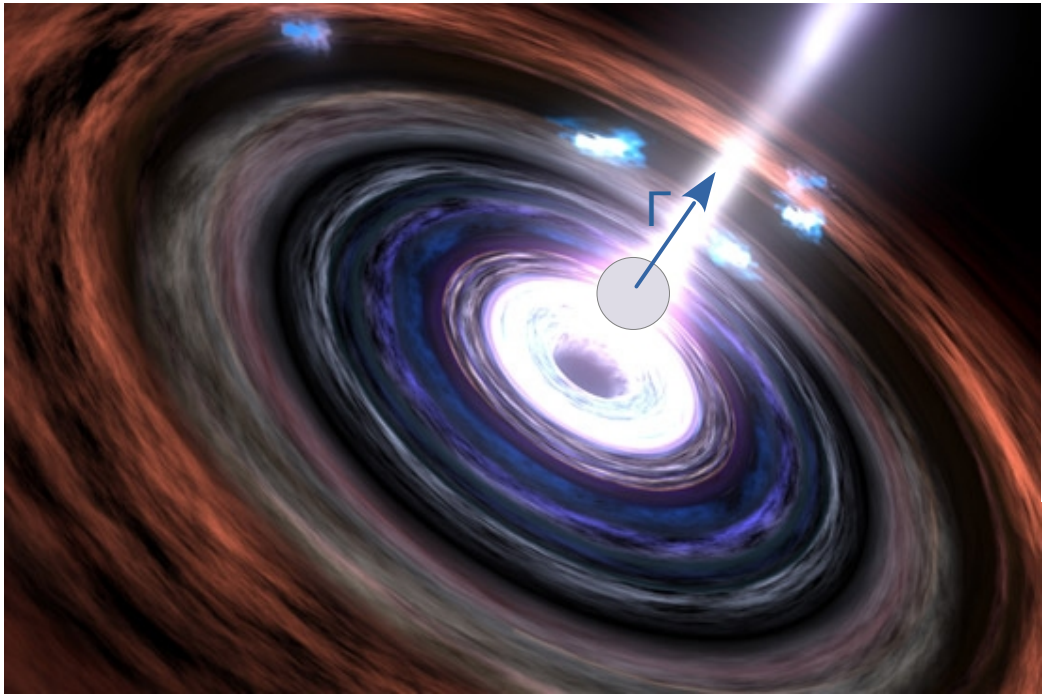
Introduction

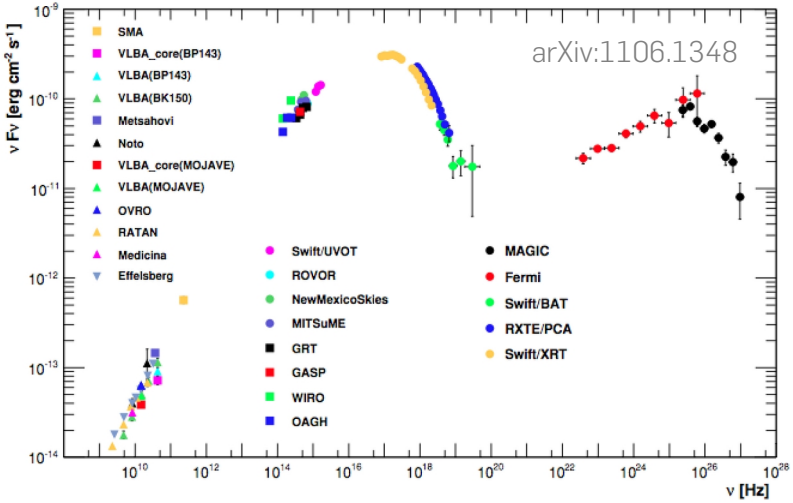


Credit: Sophia Dagnello, NRAO/AUI/NSF

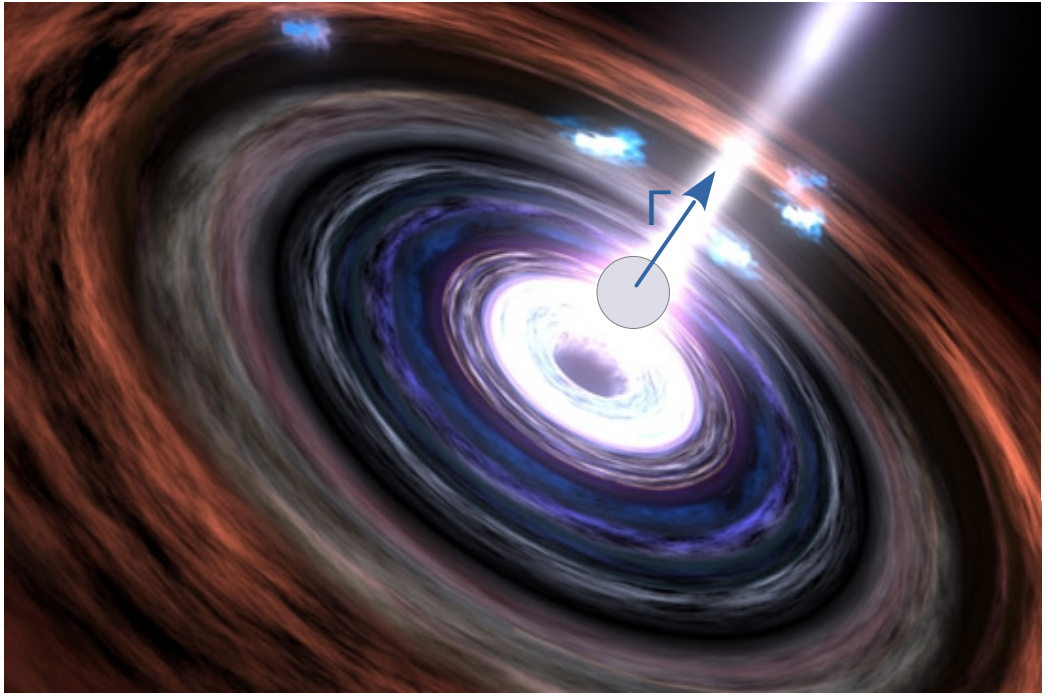


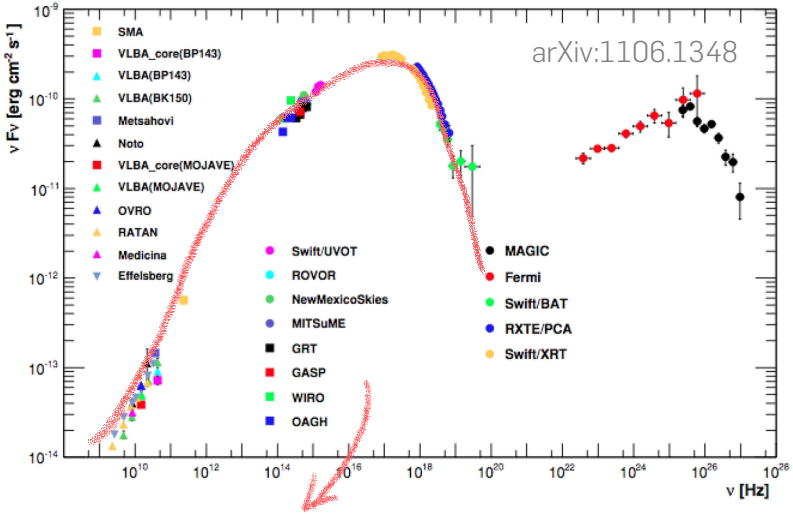
Introduction





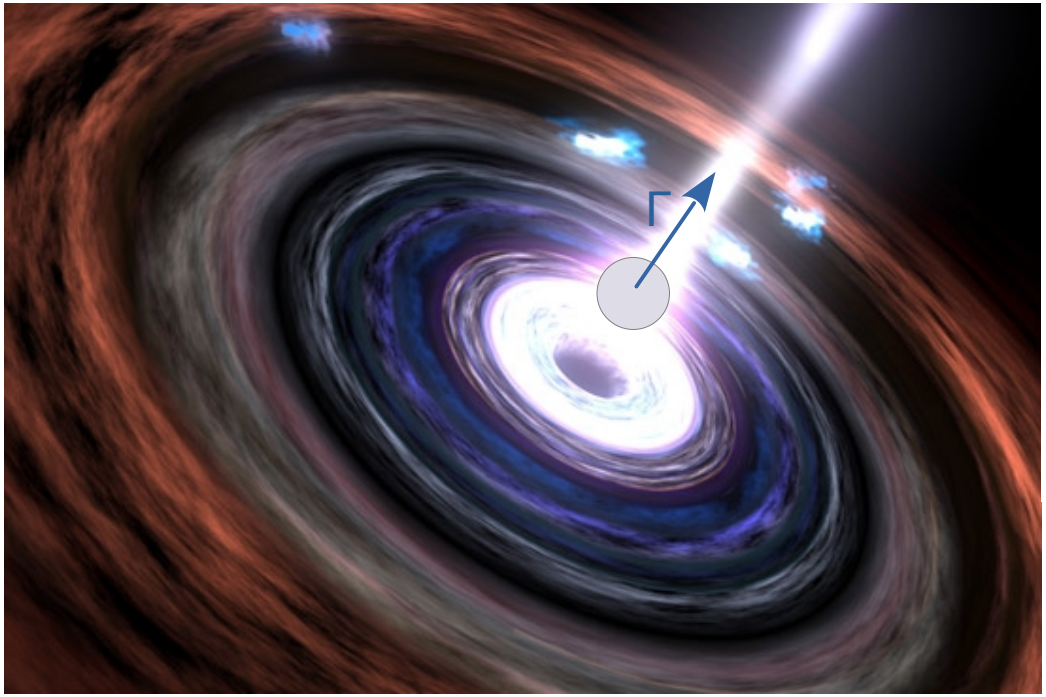
Introduction

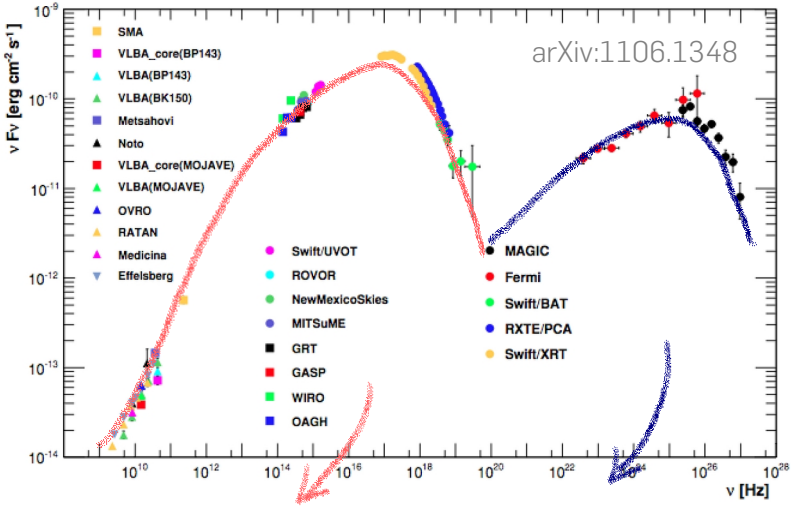




- synchrotron emission

Introduction





- synchrotron emission

- Compton emission
- hadronic cascades

Blazars as neutrino emitters?

Neutrinos from blazars

- many SEDs can be explained within only leptonic interactions
- neutrino associations require protons within the jet
  - TXS 0506+056
  - PKS 1502+106
  - PKS 0735+178

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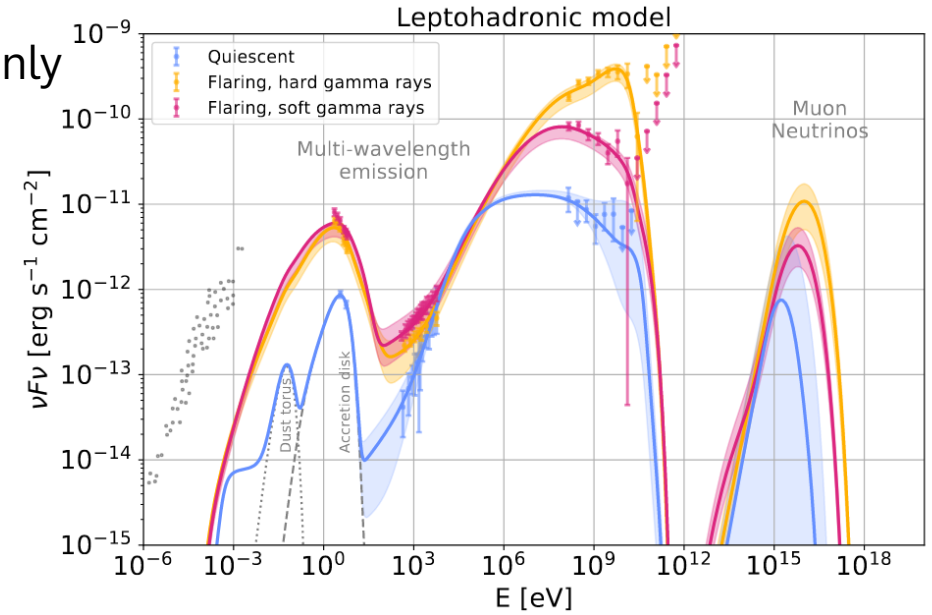
Rodrigues et al. 2021



Neutrinos from blazars

- many SEDs can be explained within only leptonic interactions
- neutrino associations require protons within the jet
  - TXS 0506+056
  - PKS 1502+106
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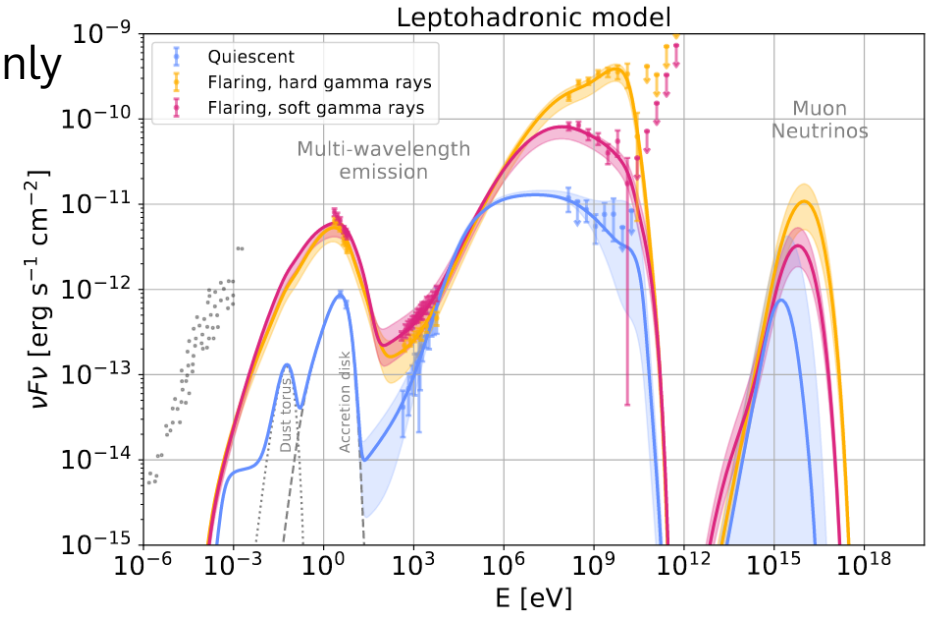
→ Neutrinos are moking-gun signature of protons in jets
→ Injection and acceleration remain key questions

Rodrigues et al. 2021



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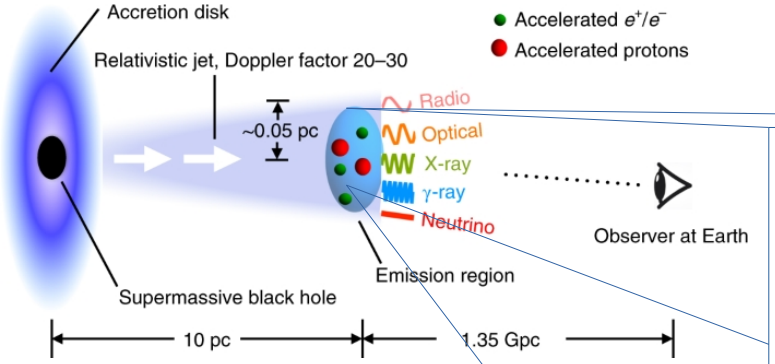
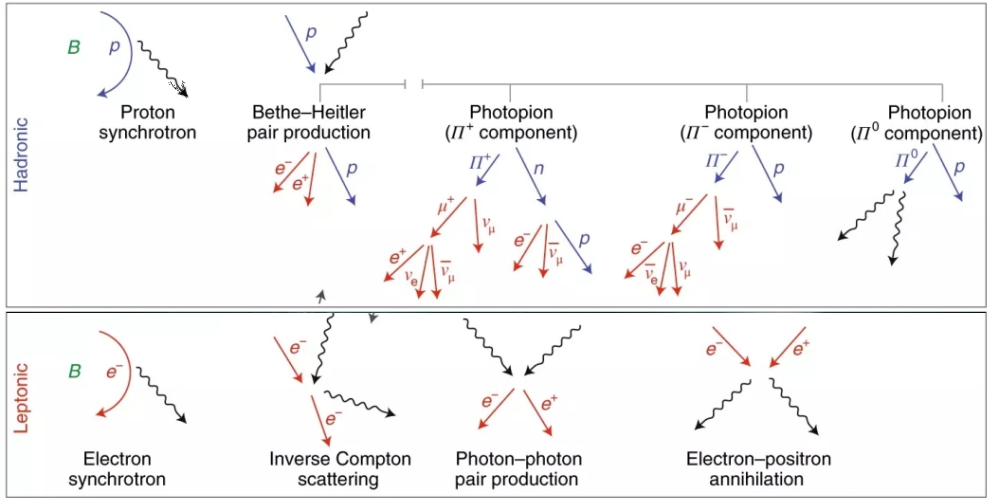
Numerical modeling

Modelling framework – AM^3





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AGNpropa and AM3 – code comparison project

AGNpropa **AM3**

- Transport equation
- Steady state solution
- Time-dependent code

- Ballistic + diffusive propagation
- Isotropic + helical magnetic fields

- Only diffusion
- Only isotropic

CIM projects:

A6 - TDEs

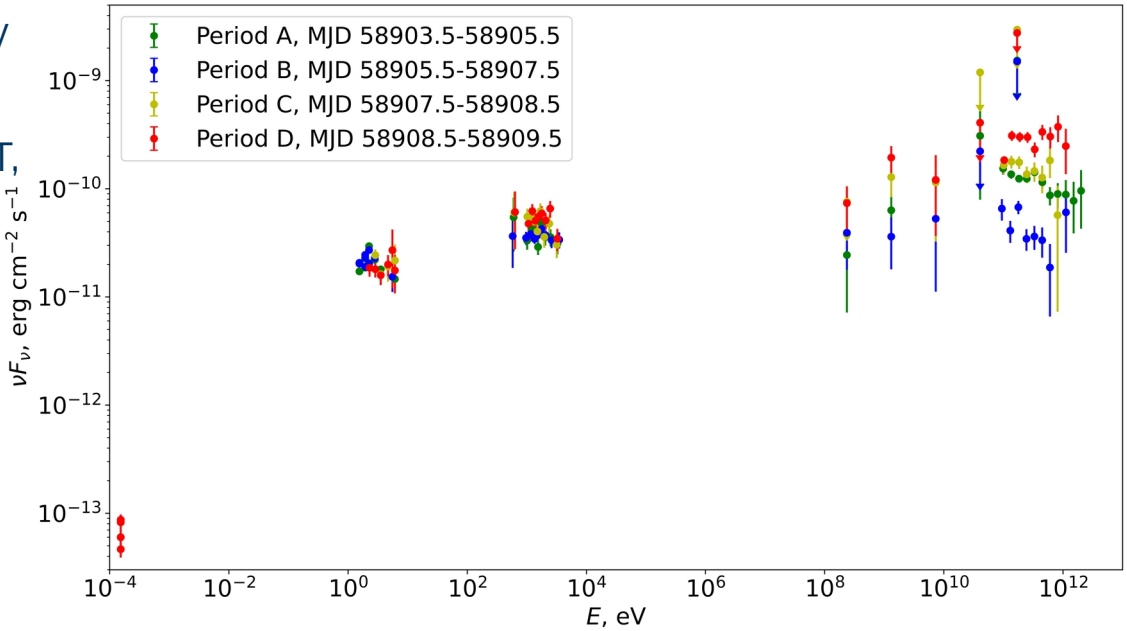
A7 - blazars

F2 – injection

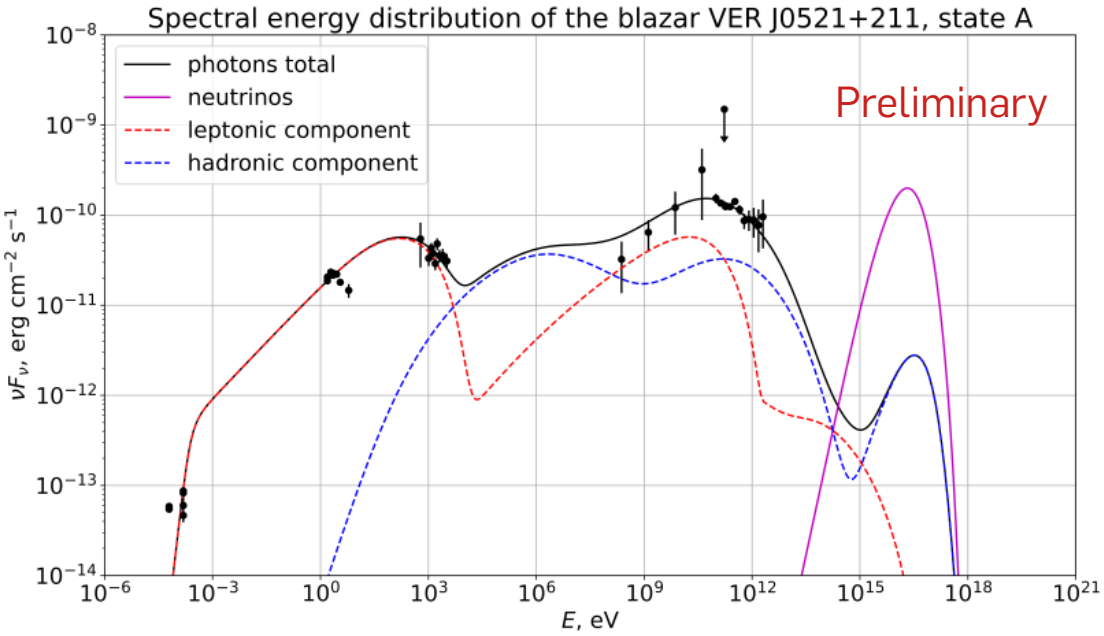
VER J0521+211 flare

VER J0521+211

- VER J0521+211 was observed between February & March of 2020 by a variety of instruments:
  - HE Gamma-rays: MAGIC, Fermi-LAT,
  - X-rays: Swift
  - Optical & UV: Swift-UVOT, Tuorla blazar monitoring program, Boston University Blazar Group, Nordic Optical Telescope (NOT), and Belogradchik Observatory
  - Radio: Owens Valley Radio Telescope



TeV blazar VER J0521+211



MAGIC Collaboration + AO, Xavier Rodrigues, Anna Franckowiak (in preparation)

Summary

Summary

- Blazars are highly energetic objects with some evidences to be neutrino sources
- Numerical modeling of radiation process in blazar jets helps us to explain the observed multi-messenger data
- Common efforts in multiple research areas makes us closer to the understanding how these powerful emitters work

Thanks for your attention!