

Multi-Messenger Astrophysics

May 22 - June 16/2023
22 Maio - 16 Jun/2023

(Astrofísica Multi-Mensageiros)

In order to stimulate the growth of this exciting new field of research, the Principia Institute is supporting two parallel events: the Principia Institute Program on Multi-Messenger Astrophysics, and the São Paulo Advanced School on Multi-Messenger Astrophysics (also financed by FAPESP).

O Instituto Principia está apoiando o crescimento dessa nova área de pesquisa através de dois eventos complementares, que vão acontecer em paralelo: o Programa Principia em Astrofísica Multi-Mensageiros, e a Escola Avançada São Paulo de Astrofísica Multi-Mensageiros (que também conta com financiamento da FAPESP).

Show more

São Paulo Advanced School on Multi-Messenger Astrophysics

A 2-week international school designed to introduce graduate students to the next frontier in astrophysics, cosmology and fundamental physics, where extreme phenomena are observed with multiple messengers: **from light to neutrinos, from cosmic rays to gravitational waves.**

May 29th - June 7th, 2023

Short Talk Cosmic rays + gamma rays

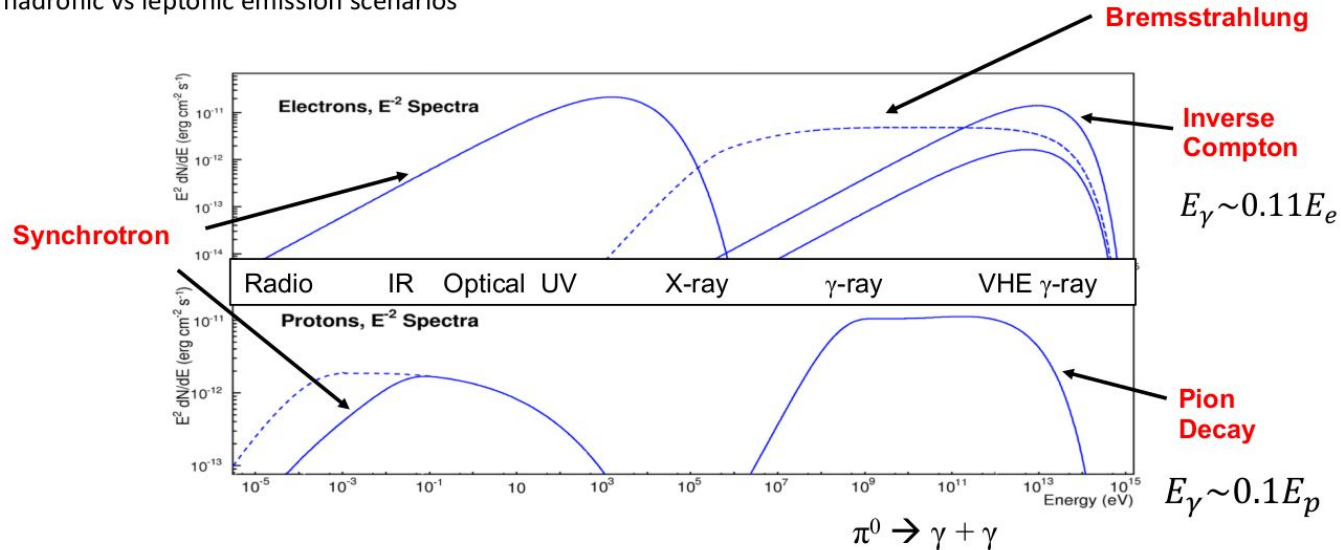
Vitor de Souza



Gamma-rays

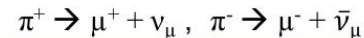
Searching for the origins of hadronic cosmic rays

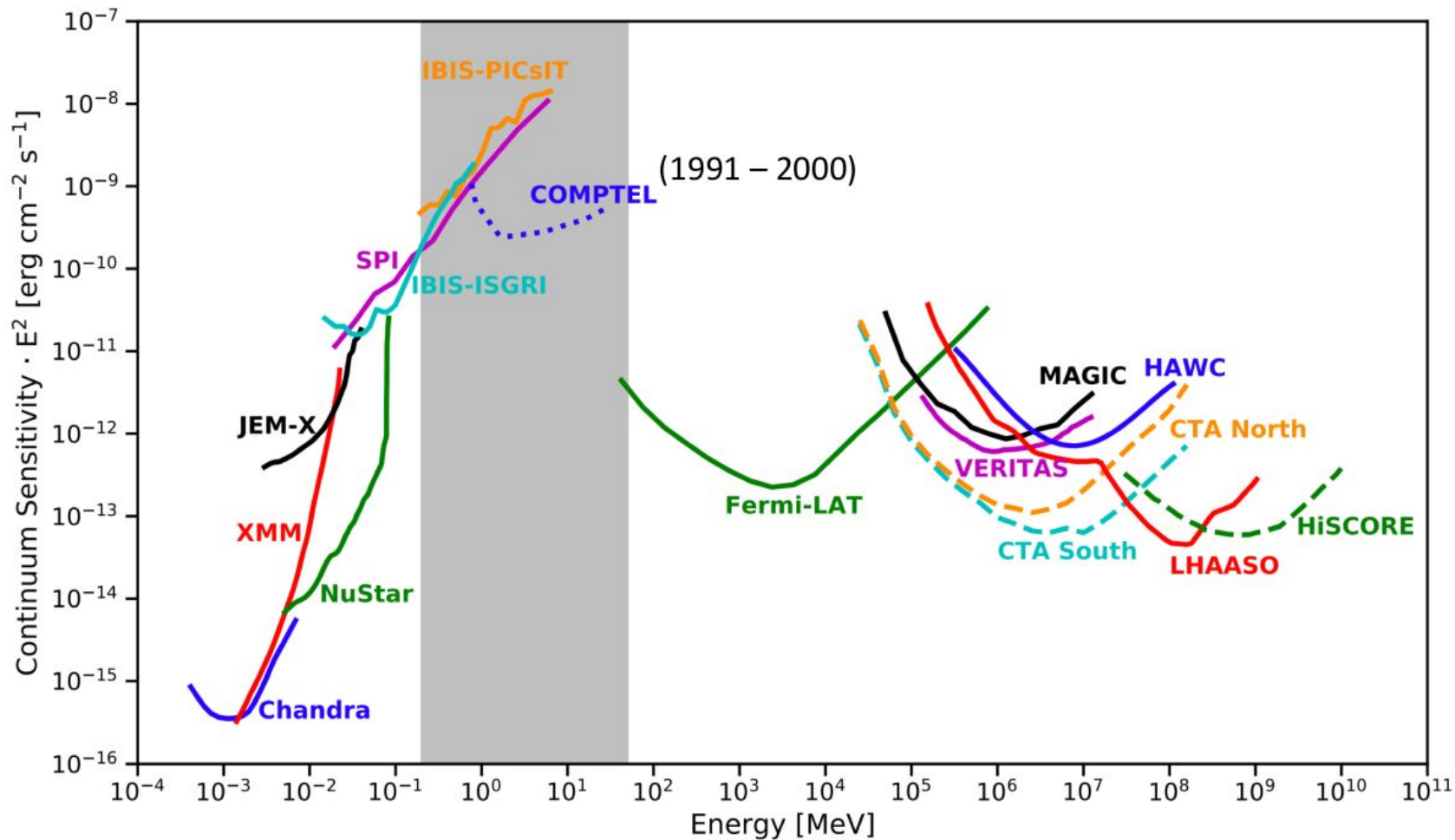
→ Constrain hadronic vs leptonic emission scenarios

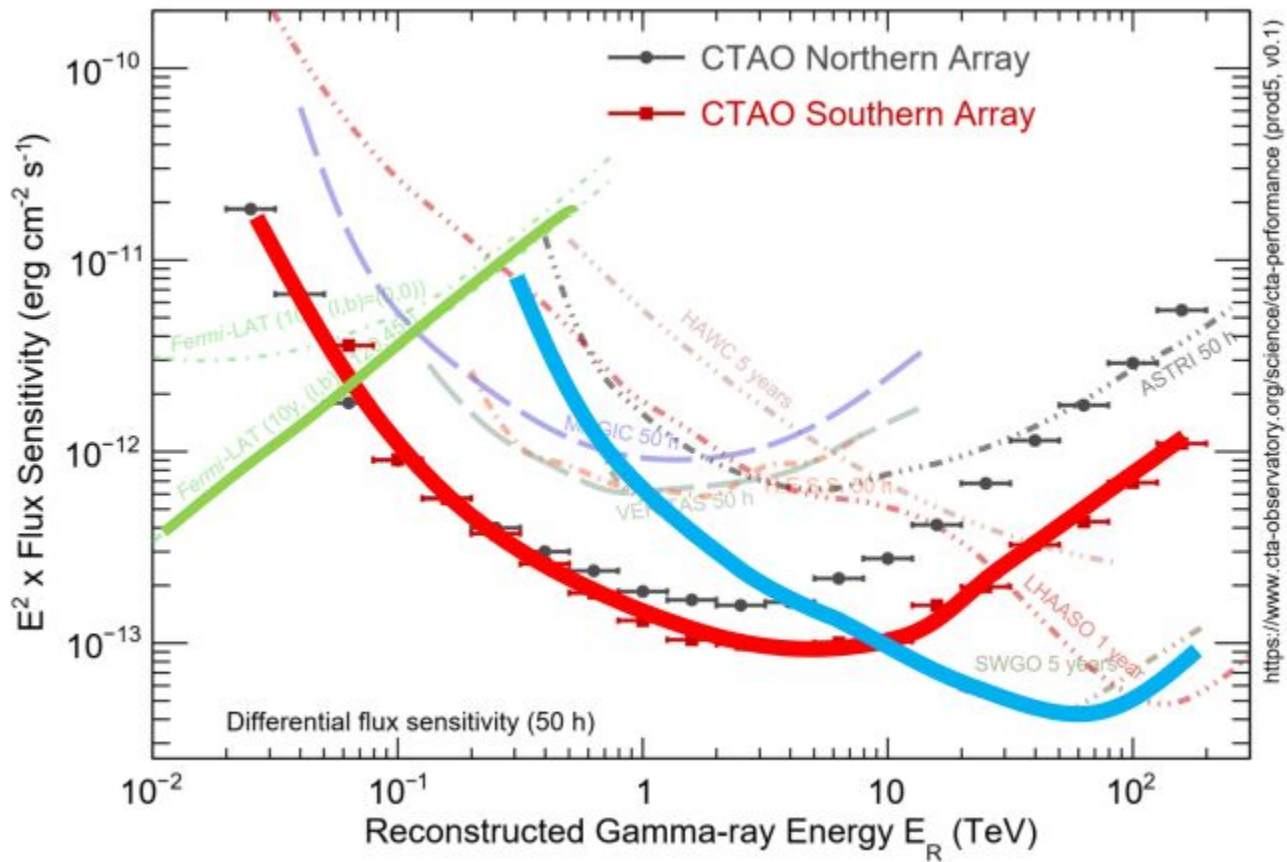


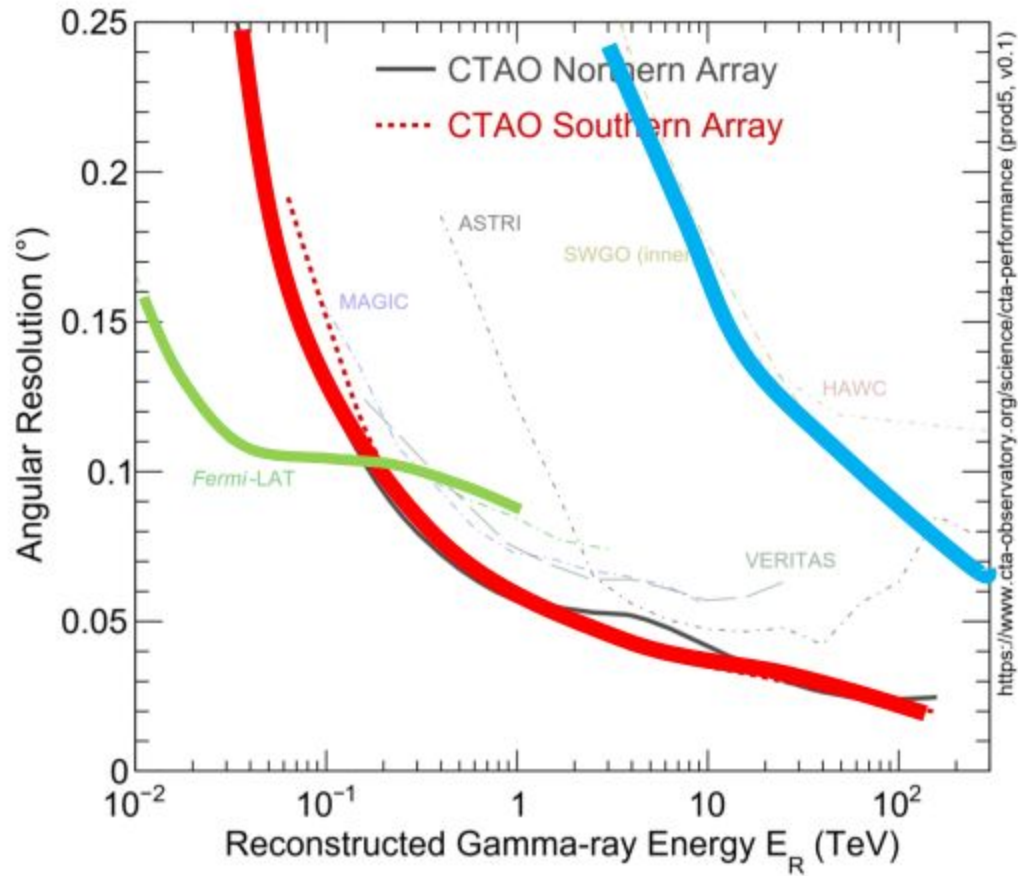
Target molecular material for hadronic interactions?

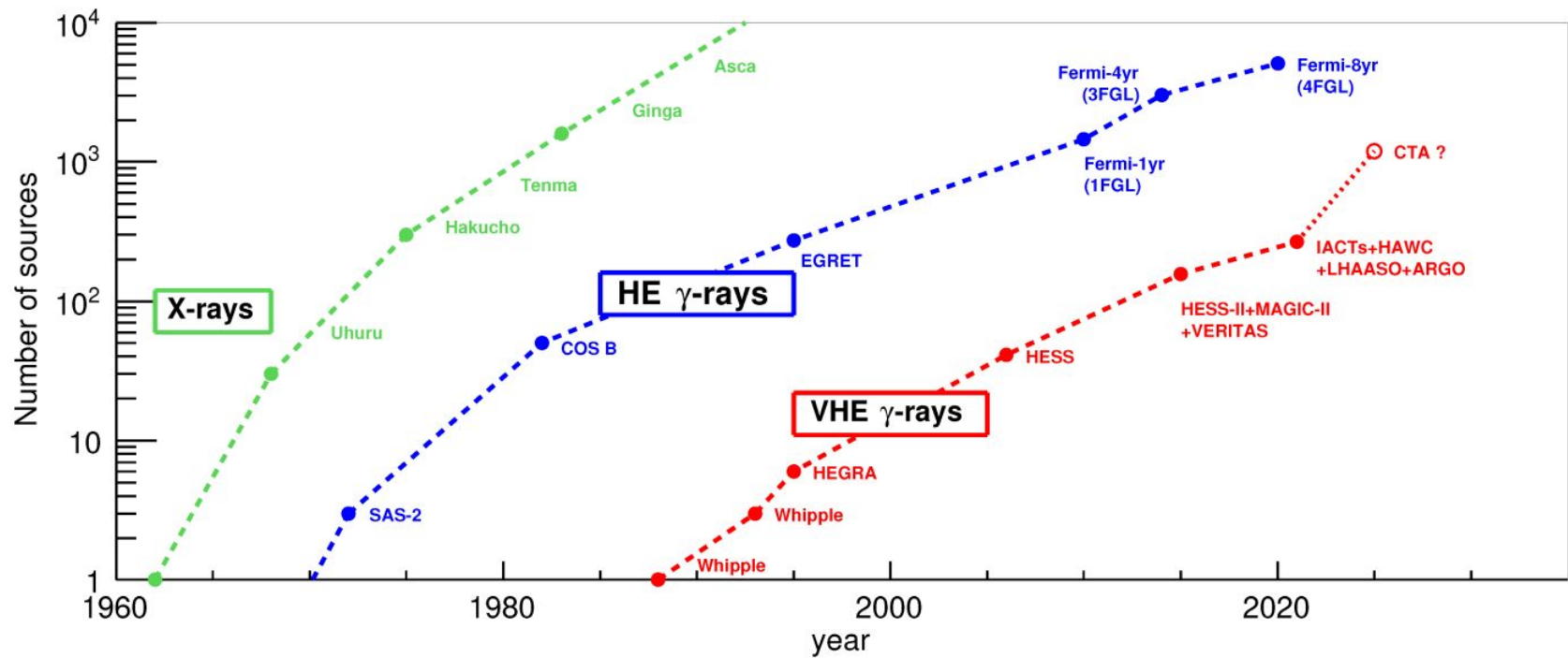
Coincident neutrinos as a smoking gun?

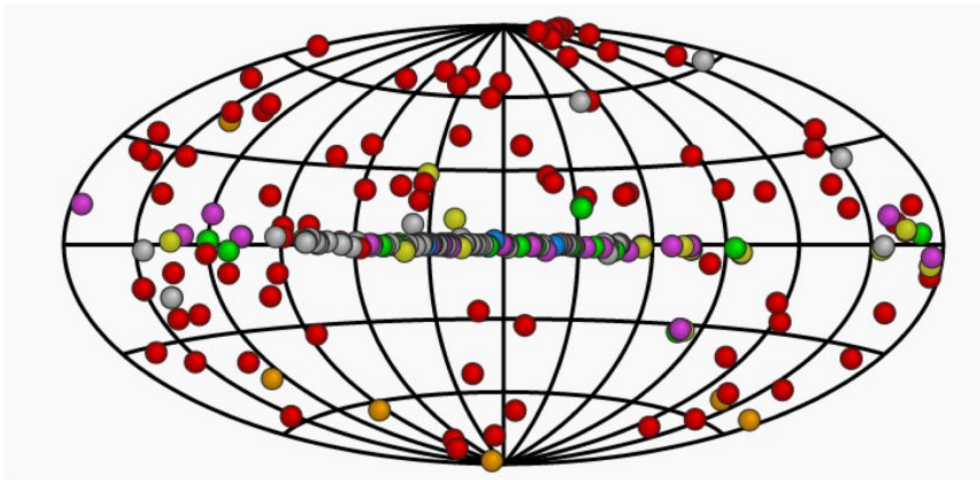






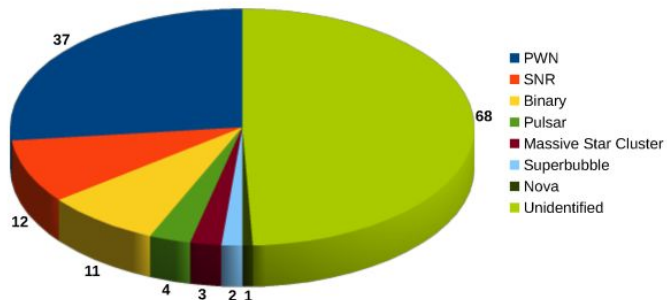




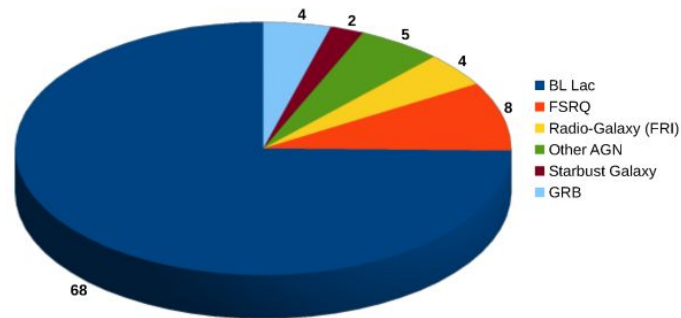


- GRB, Starburst, Superbubble
- PWN, TeV halo, PWN/TeV Halo, Composite SNR, BIN
- HBL, IBL, FSRQ, AGN (unknown type), FRI, Blazar, BL Lac (class unclear), LBL, EHBL
- Shell, SNR/Molec. Cloud, Giant Molecular Cloud, Composite SNR
- UNID, TeV halo, DARK
- Binary, PSR, Gamma BIN, Nova
- Massive Star Cluster, Globular Cluster

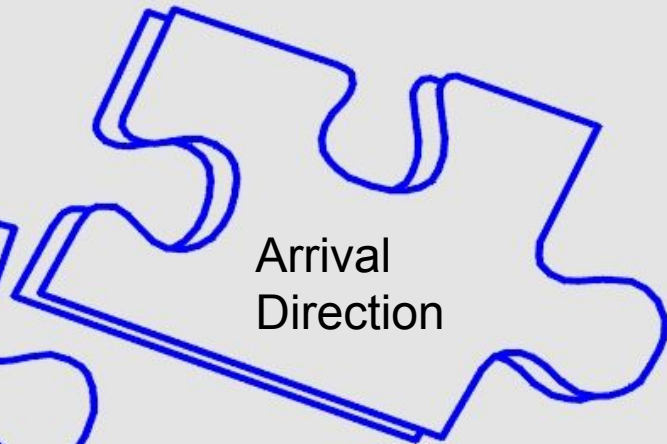
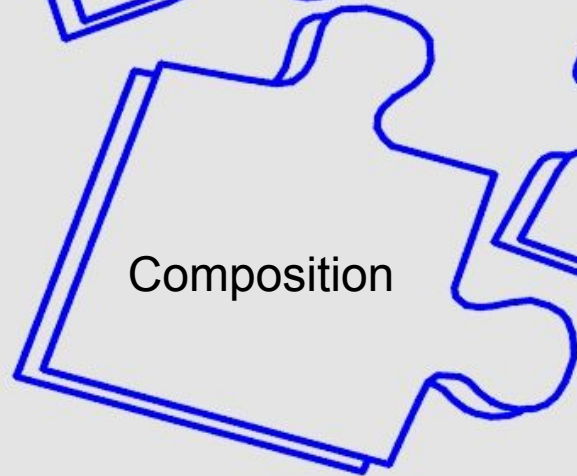
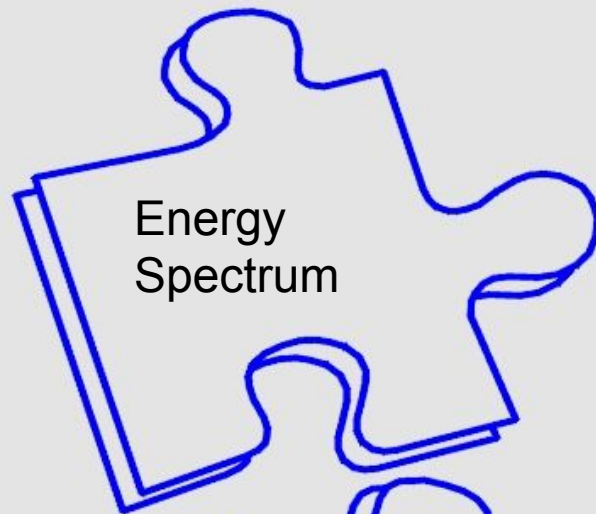
Galactic Sources

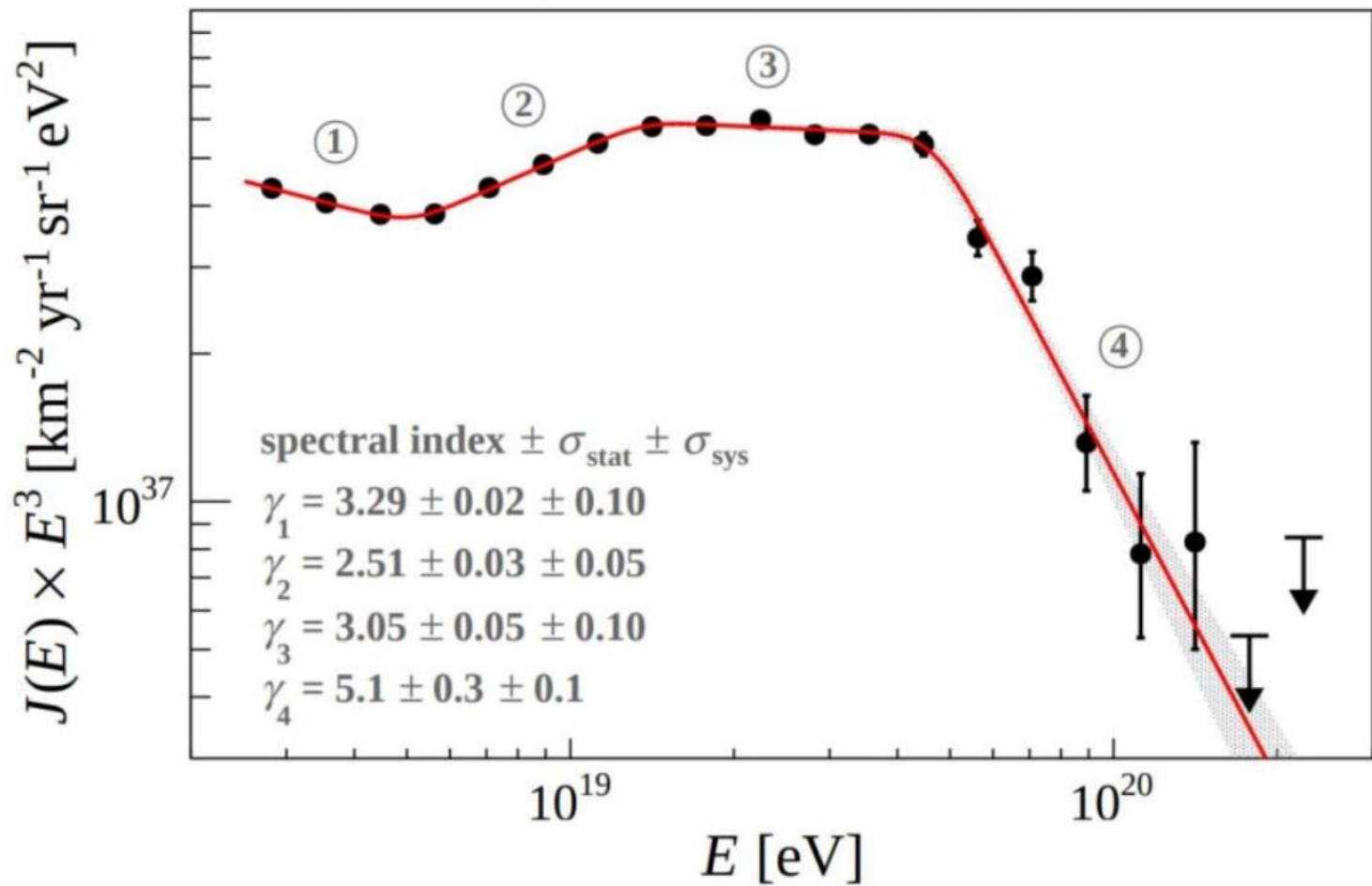


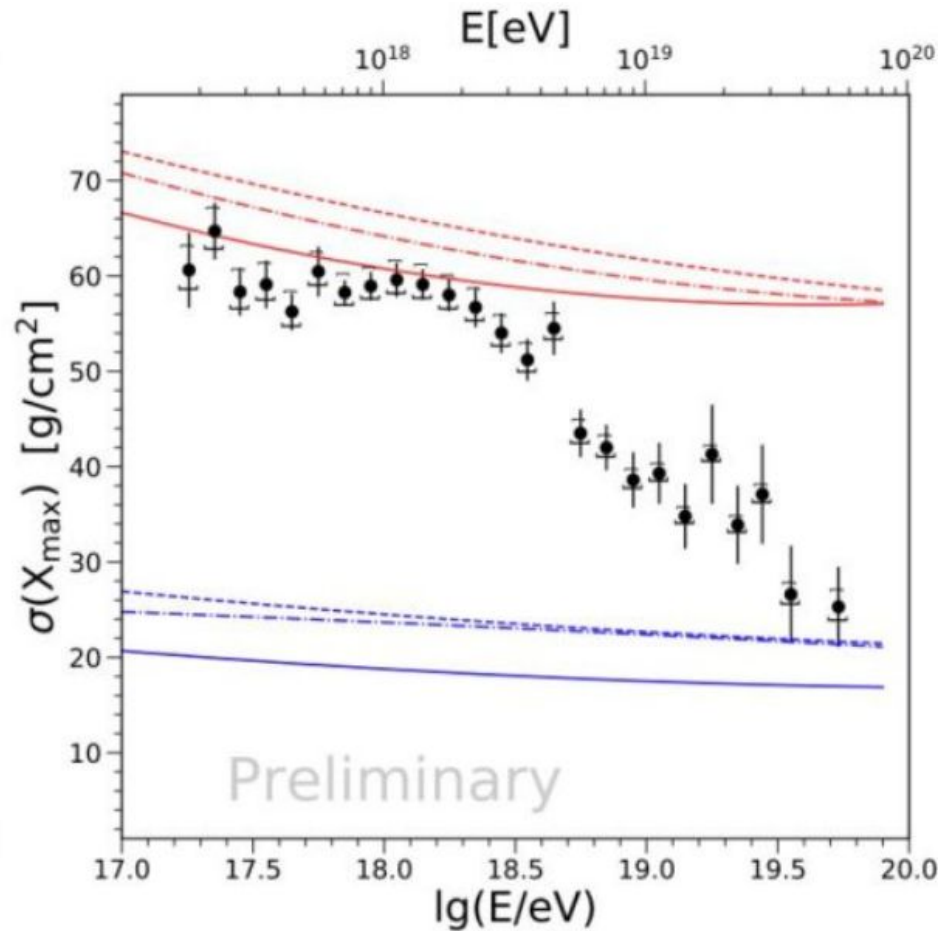
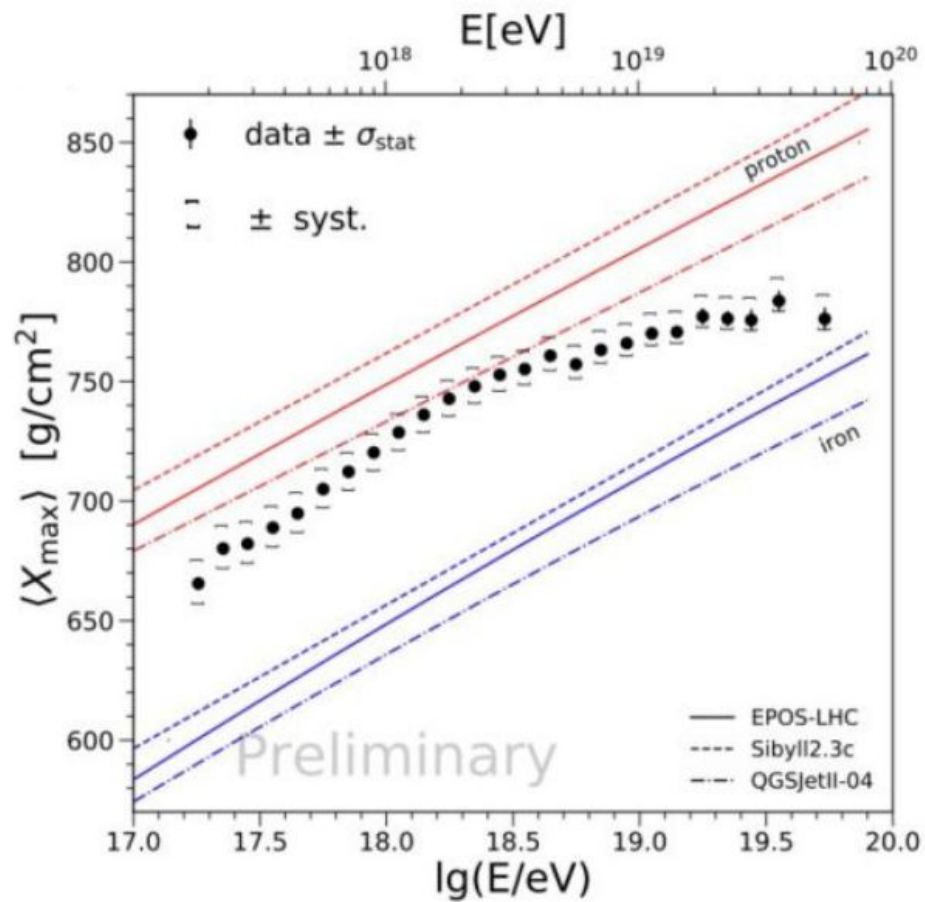
Extragalactic Sources



Cosmic rays

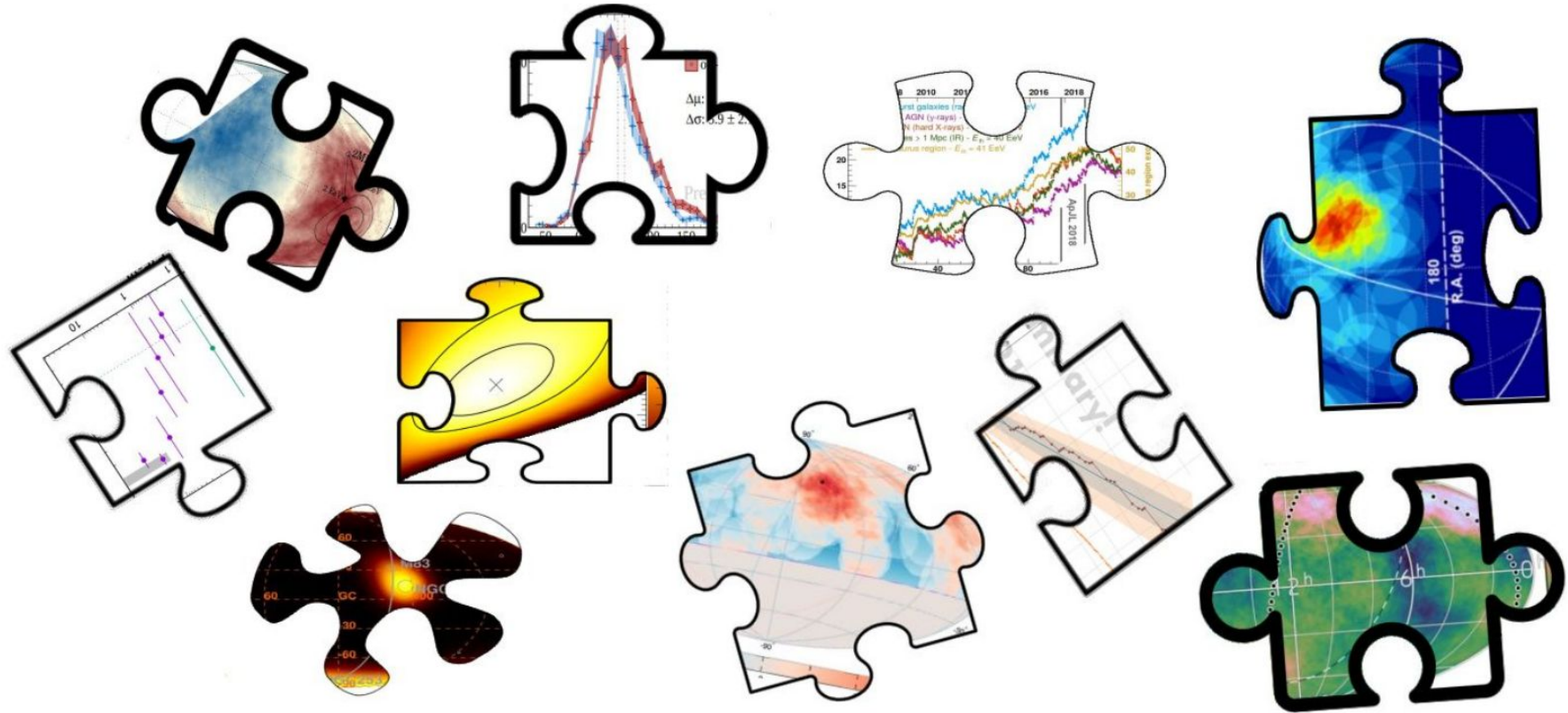






- Recent data show deviations from isotropy:
 - ~7.3% dipole at $E > 8$ EeV pointing outwards the galactic center;
 - Evolution of dipole amplitude and phase with energy;
 - Hotspots at the highest energies;
 - (Strong) hints of a correlation with Starburst Galaxies;
 - Differences in X_{\max} on and off the galactic plane;
- Several analysis trying to describe such deviations:
 - Heavily dependent on astrophysical hypotheses about things we don't know very well;
 - Many extended fit approaches as well efforts to understand better the problem;

Pieces are not matching together !

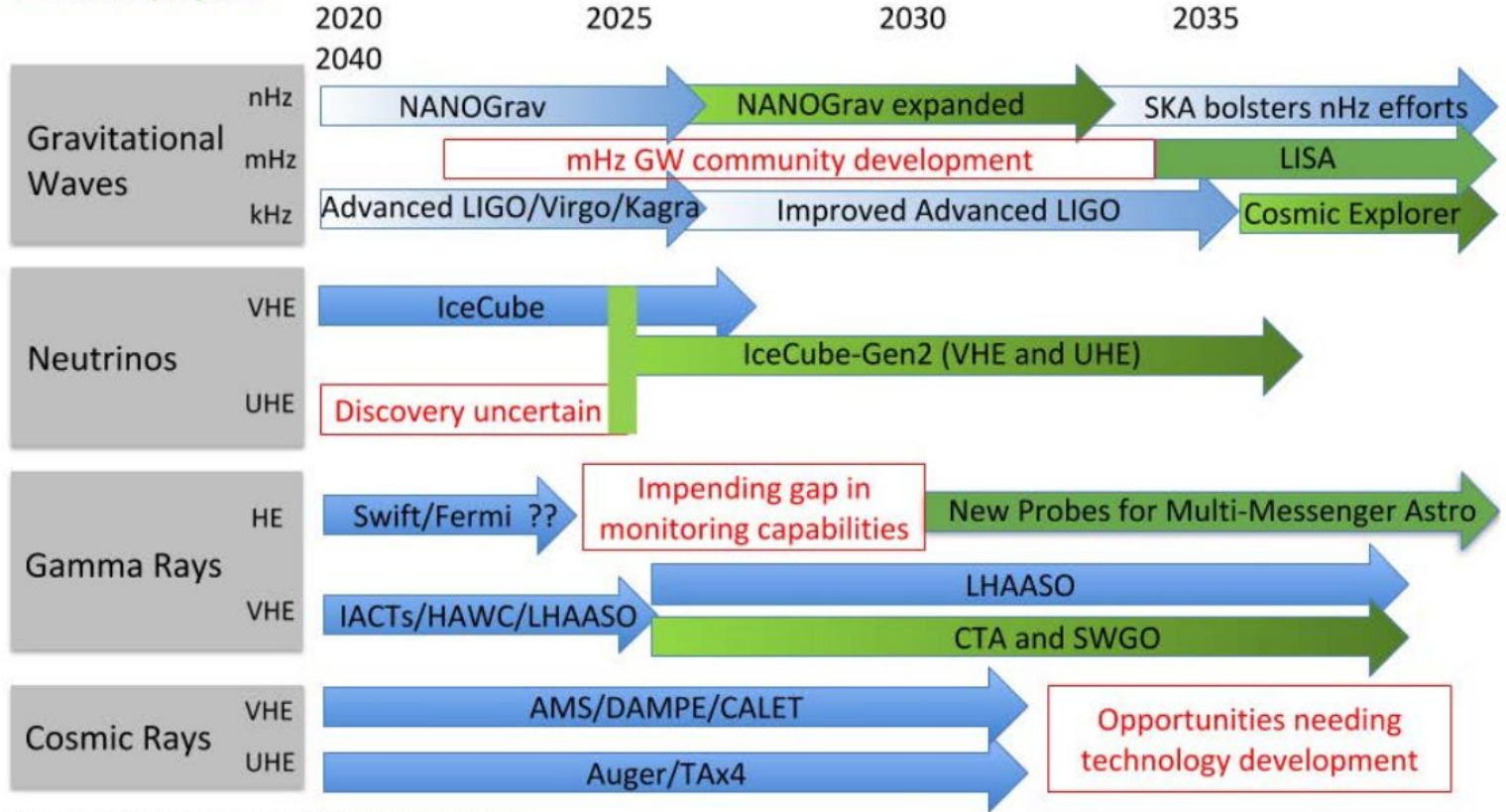


Existing/planned projects

Missing capabilities

Endorsed projects

Multi-Messenger Astronomy Must be Coordinated



HE: MeV-GeV, VHE: TeV-PeV, UHE: EeV-ZeV