The GFU Program at IceCube. Current Developments and Future Perspectives

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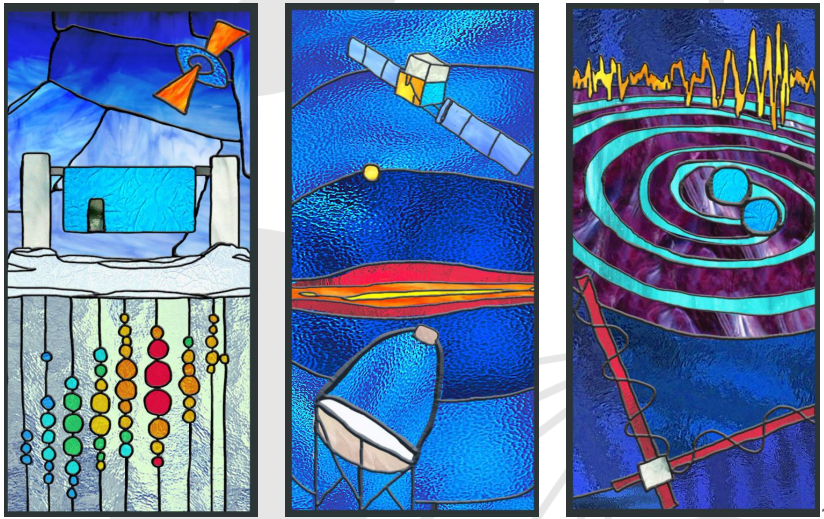

Università degli Studi di Padova

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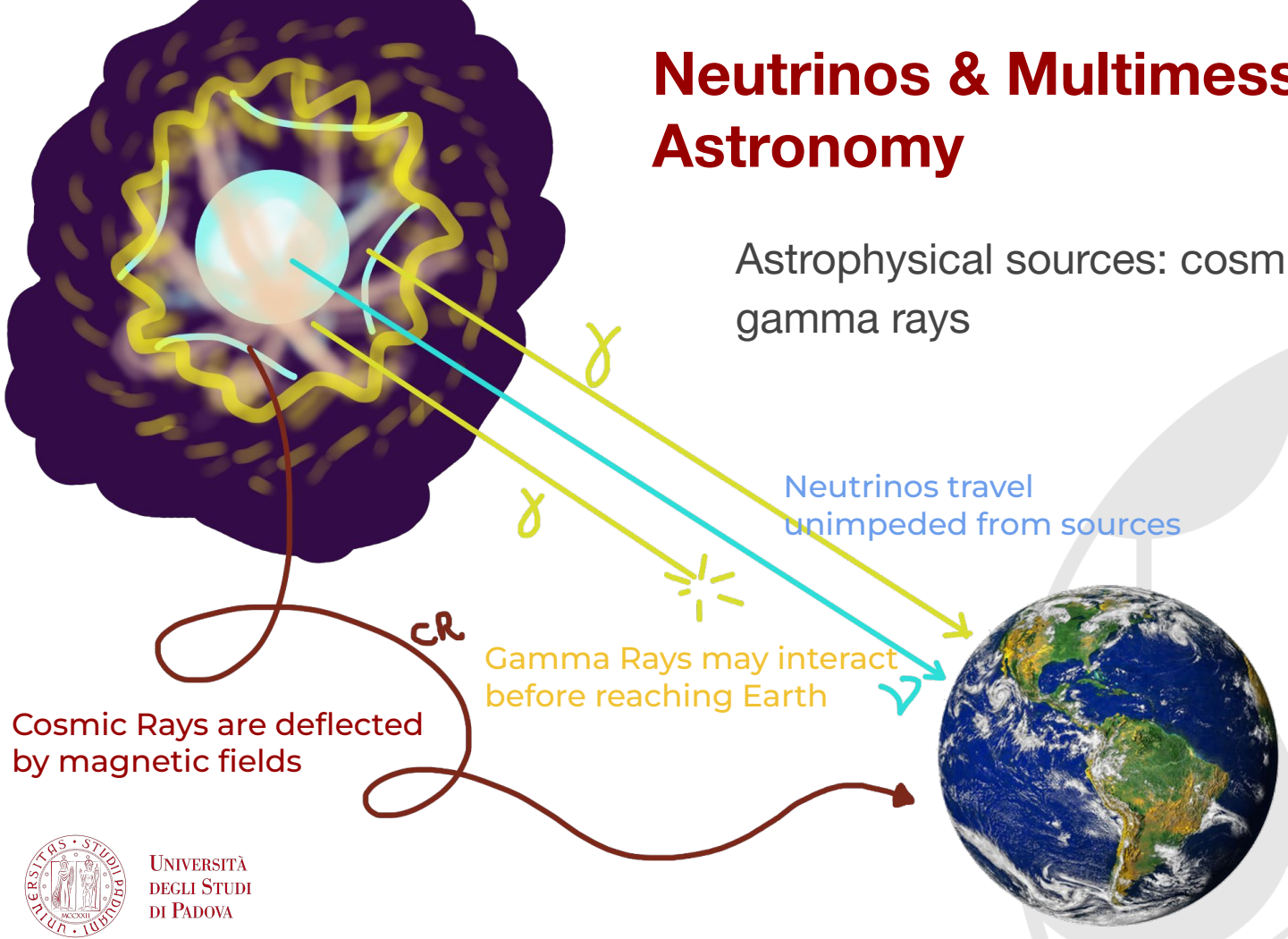
IceCube Neutrino Observatory

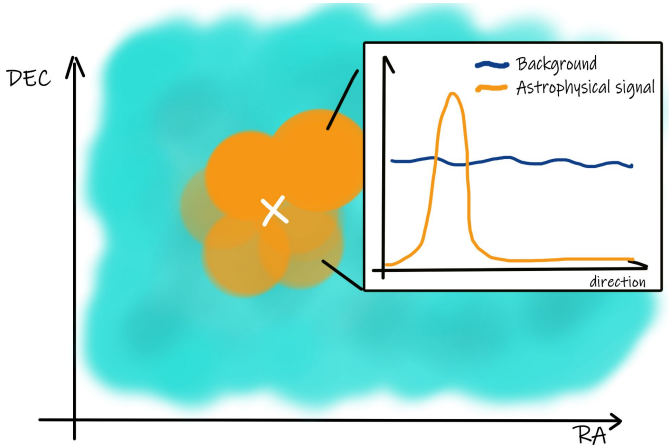
Neutrinos & Multimessenger Astronomy

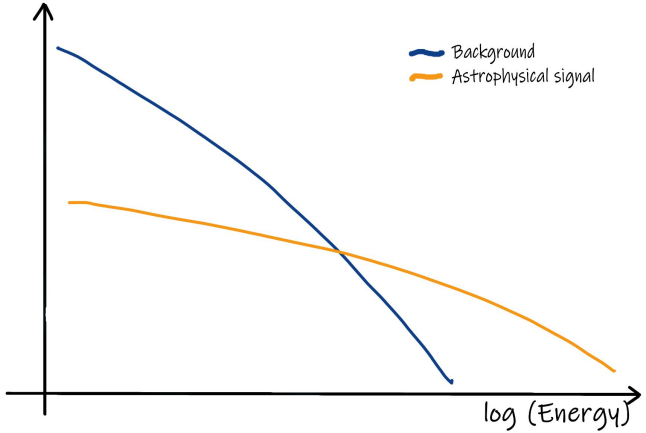
Astrophysical sources: cosmic rays, neutrinos, gamma rays



Searching for Astrophysical Neutrinos: IceCube

Neutrino observations are dominated by background

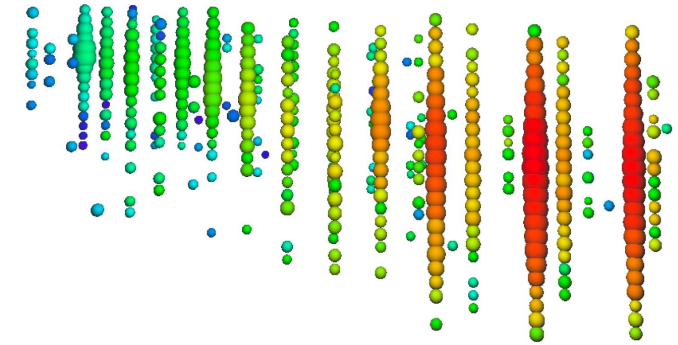


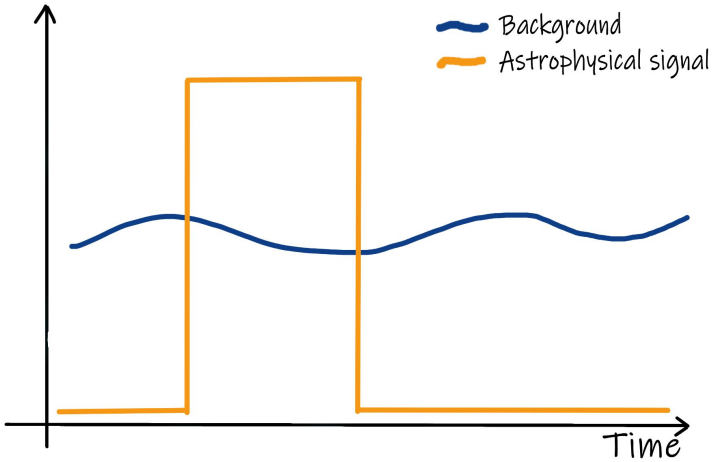


- Excesses from specific directions

- Search for highly energetic events
- BG and Signal should have different spectra.

Realtime Neutrino Astronomy in IceCube





IceCube Observatory:

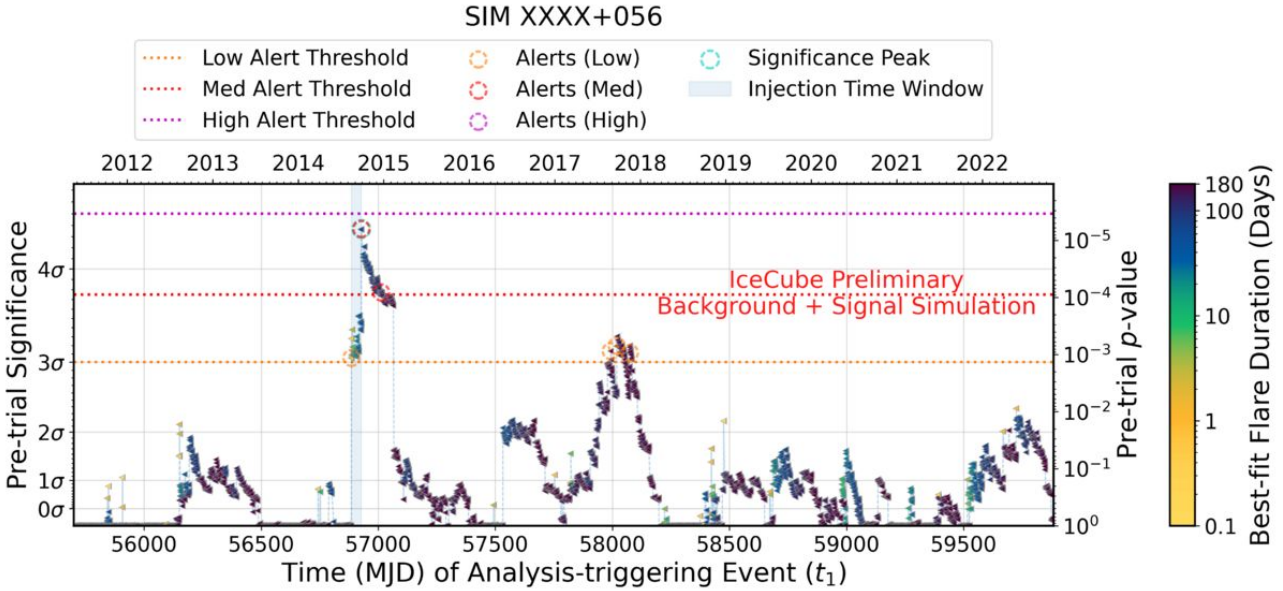
- ➔ Full view of the sky
- ➔ ~100% Uptime
- ➔ *Send Alerts!!*

Multimessenger Observations:

- ➔ IceCube triggers partner telescopes
- ➔ Combining Measurements leads to a richer picture of astrophysical processes

GFU Program: cluster alerts

- Search for flares of neutrino emissions
- Identify statistical excesses in time and space over the background
- Groups of events can be used to resolve sources

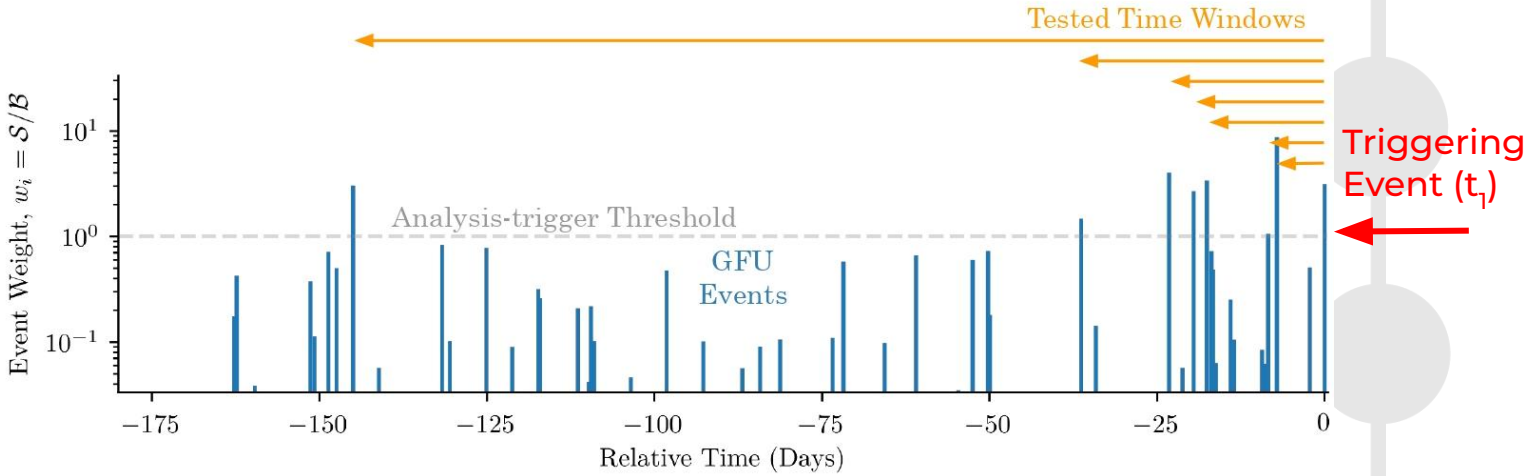


Typical Current GFU Framework

1. If event is deemed significant, triggers analysis
2. Triggers Analysis
3. Previous significant events define time windows
4. Best Flare Candidate identified
5. Alert is sent

In progress:

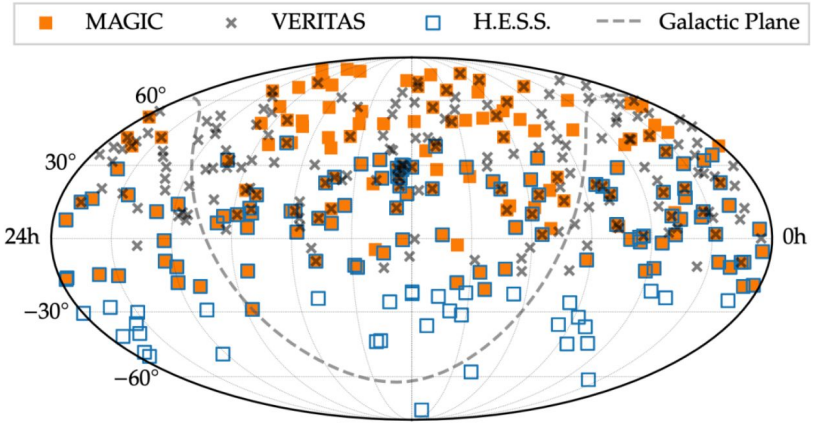
Moving towards public shared alerts



Source List Hypothesis

Test locations of know gamma-ray bright and variable blazars

- List is built around IACT observability and sent privately
- Pro: Fixed locations allows for smaller trials factor
- Con: Restricts searches to limited locations



In progress:

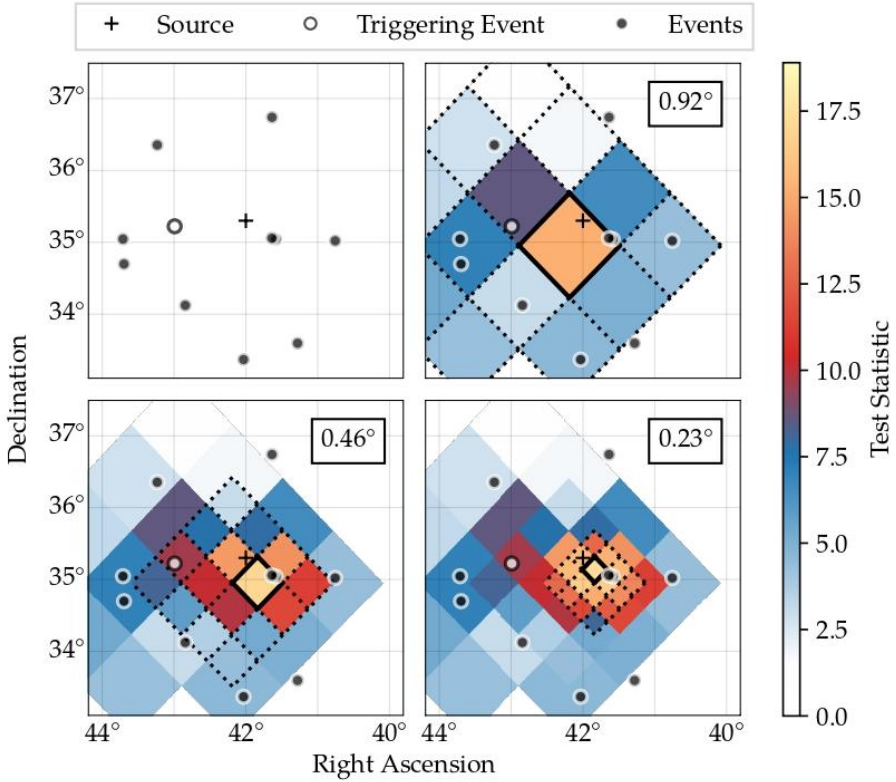
Expanding the scope of the source list for follow-up possibilities beyond Gamma-Rays

All-Sky Scan

Every pixel (HealPy) around a GFU event can be used as an event hypothesis

Best location is determined by algorithm and included in alert.

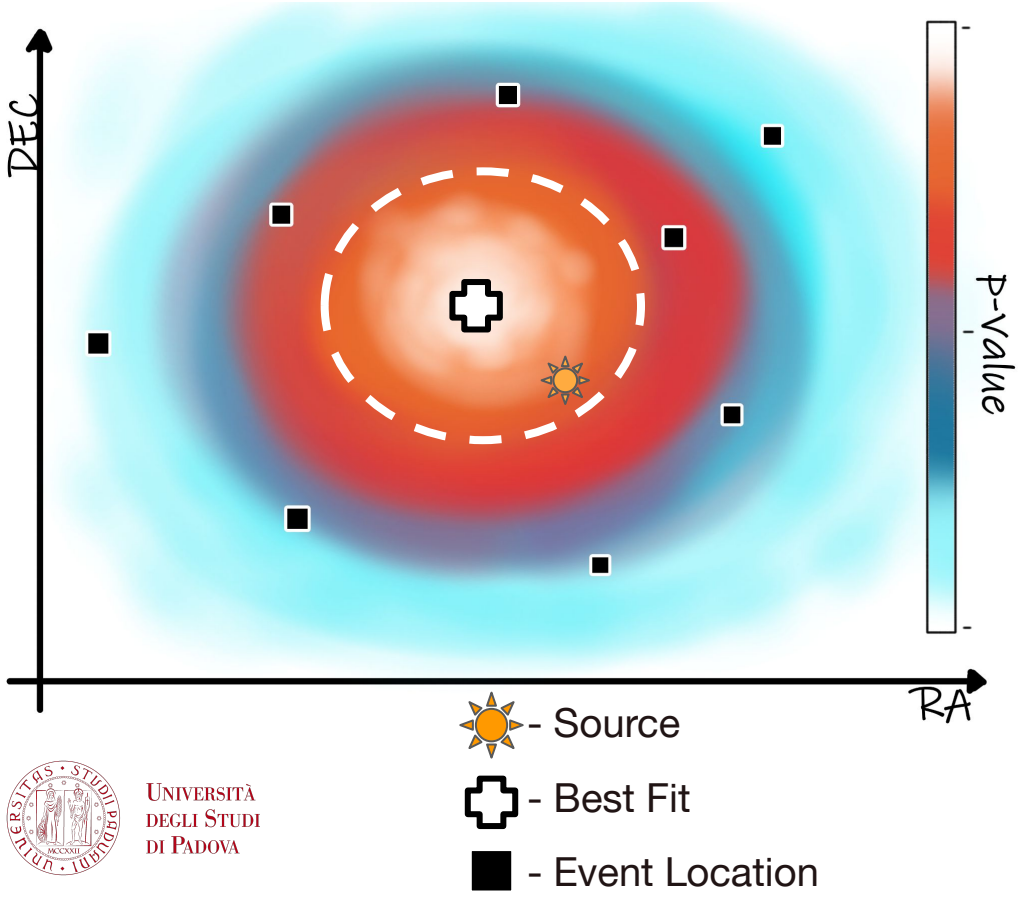
- Con: Trials Factors are larger
- Pro: Unbiased Search



In progress:

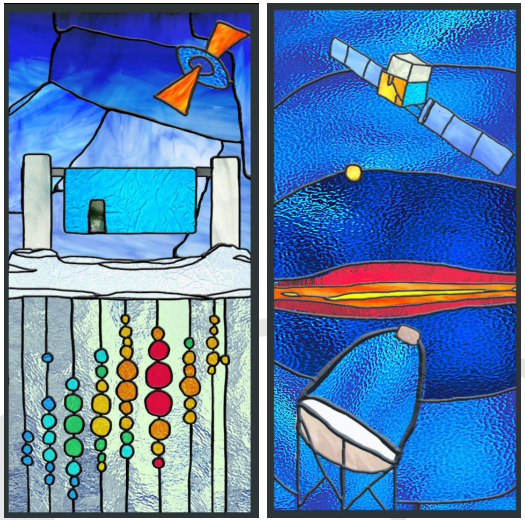
Defining confidence regions for location of All-Sky Alerts

Localizing All-Sky Alerts



- At present: All-sky Alerts reported with a fixed contour
- Plan: Use our statistical results to build confidence regions
- Currently evaluating performance of methods

Take Away Message



- GFU Program at IceCube searches for flaring neutrino signals from astrophysical sources
- Goal is currently to trigger follow-up from partner telescopes in High Energy Gamma Rays
- Currently the Program is being updated to respond to evolving understanding of sources.
- Seeking to more efficiently trigger the community.

Thanks!