

Possible Multi-Messenger Astrophysics on a Blazar

E.T. de Boone

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Outline

1 History Multi-Messenger Astrophysics

2 Neutrino Basics

3 IceCube-170922A

History Multi-Messenger Astrophysics

Event	EM	CR	GW	ν	Date
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History Multi-Messenger Astrophysics

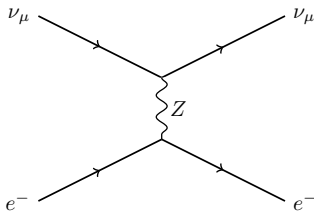
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Supernova	yes		pred	yes	1987
NS merger	yes		yes	pred	aug 2017
Blazar	yes	pred		yes	sep 2017

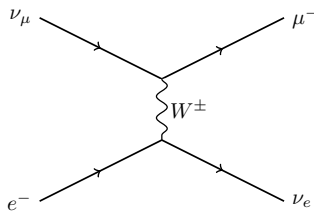
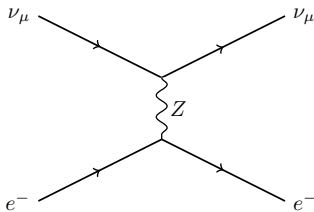
Neutrino Basics

- Neutrino interacts in atmosphere, ice or water



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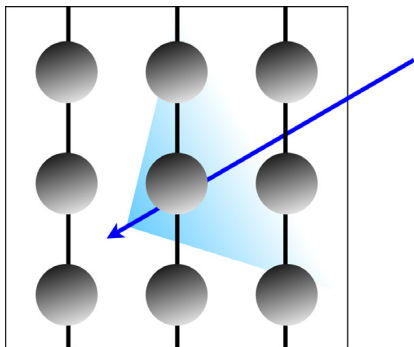


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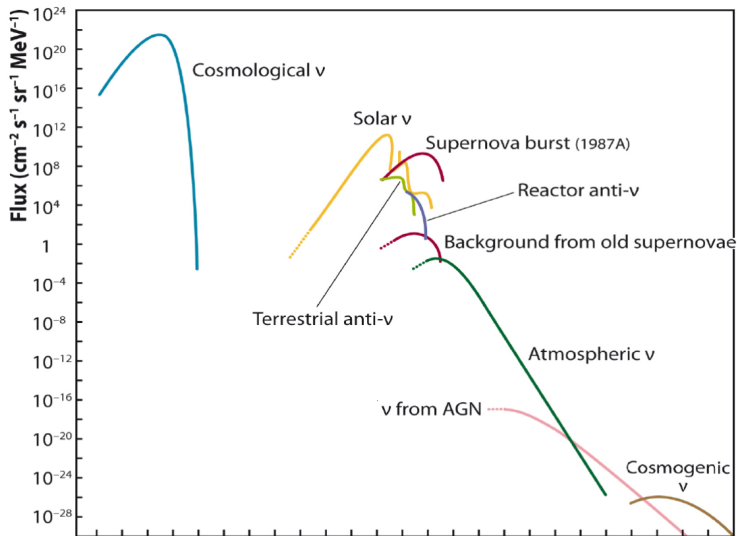
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Neutrino Basics

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- Cherenkov photons detected by DOMs in the matter



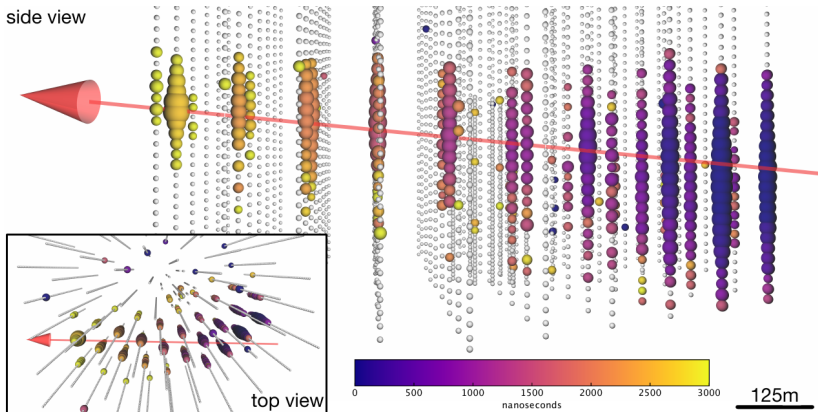
Astrophysical vs Atmospheric Neutrino



IceCube-170922A

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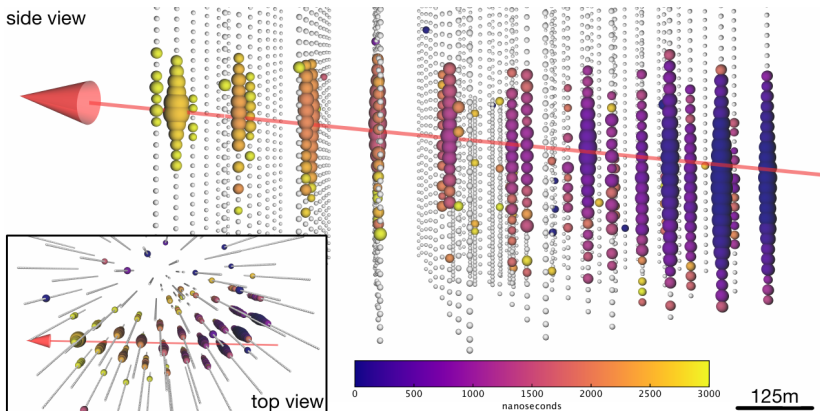
side view



- Traversing Muon
- Energy deposited 23.7 TeV

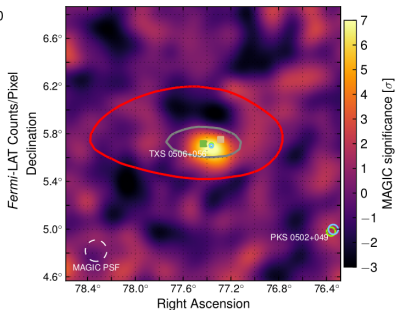
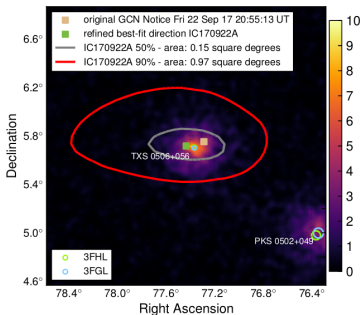
IceCube-170922A

side view



- Muon neutrino
- Energy 0.3 PeV
- Spatial Resolution $< 1^\circ$

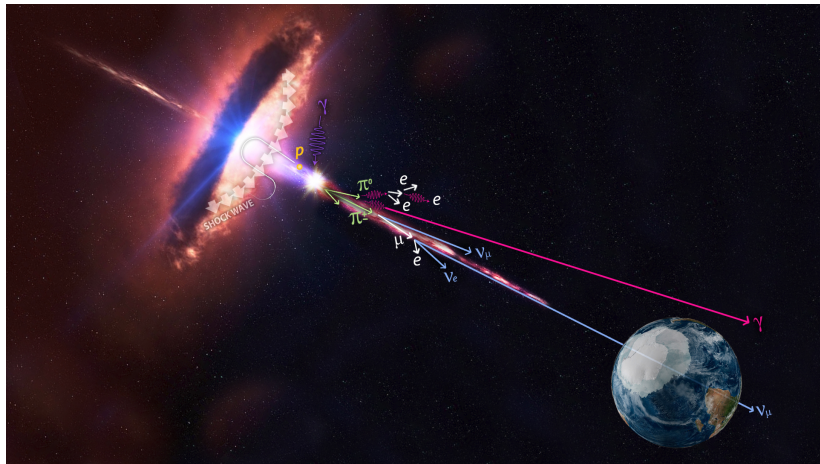
EM pinpointing of IC170922A



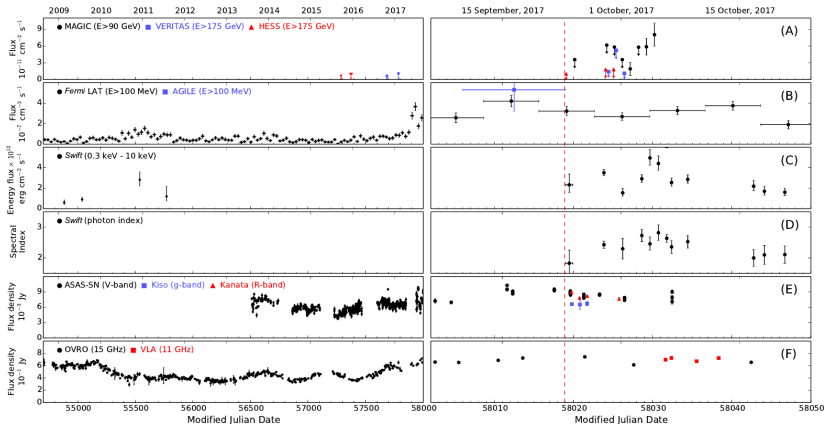
- γ -ray blazar TXS 0506+056 within 0.1° of IC event

What is a Blazar

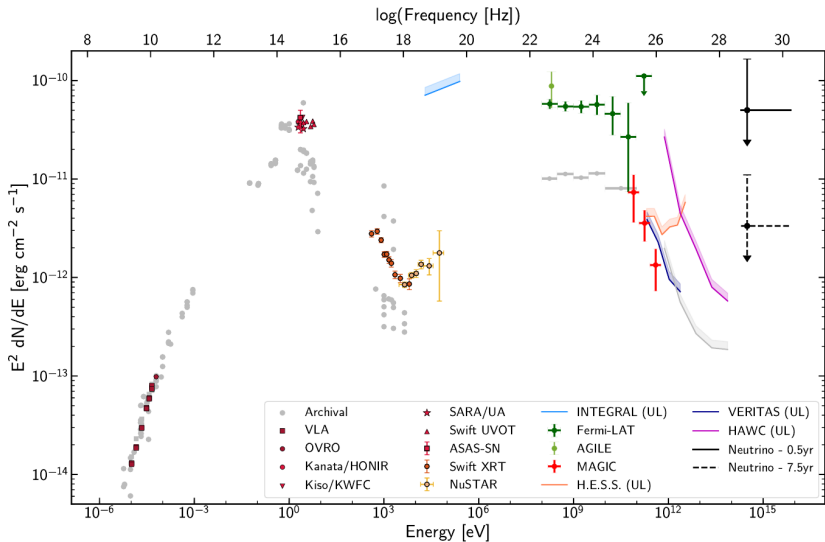
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Further Observations



Broadband Spectrum of TXS 0506+056



Chance Coincidence and Archival Data

- 3σ non-random coincidence \rightarrow inconclusive

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- ν detection in 2014 in vicinity of TXS 0506 + 056

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Question Time