

MAGIC observation strategy of IceCube neutrino alerts

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Alerts received by MAGIC

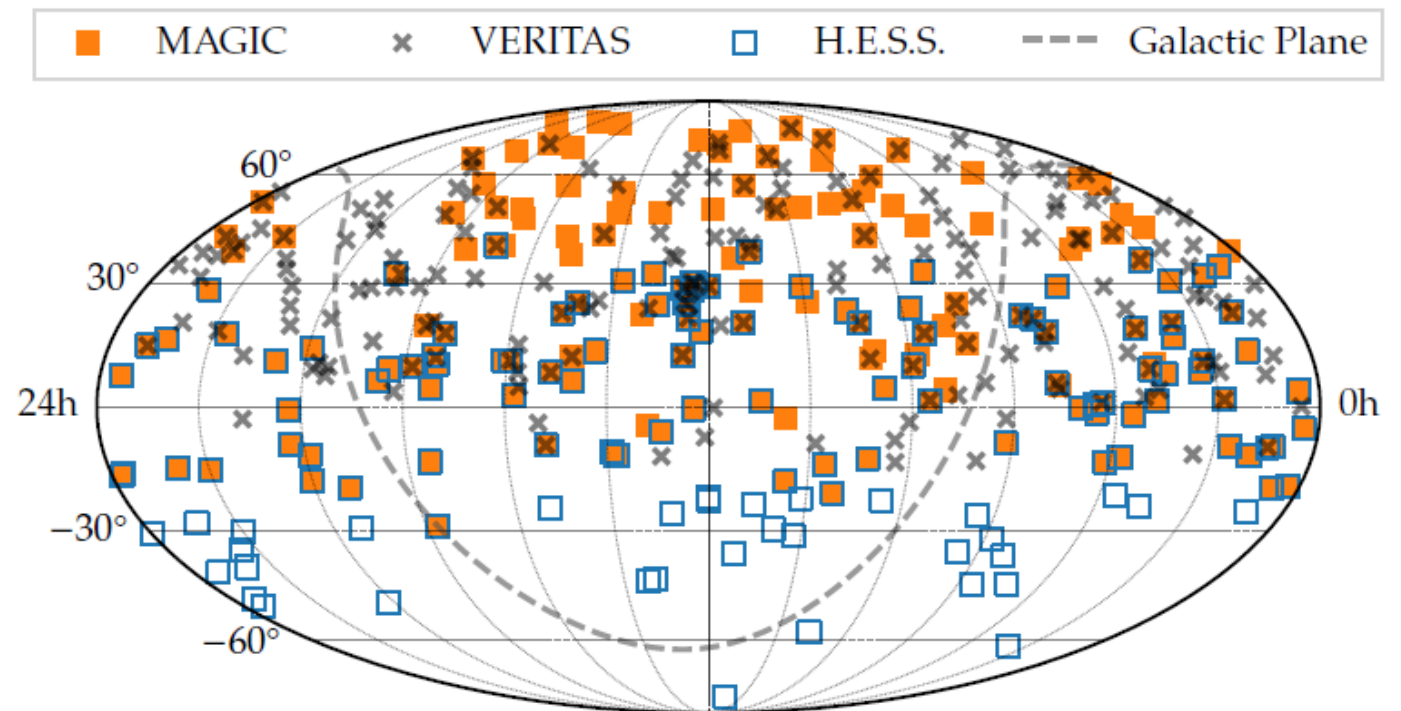
Alerts from IceCube:

- Single high energy tracks, $E > 60$ TeV
 - BRONZE and GOLD alerts
- Neutrino clusters, $E > 100$ GeV
(see Caterina Boscolo Meneguolo's talk for more details)

Sources selection:

- Extragalactic
- Redshift < 1
- Flux variability
- detectability prospects for MAGIC

Total of 179 interesting sources for MAGIC



MAGIC follow-up observations

MAGIC observations (neutrino clusters and BRONZE tracks):

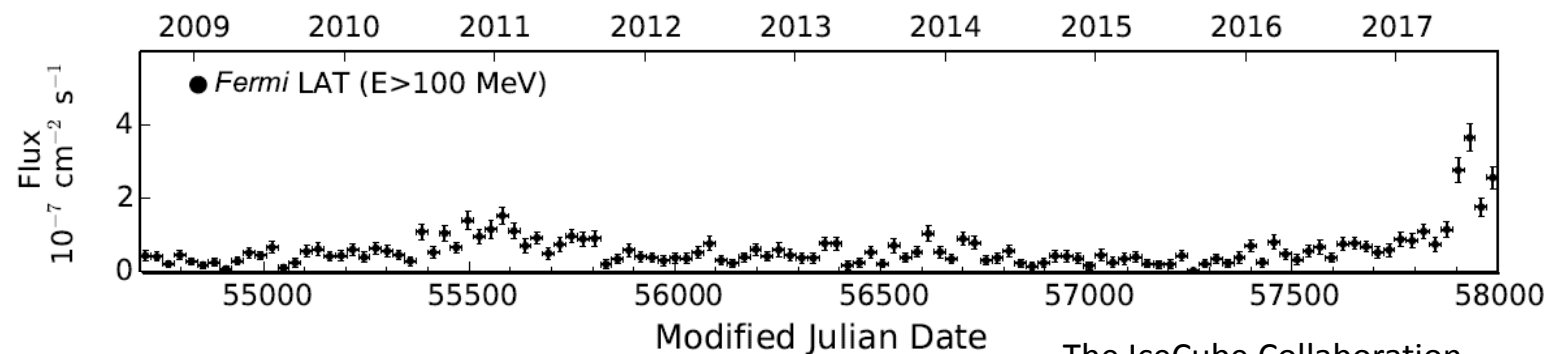
- Significance of neutrino alert
- Observing conditions
- Multiwavelength information

Automatic repointing (GOLD tracks):

- IC error region < 0.5 deg
- fast movement to alert position (~ 7 deg/s)

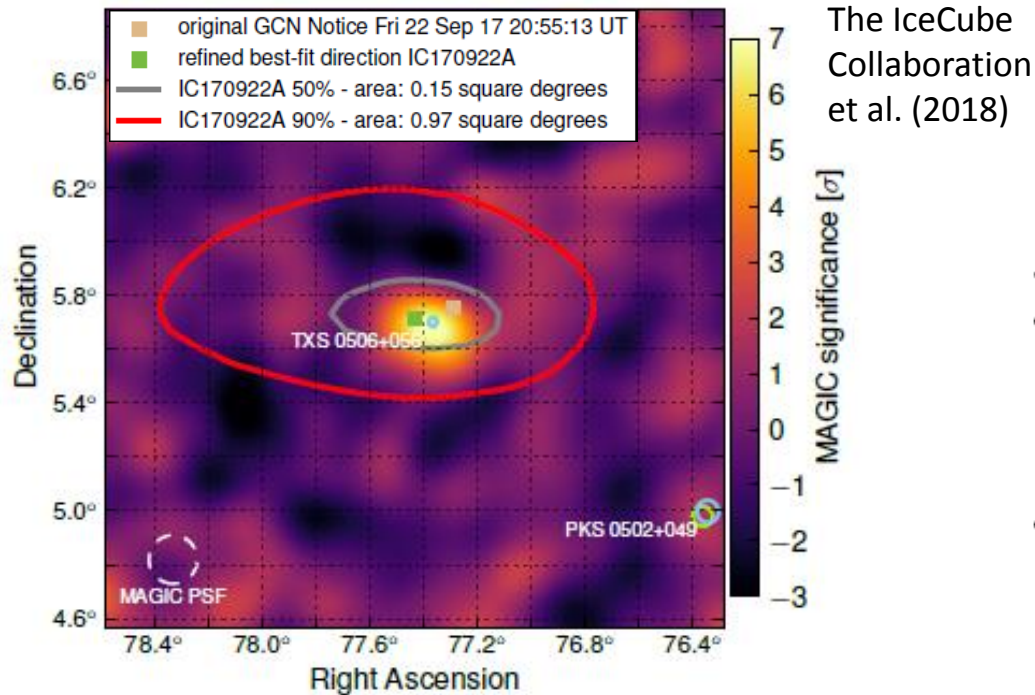
If interesting alert:

- Observe as soon as possible
- Continue observations if:
 - Excess $> 3.5\sigma$ in IC error region
 - Enhanced flux in multiwavelength observations

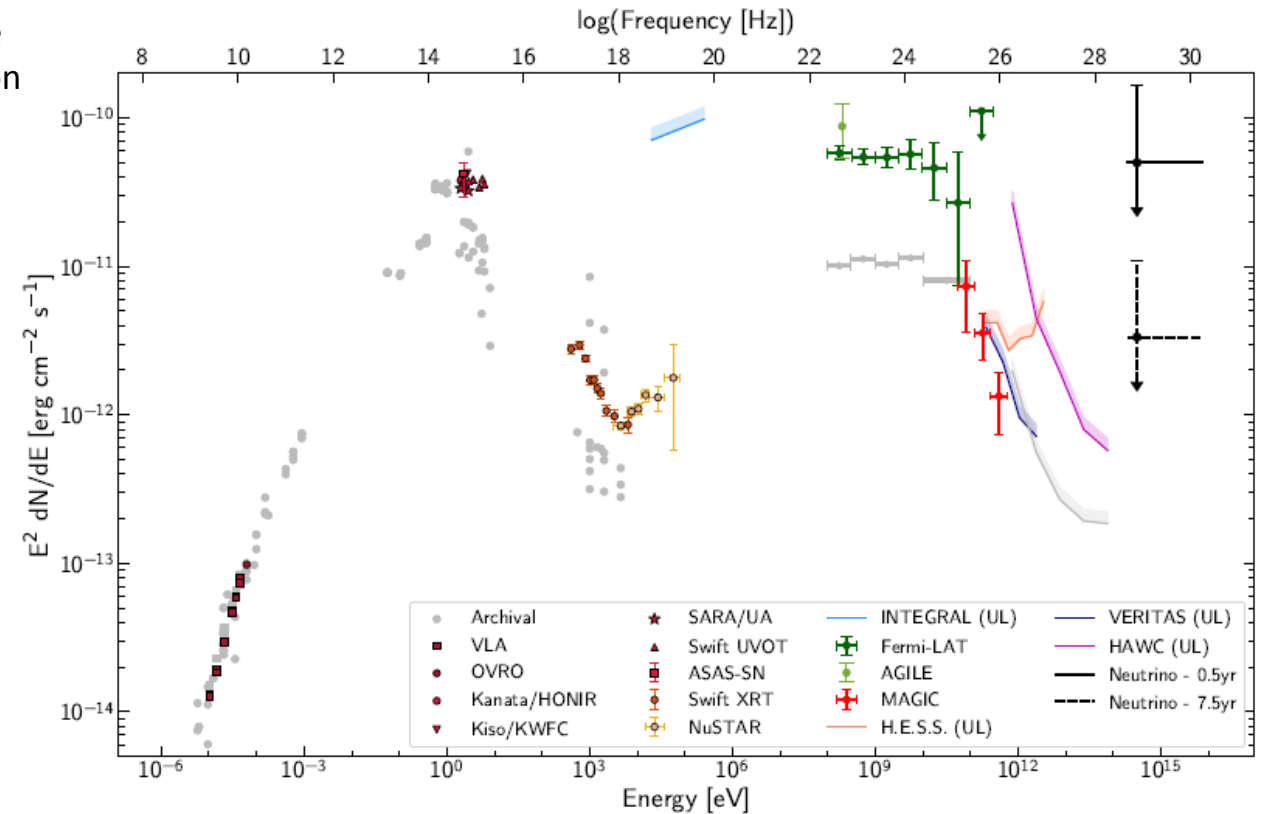


The IceCube Collaboration
et al. (2018)

A successful follow-up: TXS 0506+056



IC-170922A: Track-like event with $E \sim 290$ TeV
MAGIC observations: detection in VHE γ -rays
 ($E > 90$ GeV) with 6.2σ significance

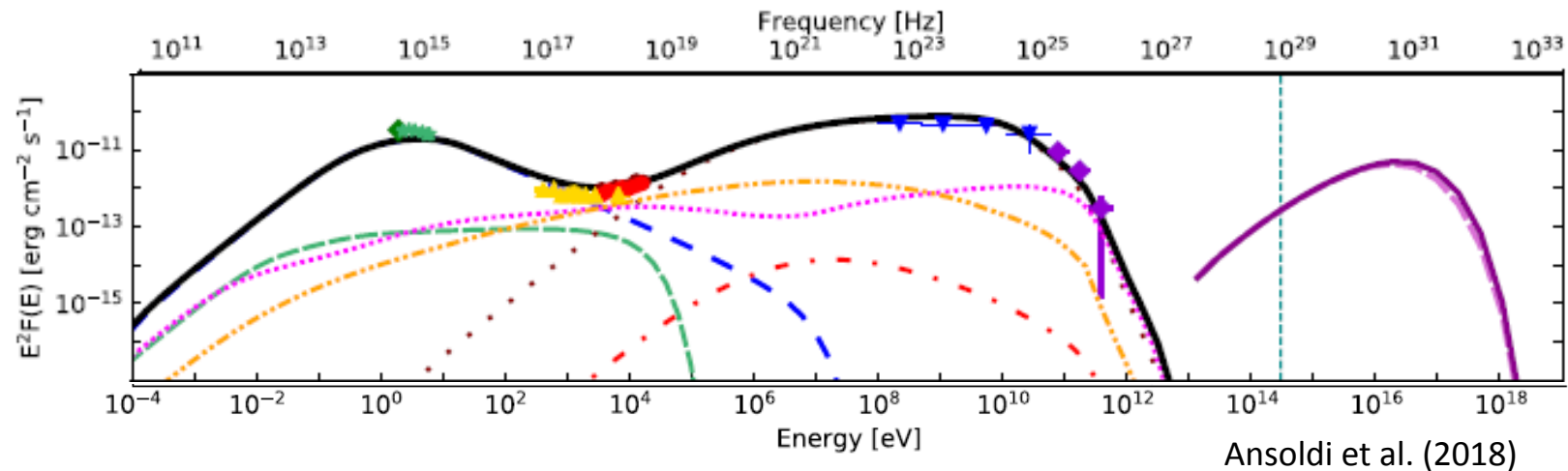
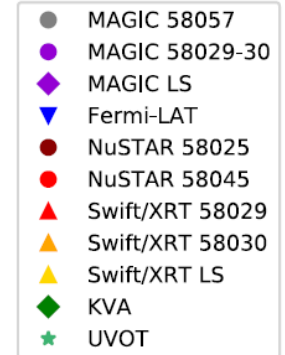
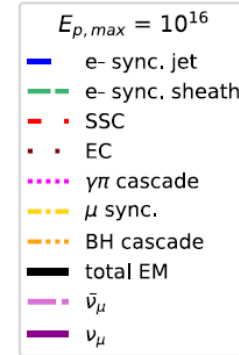


Significance of blazar-neutrino coincidence: 3σ
First multimessenger SED!

Modeling

One zone lepto-hadronic model:

- Dominant contribution of leptonic emission
- Constraints from X-rays and VHE γ -rays on hadronic one
- Neutrinos from hadronic processes



Ansoldi et al. (2018)

Thank you for your attention!



Backup

Real-time neutrino alerts from IceCube

Three types of alerts sent to MAGIC:

1. Neutrino flares from pre-selected sources:

- Cluster of neutrino events with $E > 100$ GeV
- Duration from few seconds to 180 days
- Location of a known γ -ray emitter
 - Sources selection based on flux variability, redshift and detectability prospects for MAGIC

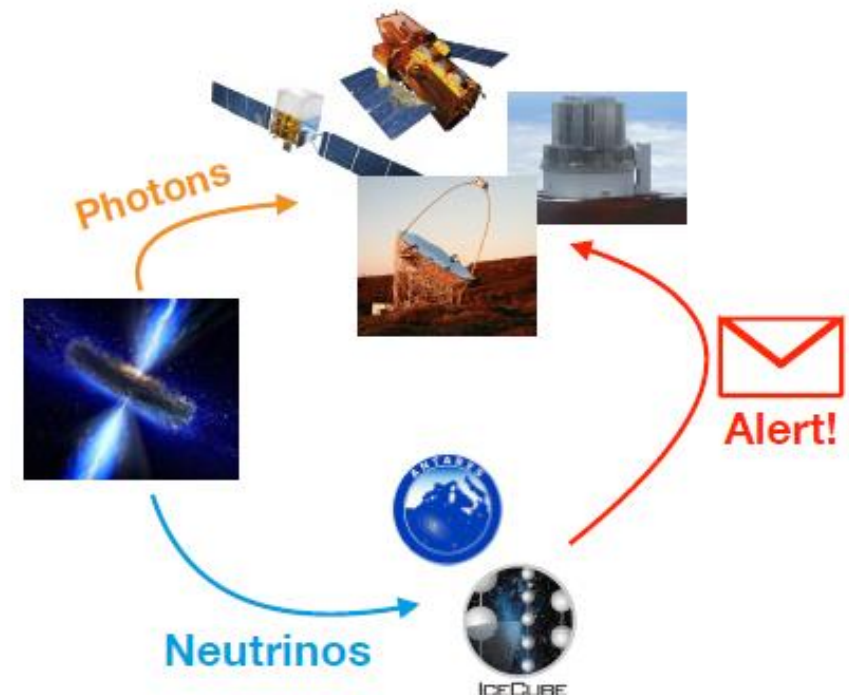
2. Single high energy astrophysical neutrino tracks:

- Single high energy (> 60 TeV) track-like event
- BRONZE and GOLD events
- Expected events: 10/yr GOLD, 30/yr BRONZE

Real-time neutrino alerts from IceCube

3. All-sky neutrino flares:

- Neutrino clusters from the whole sky
- Clusters hint at a transient point source, compared to the isotropic background
- Angular resolution $<0.3^\circ$
 - Constrains the search area for counterparts in MAGIC



MAGIC automatic repointing

- Alert from IceCube interpreted by the **automatic alert system**
- Check alert **visibility** : maximum allowed zenith angle 50 deg.
- If visible:
 - Automatic repointing: telescopes stops the current observation and move in fast mode (~ 7 deg/s) to the target position
 - 2.5h observation maximum with automatic procedure
- **BRONZE alerts**: no automatical repoint
- **GOLD alerts**: automatic repointing only for alerts with error circle < 0.5 deg.
- **Neutrino clusters**: automatically generated emails --> no automatic procedure