AMEGO – Exploring the Extreme Multimessenger Universe

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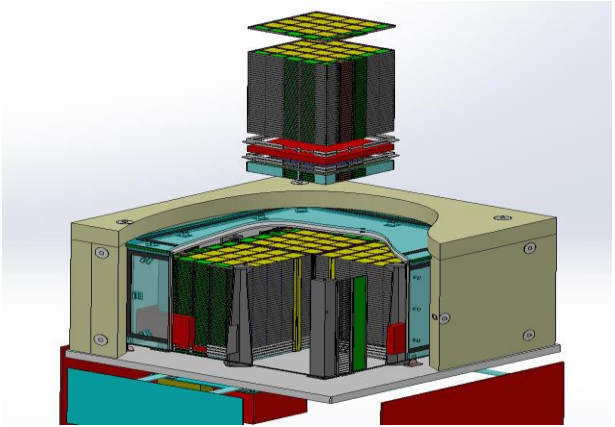
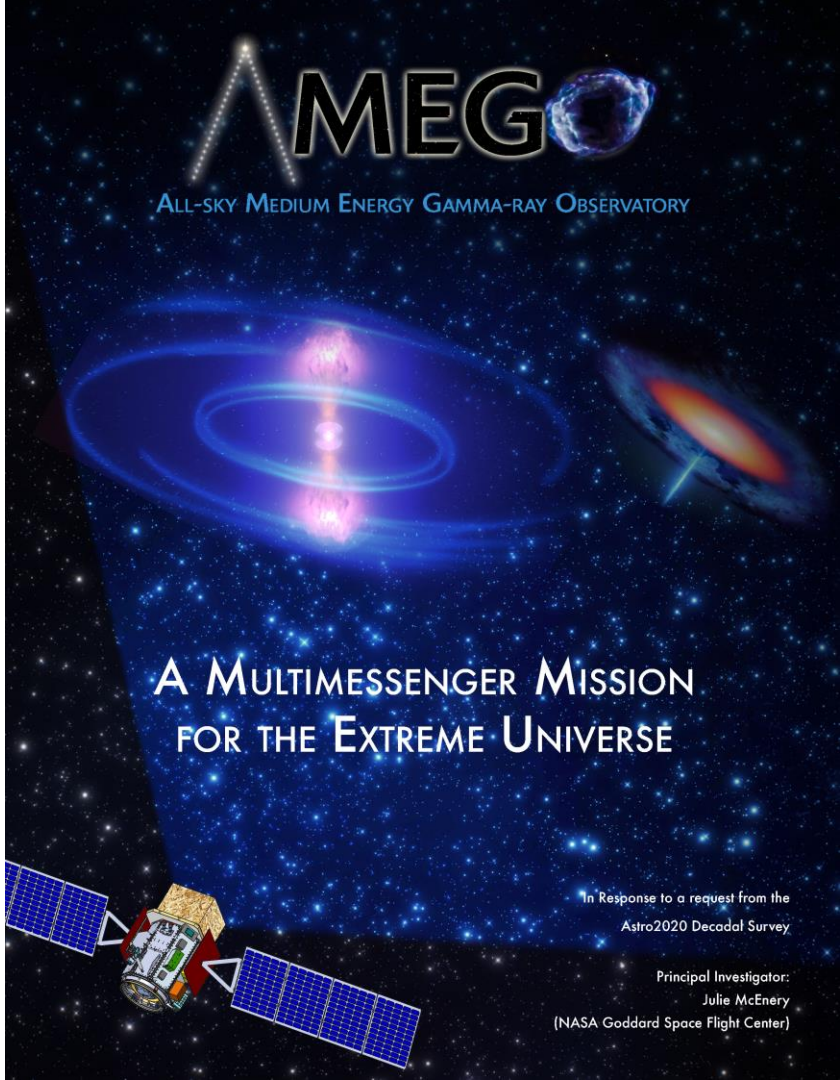
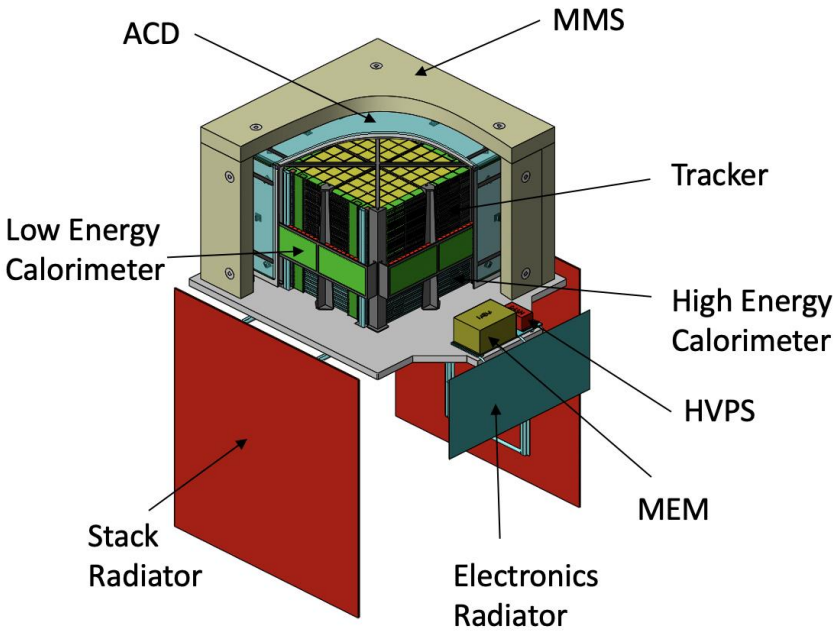




AMEGO Mission

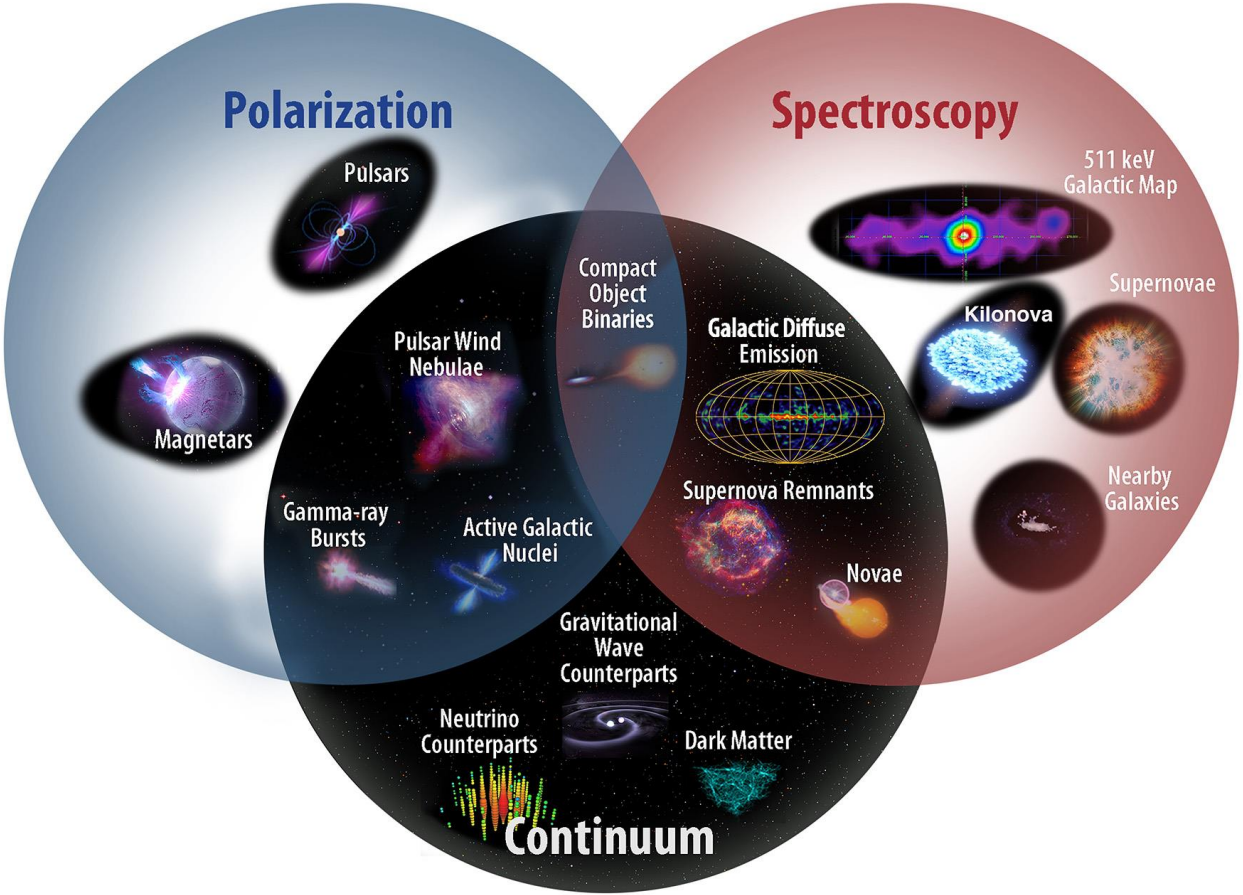
- Probe class mission that provides ground breaking new capabilities for multimessenger astrophysics
  - Identifying and studying objects that produce gravitational waves and neutrinos
- Surveys the entire sky from 200 keV to over 5 GeV with more than an order of magnitude improvement in sensitivity relative to previous missions



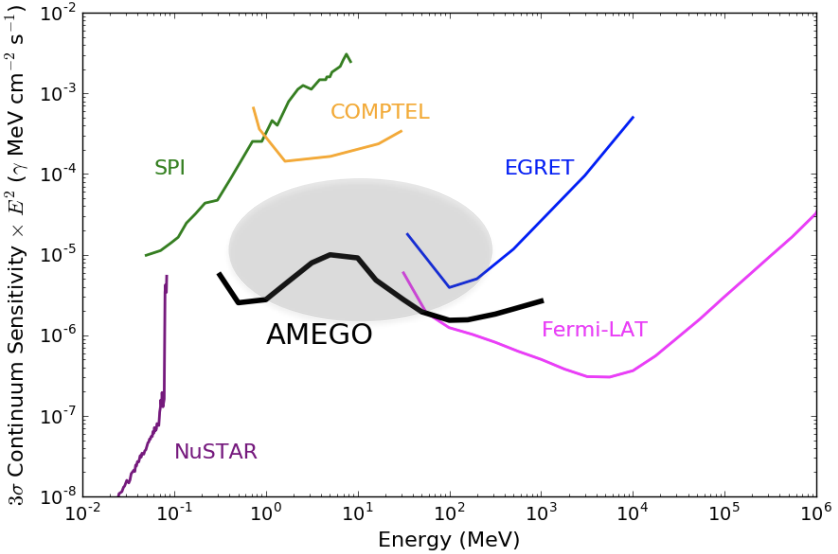
https://asd.gsfc.nasa.gov/amego

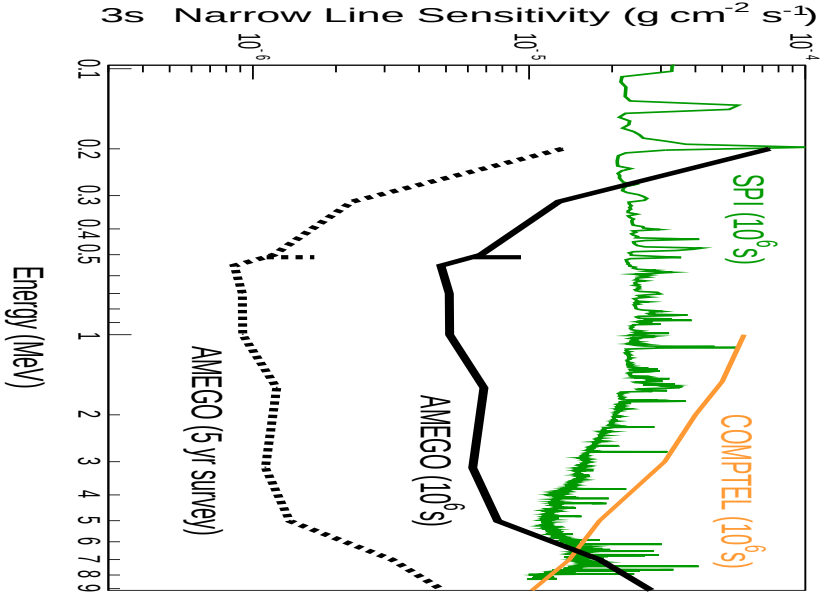
https://asd.gsfc.nasa.gov/amego/files/AMEGO_Decadal_RFI.pdf

AMEGO Opens Huge Discovery Space



AMEGO opens huge discovery space!





Huge field of view: 2.5 sr, survey full sky every 3 hours – explore time domain!
Broad Energy Range: 200 keV - >10 GeV
Angular Resolution: 2.5 deg@1 MeV, 1.5 deg@5 MeV, 2 deg@100 MeV
Energy Resolution: <1% (<2 MeV)
Polarization sensitivity: <20% MDP for a source 1% of the Crab flux observed for 10^6s

Multimessenger Astrophysics

Identifying and studying the astrophysical counterparts of gravitational wave and neutrino sources

i.e.

The science of extreme explosions and extreme accelerators

Multimessenger Science to date

Understanding Extreme Environments

MeV Spectroscopy

Discovery of thermal neutrinos and gamma-ray lines from SN1987a

Compact Objects

Discovery of a gamma-ray burst, kilonova and gravitational waves from GW 170817

Astrophysical Jets

Association of a gamma-ray flare and high energy astrophysical neutrino in the blazar TXS 0506+056

Active Galactic Nuclei

Gamma-ray Bursts

Supernovae /Supernova Remnants

Large Magellanic Cloud

AMEGO Science

Understanding Extreme Environments

MeV Spectroscopy

Resolve the processes of element formation in extreme environments such as kilonovae and supernovae

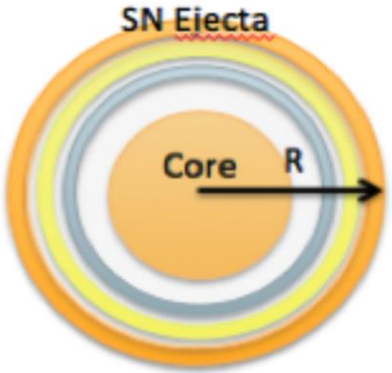
Compact Objects

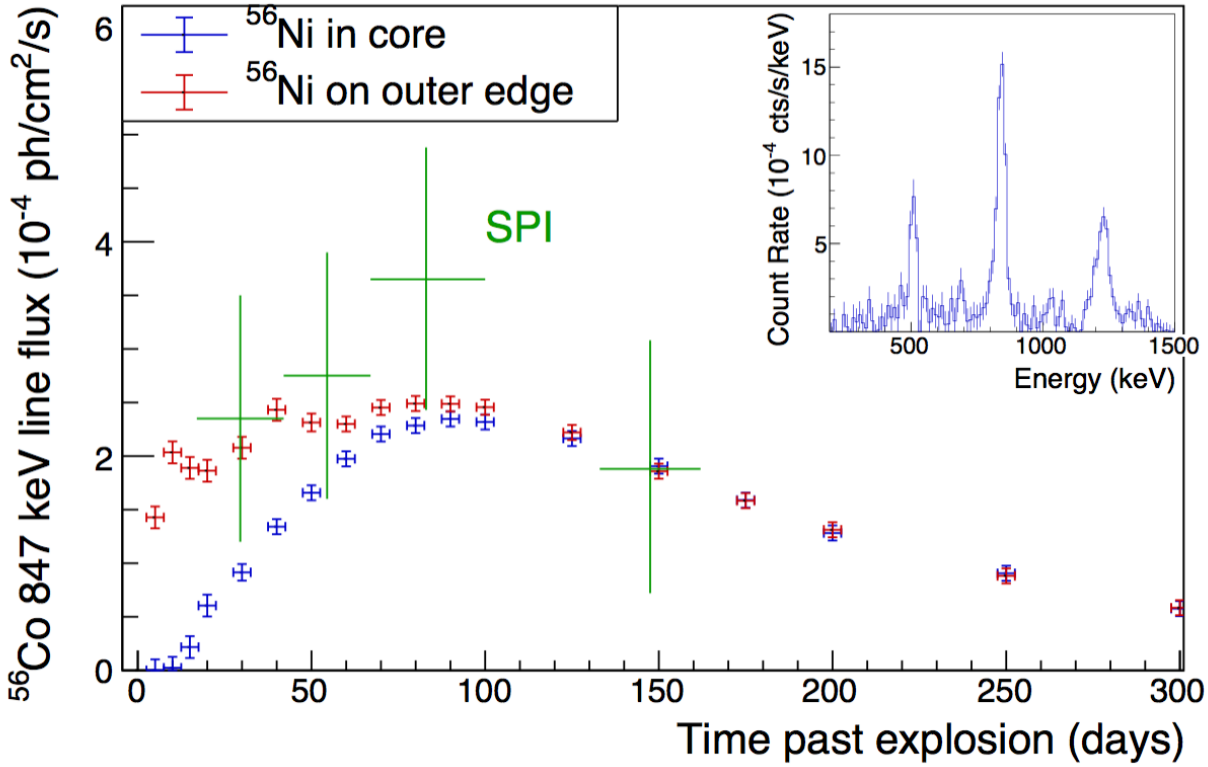
Understand the physical processes in the extreme conditions around compact objects involved in gravitational wave events and other energetic phenomena

Astrophysical Jets

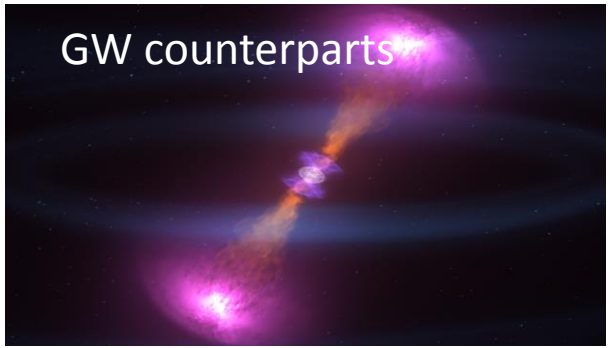
Decipher the operating processes of jets in extreme environments such as gamma-ray bursts and active galactic nuclei

Supernova Ia

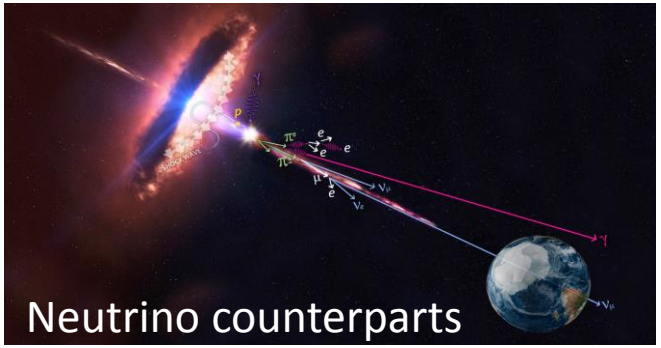




AMEGO is a Multimessenger Observatory



Gamma-ray Observations played a critical discovery role in ALL major multimessenger discoveries in the past 5 years

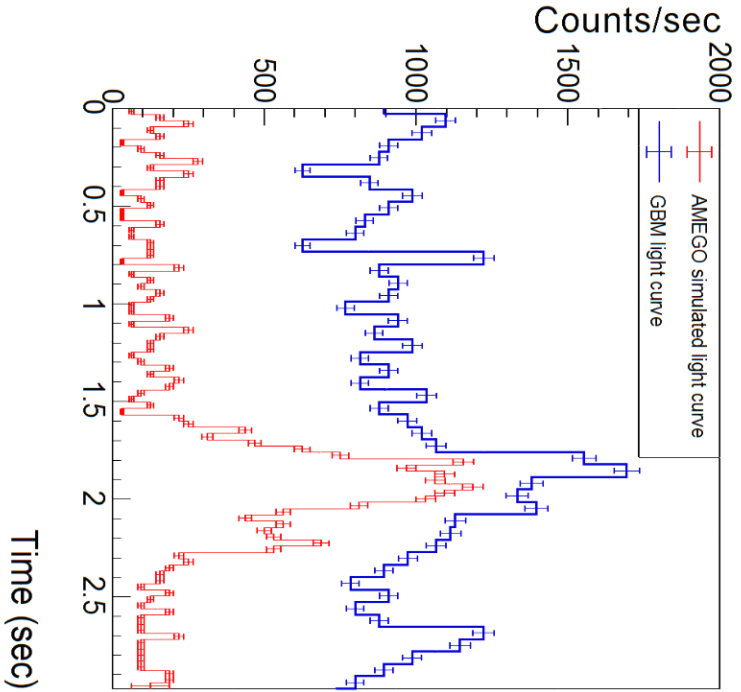


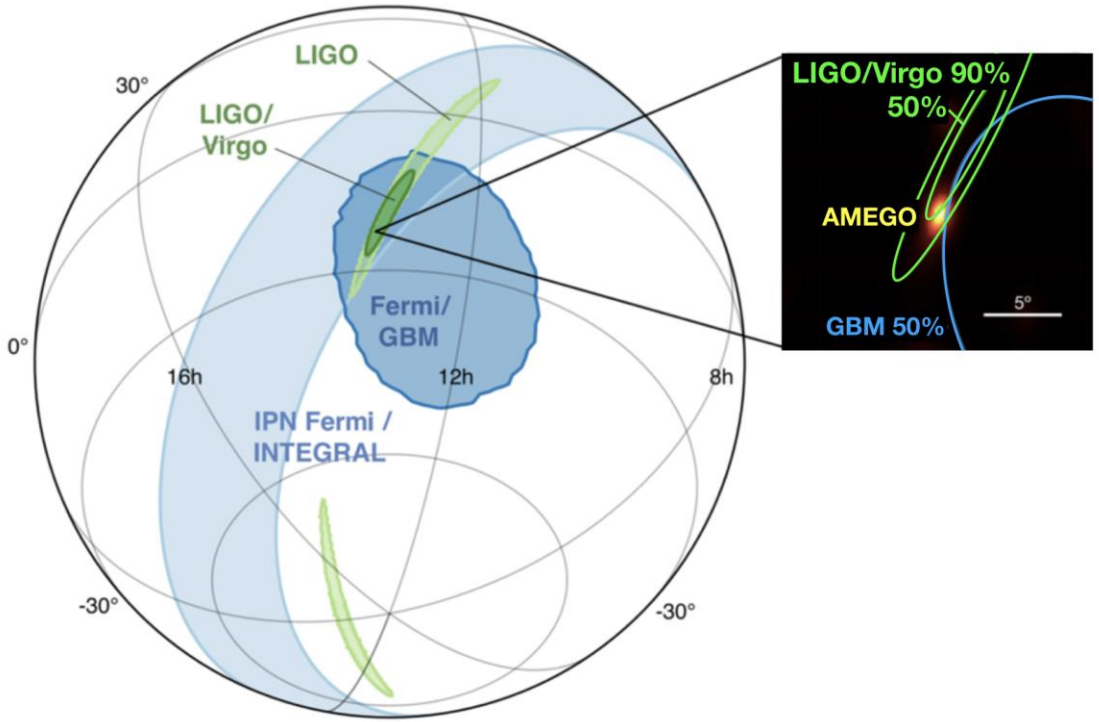
- High rate of well localized (~<1 deg) GRB
  - >100 short GRB/year
  - ~450 long GRB/year
- Polarization probes GRB jets
- Direct observation of gamma-rays from nuclear processes in nearby kilonova

- Gamma-rays are generated in the same physical process that produces neutrinos
- Continuous monitoring of hundreds of the most luminous blazars
- MeV flux good proxy for neutrino flux
- Polarization observations probe jet composition

AMEGO will provide essential capabilities in the gamma-ray band to enable multimessenger astrophysics with the next generation of GW and neutrino observatories

Gamma-ray Bursts and Gravitational Waves



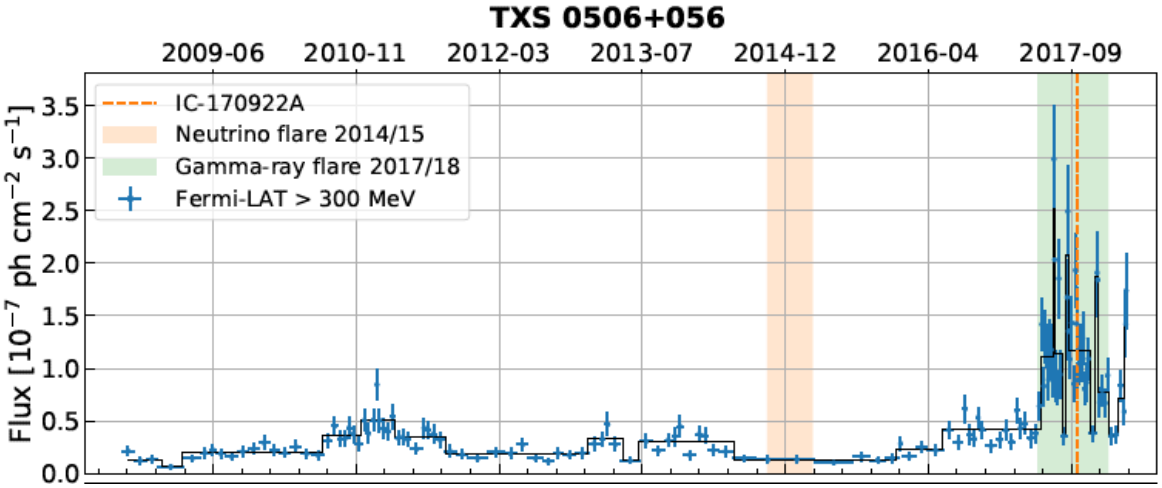


AMEGO will localize >100 short GRB/year (c/f 40 with Fermi-GBM and 10 with Swift-BAT) – see talk by D. Tak

Science Questions with GW/GRB counterparts

- How do relativistic jets form, launch and evolve
  - Time between GW chirp (energy deposit) and first photon emission provides unique information
  - Where is the photosphere? (how is energy carried in the jet)
- What is the structure of the jet in sGRB
  - Measure time dependent gamma-ray properties (flux, spectrum) as a function of jet angle (provided by GW observations)
- Where are GW ns mergers
  - AMEGO will provide good localizations for a subset of NS mergers detected by GW detectors in NEAR REAL TIME
- What fraction of short GRB have hard spectrum components?
  - AMEGO will provide the sensitive observations needed in the region between LAT and GBM

Active Galaxies and Neutrino Sources



AMEGO would be able to find counterparts to both neutrino flares!

Fermi-LAT identified a gamma-ray flare from the active galaxy TXS 0506+056 coincident in space and time with a high energy neutrino (IC-170922A)

Search in archival data found a flare (13 neutrinos) in December 2014
Huge power release – likely the result of a massive accretion event onto the central black hole. High energy gamma-rays cannot escape this environment and are reprocessed down to the MeV band where they could be seen by AMEGO

AMEGO and Multimessenger Astrophysics

- Space-based wide-field, survey mode gamma-ray observatories have been central to multimessenger discoveries
- Very close overlap between gamma-ray and multimessenger sources!
- Entering a golden age of gravitational wave and neutrino astrophysics
  - Need a capable gamma-ray observatory to continue multimessenger discovery potential
  - Need to start AMEGO development soon to minimize (or eliminate) gap in coverage expected at the end of the Fermi mission

https://asd.gsfc.nasa.gov/amego/