Synergies with gamma-ray Astrophysics

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on behalf of the AGILE Team

INAF-IAPS

Gamma-ray surveys: Exploring the changing sky

- The gamma-ray sky is highly variable
- Large FoV (2-3 sr) in each pointing
- A large sky coverage (~ 80%) possible on sub-daily integration time (scanning mode)
- Fast alerts for multi-wavevelength follow-up
- **Multifrequency data are the key to understand the physial mechanisms undergoing the gamma-ray emission**

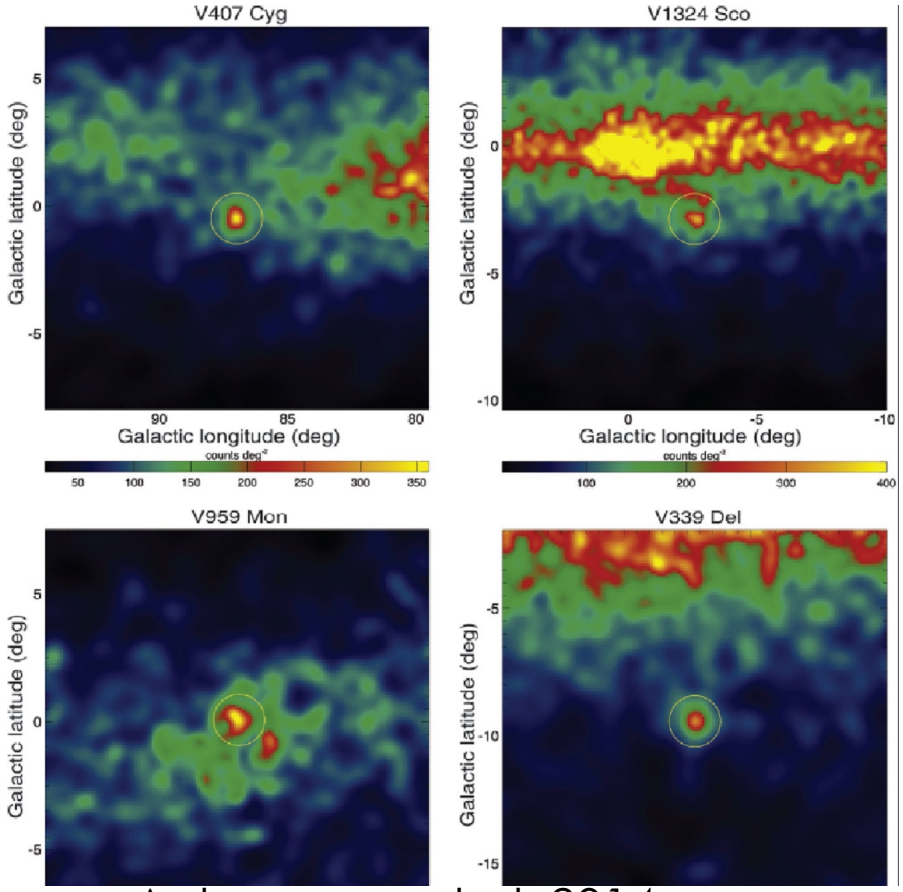
The synergy relies on:

- **Fast LSST alerts for transients**
- **Access to long-term light curves**

LSST crucial for a variety of gamma-ray sources

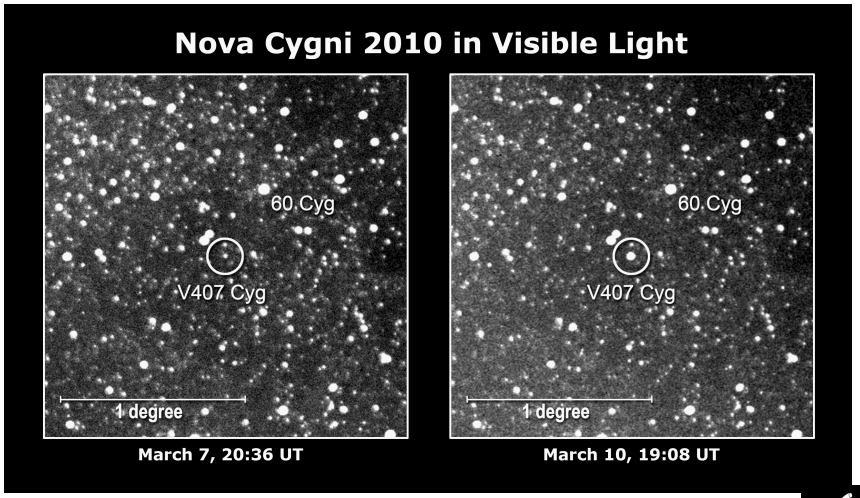
- Galactic transients and binaries
- Optical flares and long-term monitoring of blazars
- GRBs
- GW source counterparts
- Crazy transients (e.g. tidal disruption events)
- Large sky coverage with multiple-cadence at different wavelengths is crucial for most of these sources

Optical and γ-ray synergy: gamma-ray novae discovery

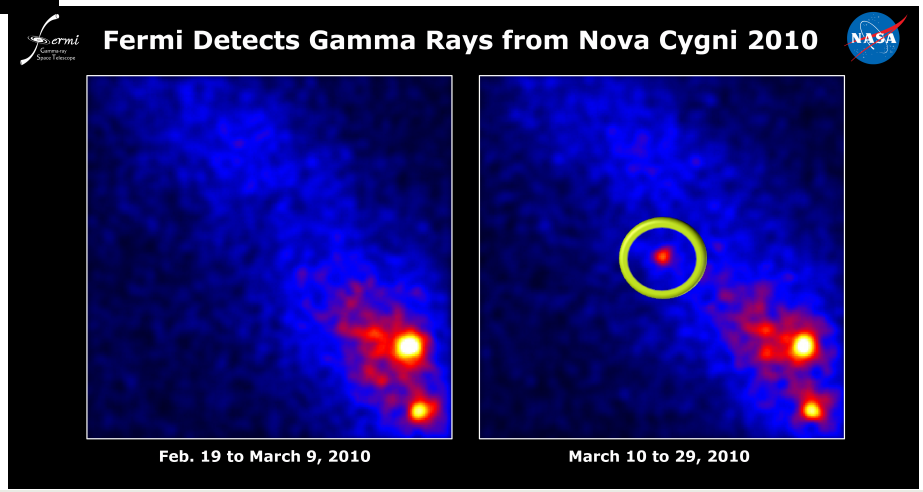


Ackermann et al. 2014

Nova V407 Cygni:
particles in the explosion's shock wave crash into the red giant's stellar wind



Optical and gamma-rays: Mutual triggers



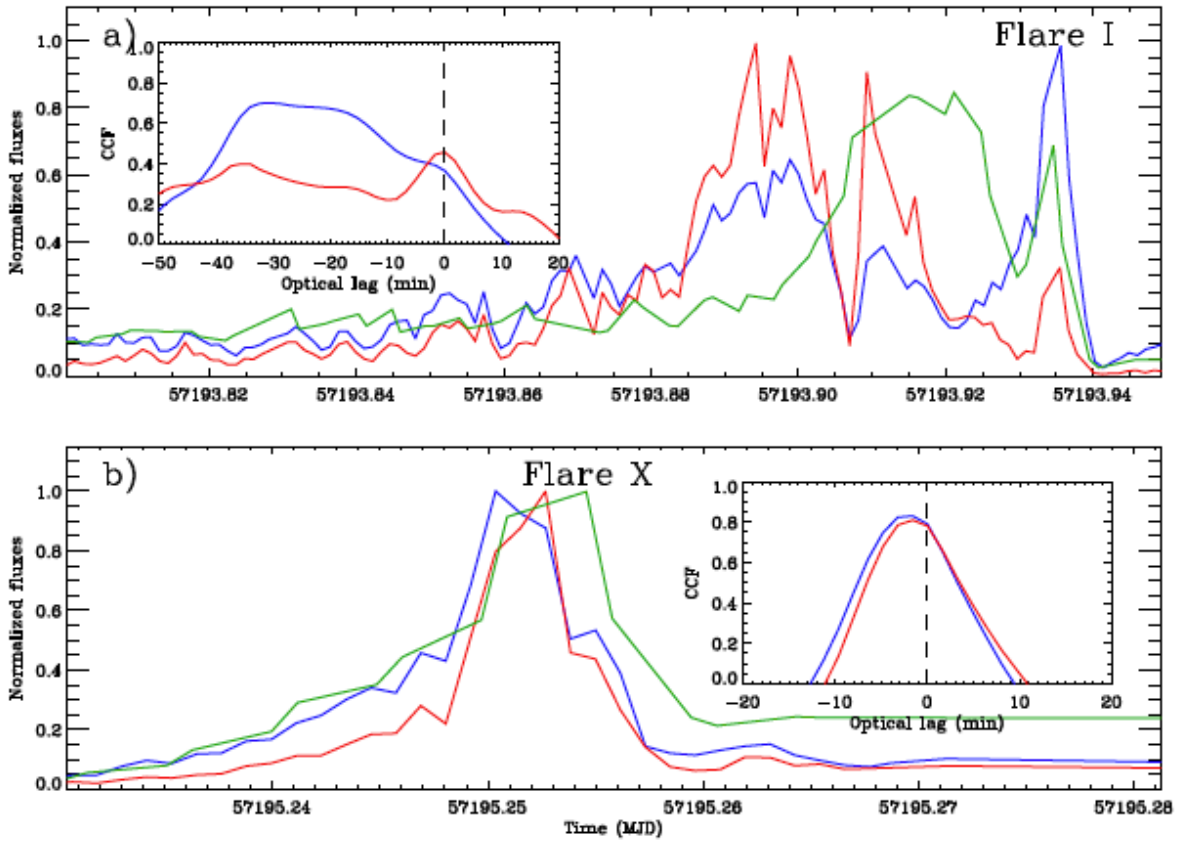
Nova shell interaction with the dense ambient medium of the red giant primary emission, proton-electron acceleration:

Gamma-rays produced by π_0 decay from proton-proton interactions or inverse Compton scattering of the red giant radiation

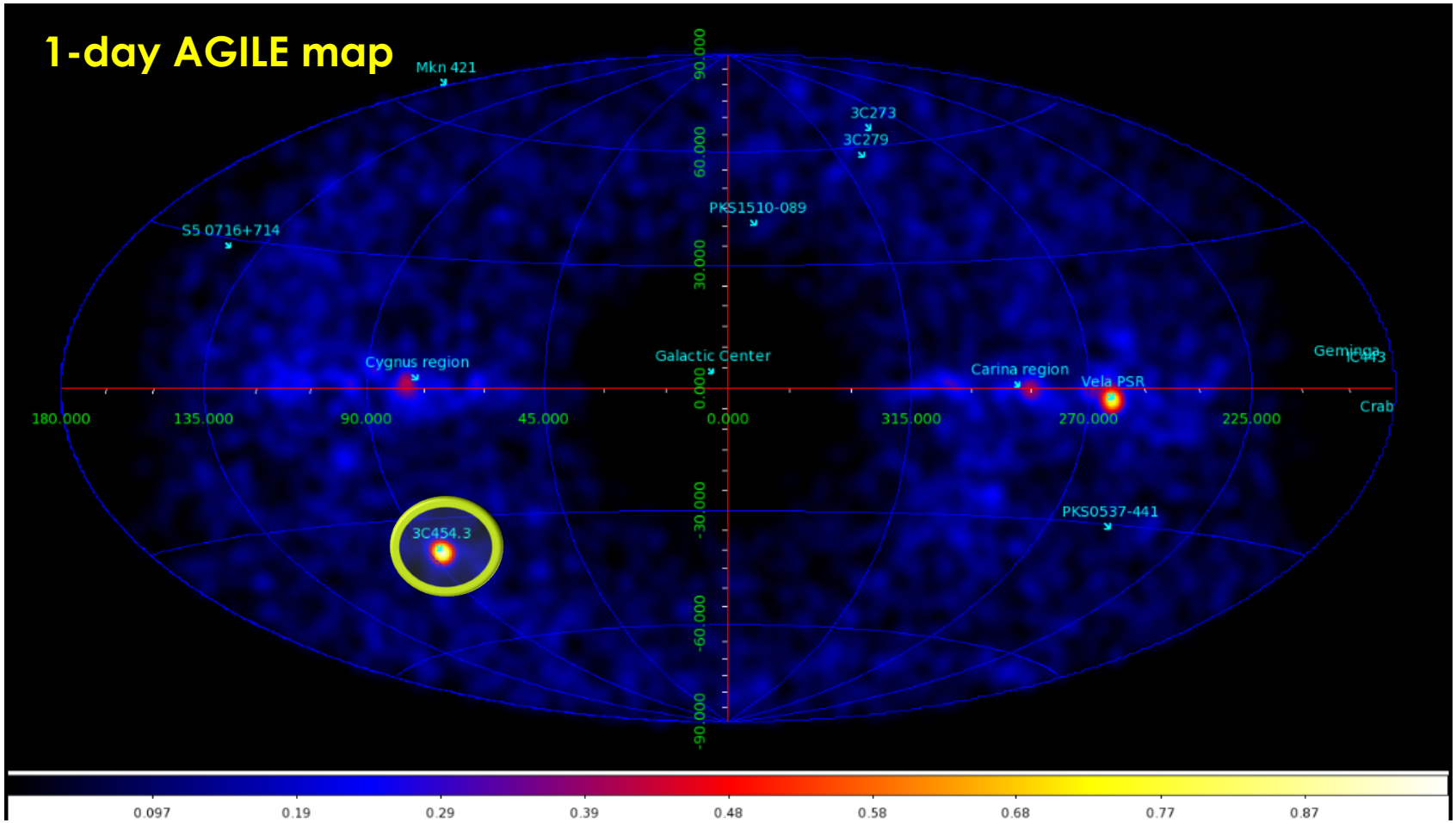
BH-binary systems: The monster V404 Cygni

Some optical flares occur in conjunction with the X-rays, while other activity periods show delays

J. Rodriguez et al. 2015

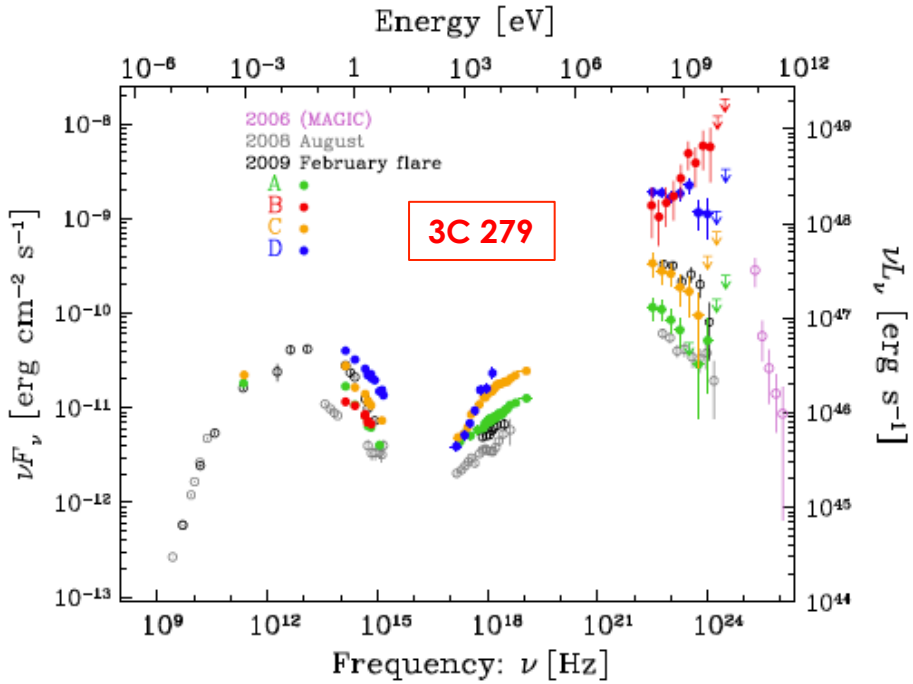


The gamma-ray transient sky
Blazars

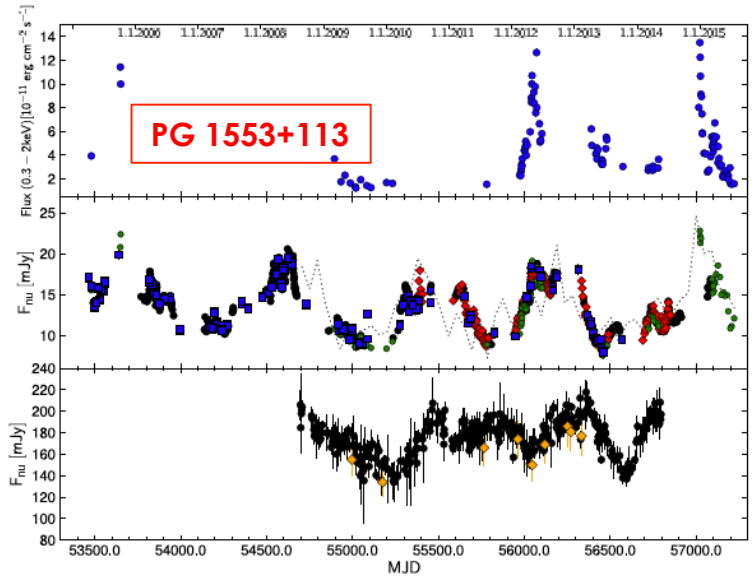


Blazars

- The **LSST long-term monitoring** of a large sample of blazars will allow us to
  - Interpret the SED variability (high Compton dominance)
  - Search for signature of multiwavelength periodicity (jet QPOs, binary SMBHs)

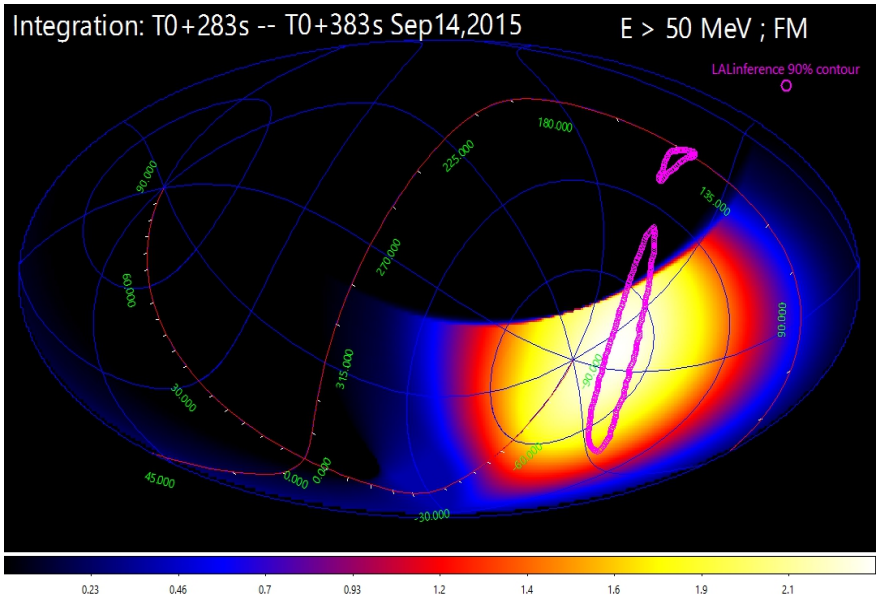


Hayashida et al. 2015



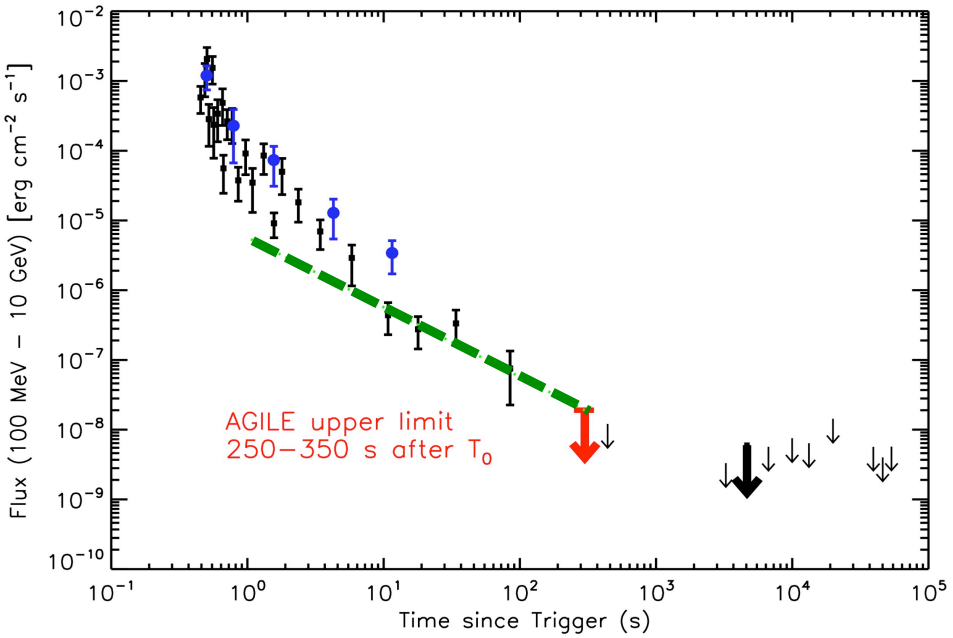
Ackermann et al. 2015

GW counterparts



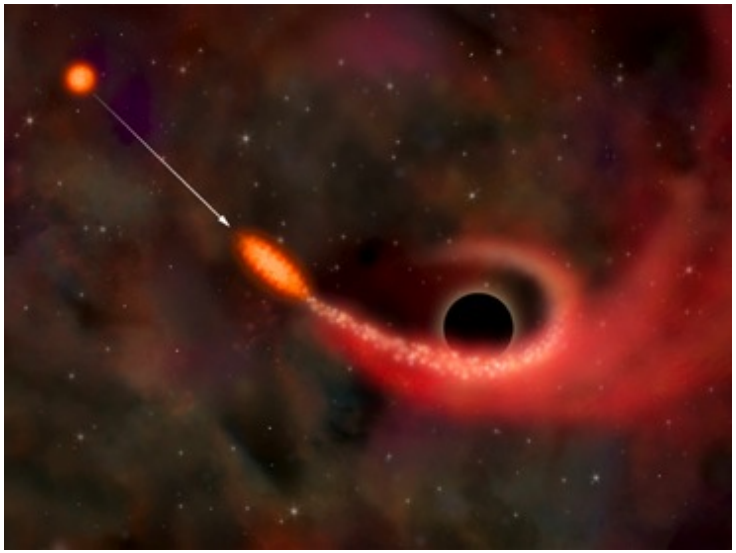
LSST - gamma-ray survey Complementarity

AGILE and Fermi-LAT upper limits in the GRB090510 lightcurve

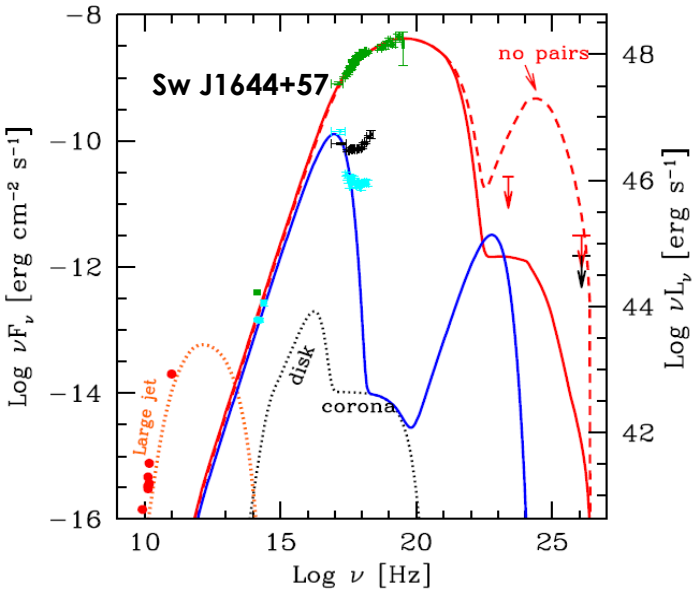


Tidal disruption events

- LSST will be an **optima**l Tidal Disruption Event **Hunter** (thousands per year, see Strubbe & Quataert 2011)
- SKA will be an **optima**l jetted Tidal Disruption Event **Hunter** (hundreds per year, Donnarumma & Rossi 2015)
- X-ray and Gamma-ray surveys crucial to understand the HE emission in jetted TDEs



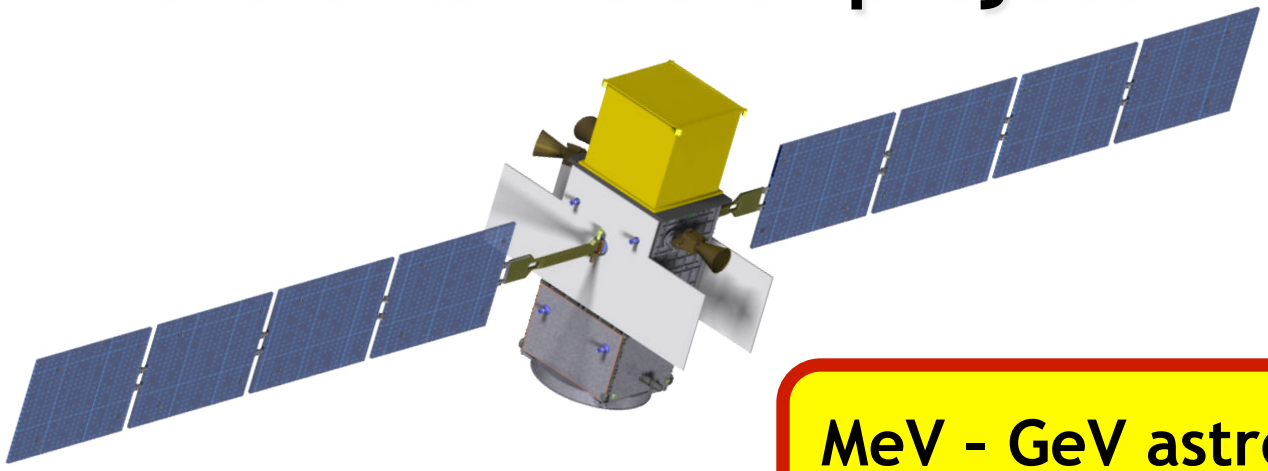
Burrows et al. 2011



Summary

- LSST monitoring of the Optical sky will **uniquely** provide the low-energy counterparts of the most extreme gamma-ray sources
- LSST will open a new window on the **changing sky** -> new discoveries based on the synergy with future radio (SKA) and gamma-ray surveys(Fermi, e-ASTROGAM, ComPair)

The next gamma-ray MeV-GeV mission: the e-ASTROGAM project



MeV – GeV astrophysics
MeV – GeV community

LoI submitted to ESA M5 call on June 6th;

e-ASTROGAM is focused on gamma-ray astrophysics in the range 0.3-100 MeV with excellent capability up to GeV energies.

The e-ASTROGAM core science

- **Extreme phenomena in the era of new astronomy**

  Gravitational waves ……

- **The mysteries of the GC and Inner Galaxy**

  Central BH, compact objects, anti-matter

- **Supernovae, nucleosynthesis, and Galactic chemical evolution**