

MAGIC Observations of Markarian 421



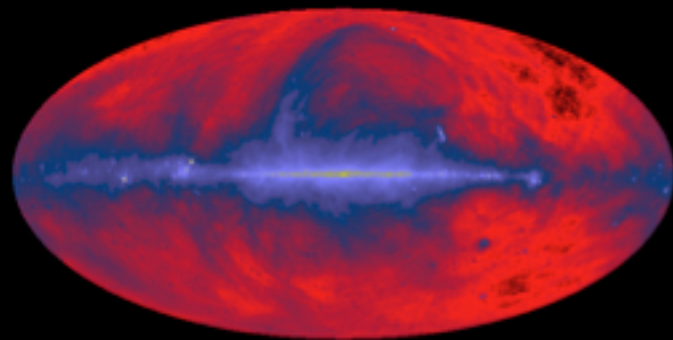
IMPRS Colloquium June 11th 2010

Burkhard Steinke, MPI für Physik, München

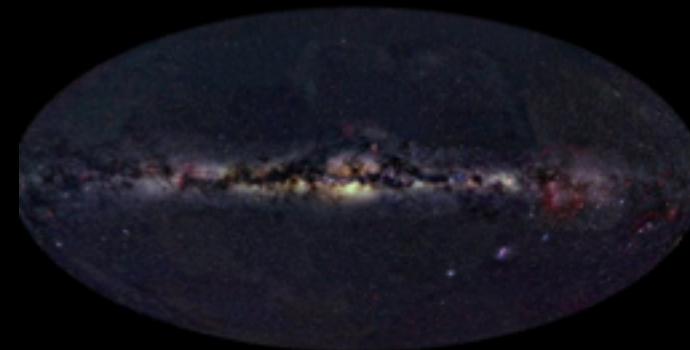


- Motivation for γ -ray-astronomy
- Introduction to the MAGIC telescopes
- Imaging Air Cherenkov Technique
- Active Galactic Nuclei (AGN)
- Recent results for Markarian (Mrk) 421

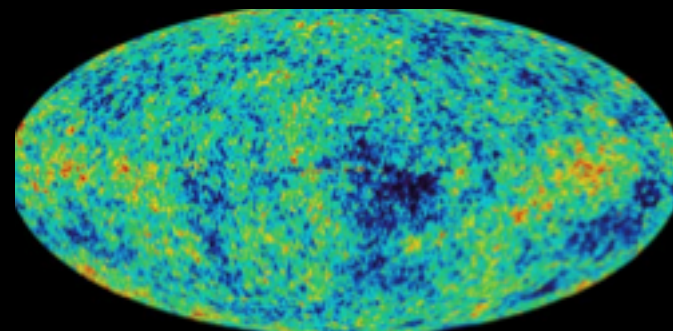
Universe in different energies



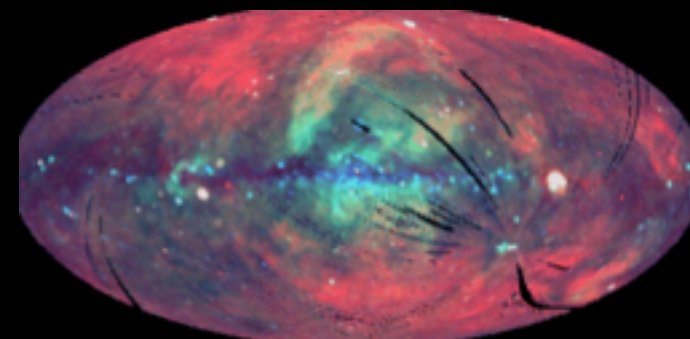
Radio
 10^{-6} eV



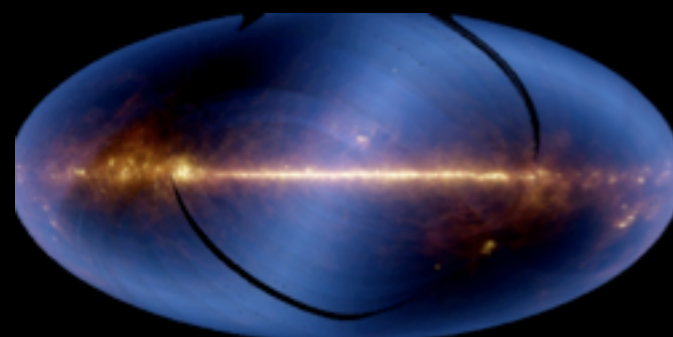
Optical
1 eV



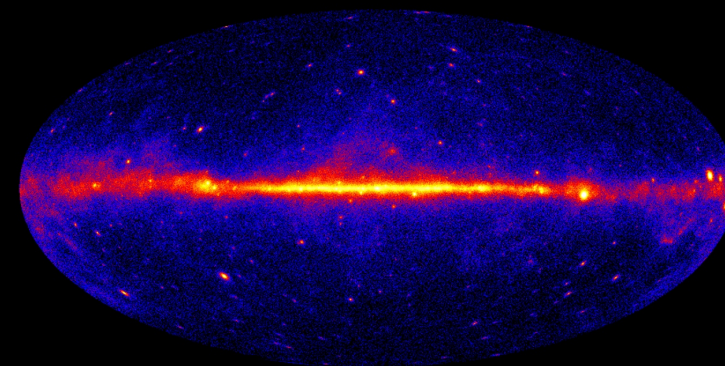
CMB
 10^{-4} eV



X-Ray
 10^3 eV



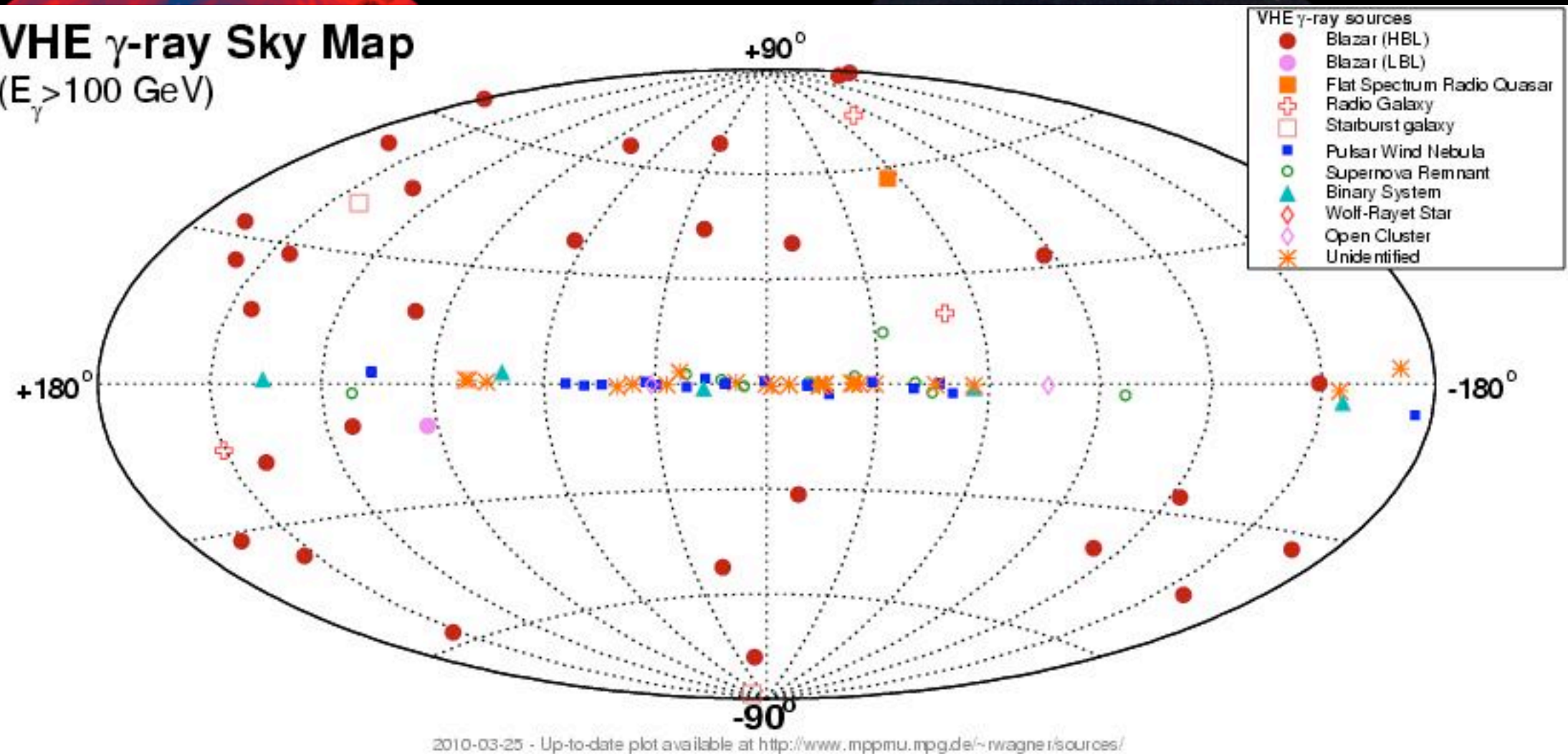
IR
 10^{-2} eV



γ -Ray
 10^8 eV

Universe in different energies

VHE γ -ray Sky Map
($E_\gamma > 100$ GeV)



The MAGIC telescopes



System of two IACT (Imaging Atmospheric Cerenkov telescopes)

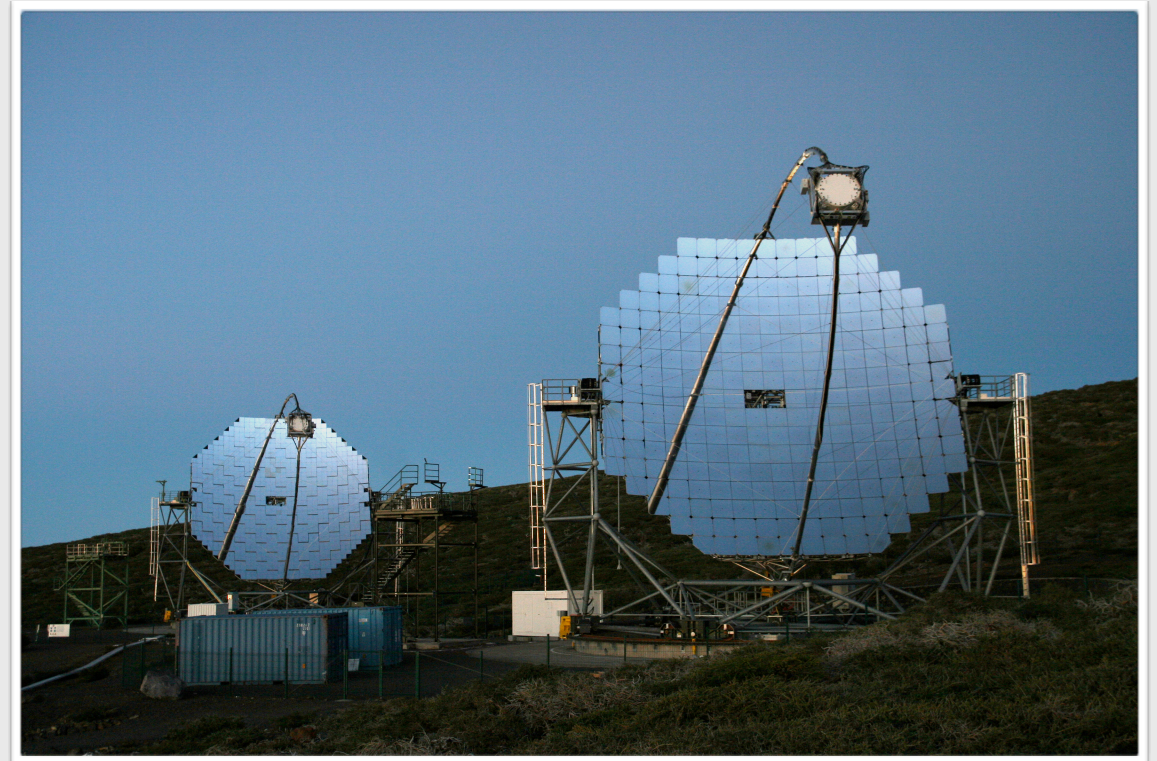
International Collaboration:
 \approx 150 scientists from 9 countries

MAGIC-I started routine operation in 2004,
construction of MAGIC-II has been
completed in early 2009

Threshold \approx 50 GeV

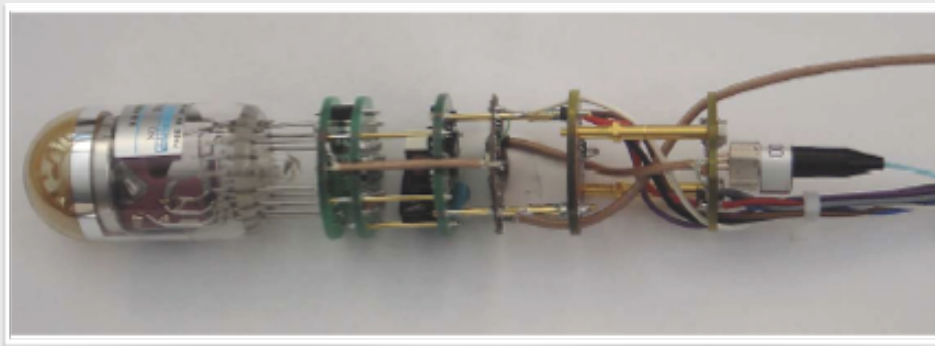
Each MAGIC telescope:

- 17m diameter mirror surface of 236 m² (world largest)
- 60 tons
- 0.1° high resolution camera

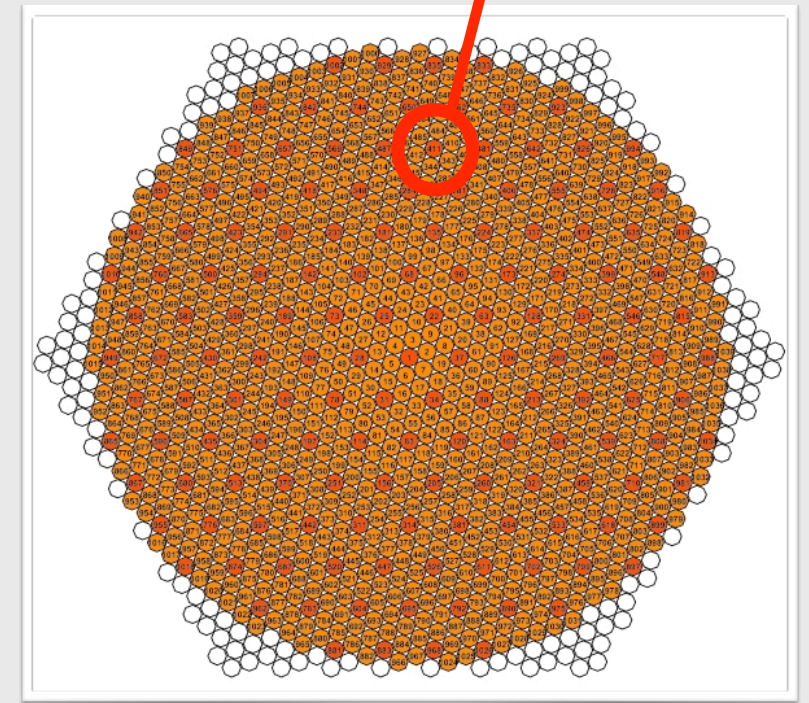
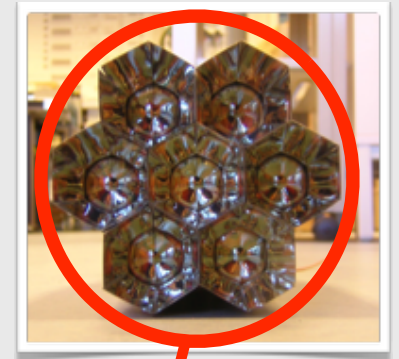
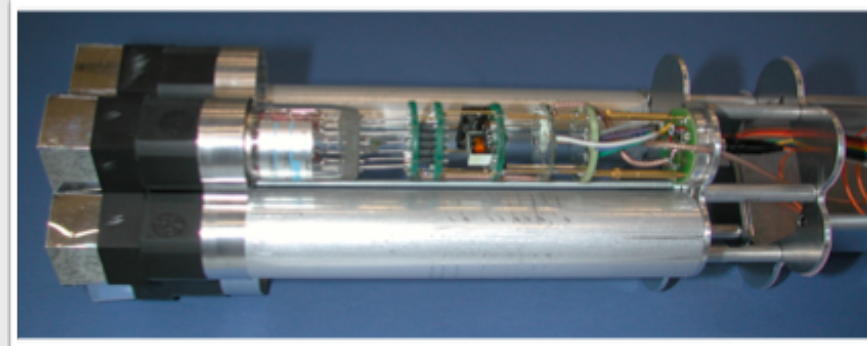


The MAGIC II camera

Hemispherical High QE PMT

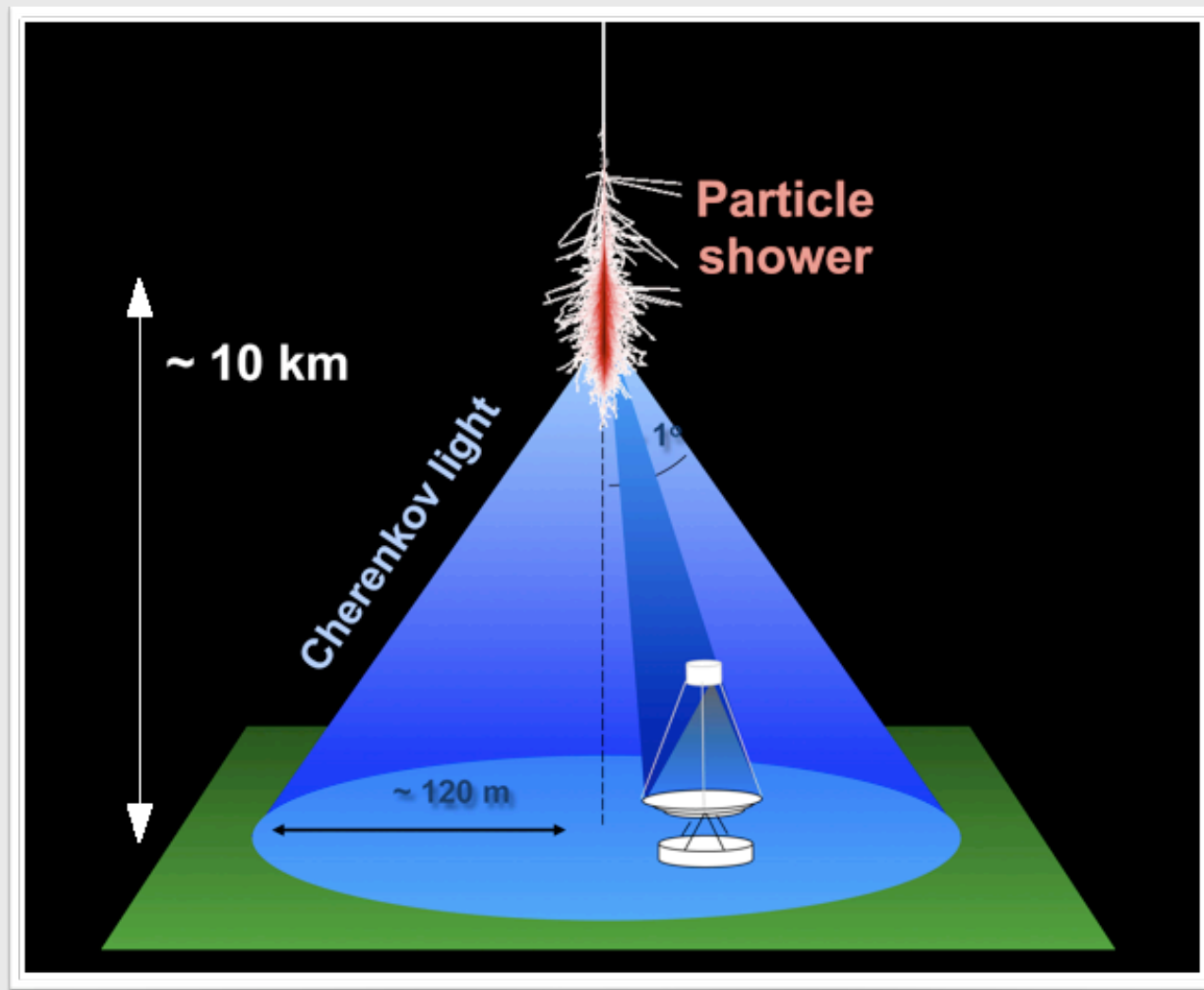


7 PMT grouped in a cluster

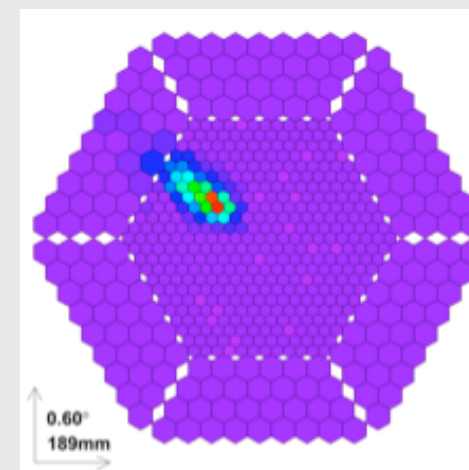


1039 PMT in total

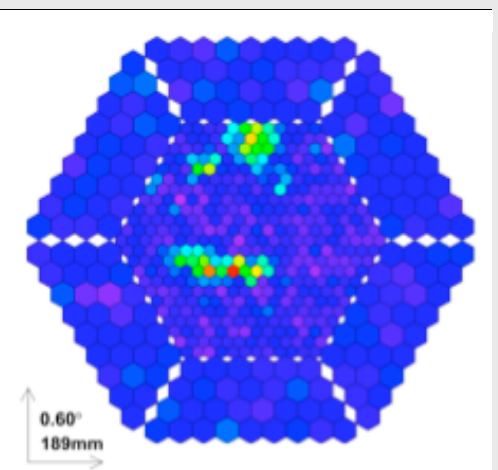
Imaging Air Cherenkov Technique



γ event

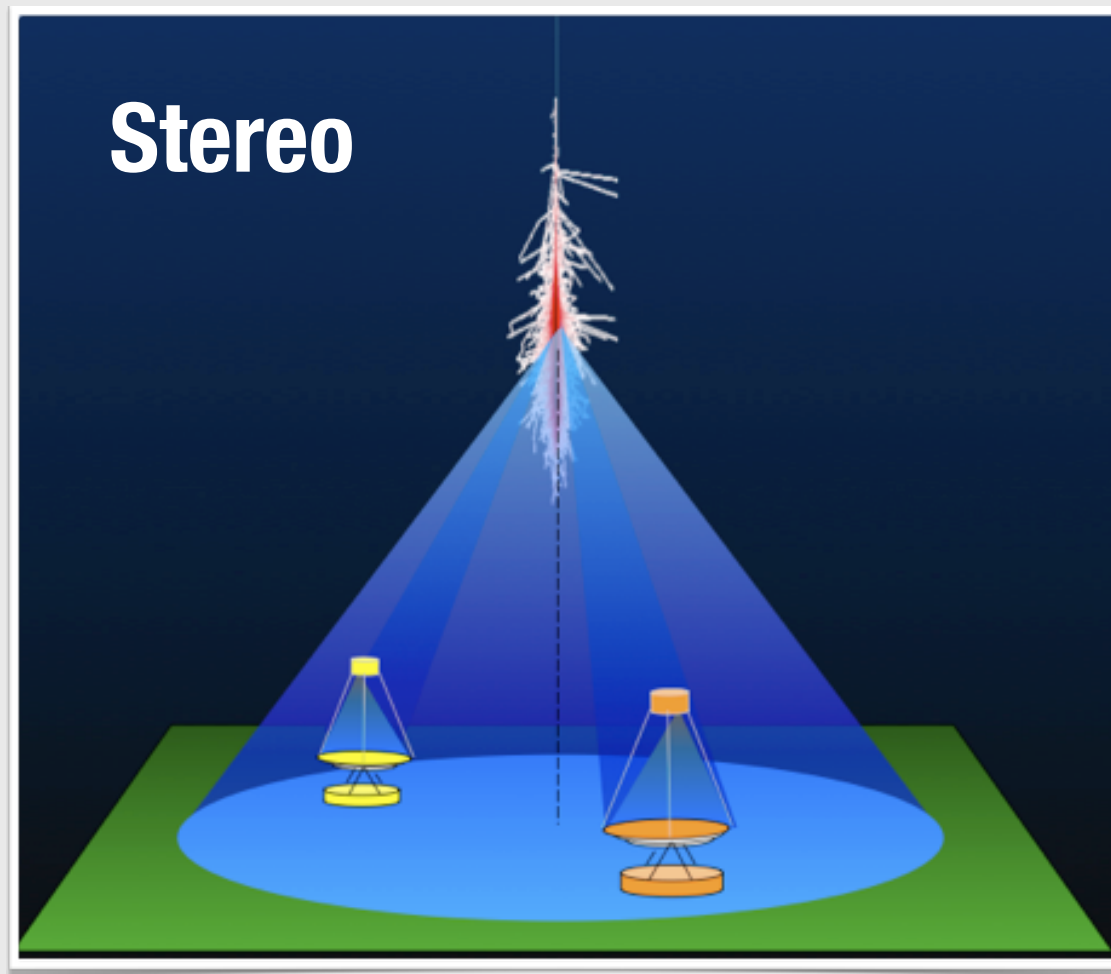


Hadron event

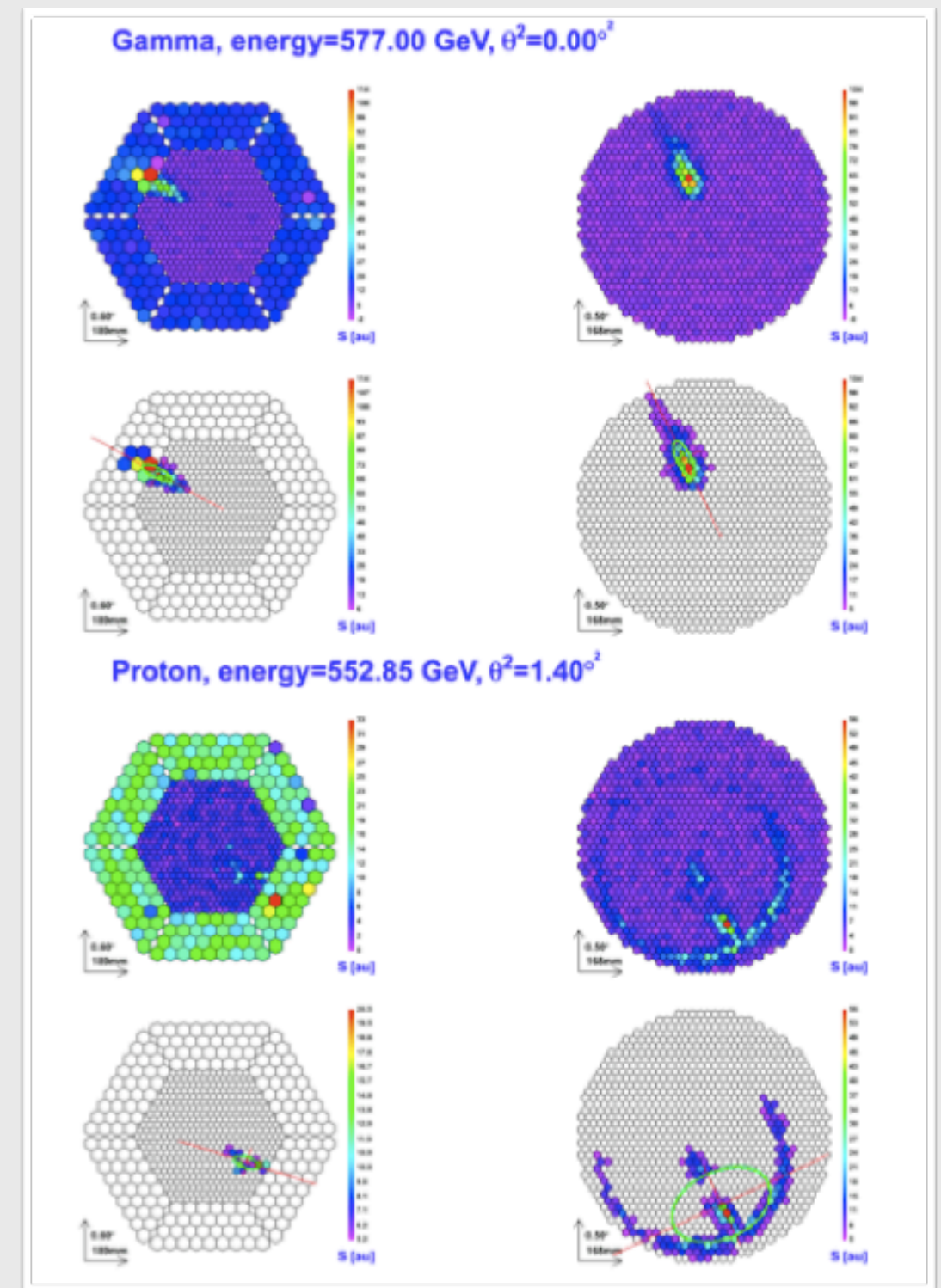


Hadrons (background) dominate over γ (signal) by a factor of several 100. They are rejected in the analysis.

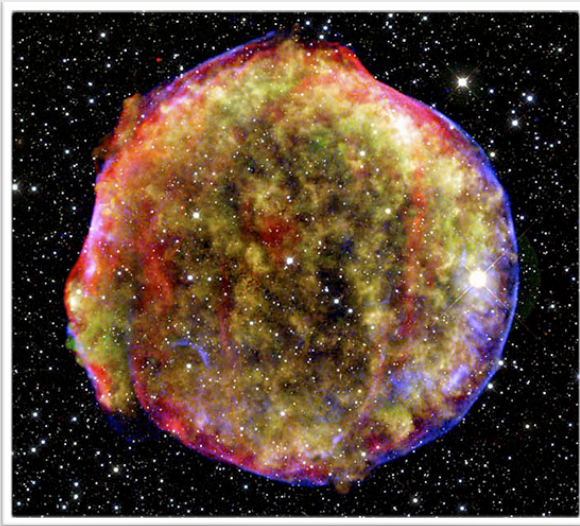
Imaging Air Cherenkov Technique



- 3D reconstruction of shower parameters
- Better source position determination
- Improved background reduction



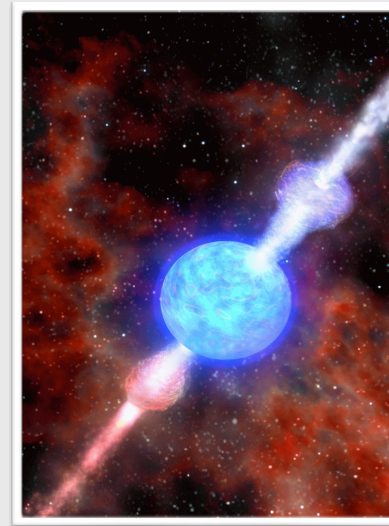
γ -Ray sources and objectives



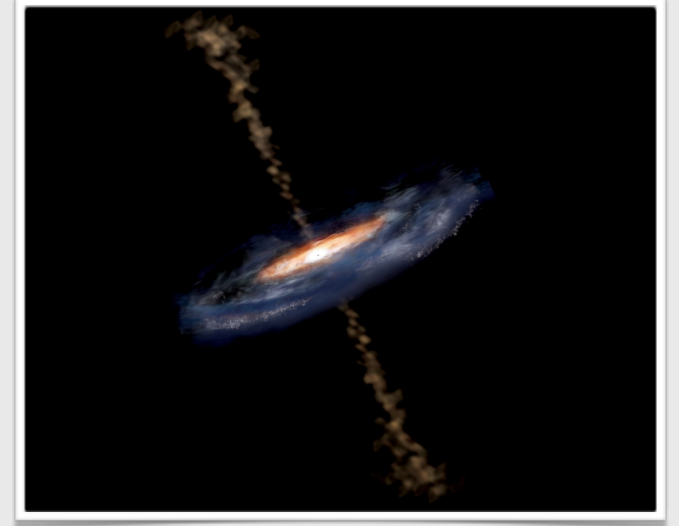
Super Nova
Remnants
(Tycho's SNR)



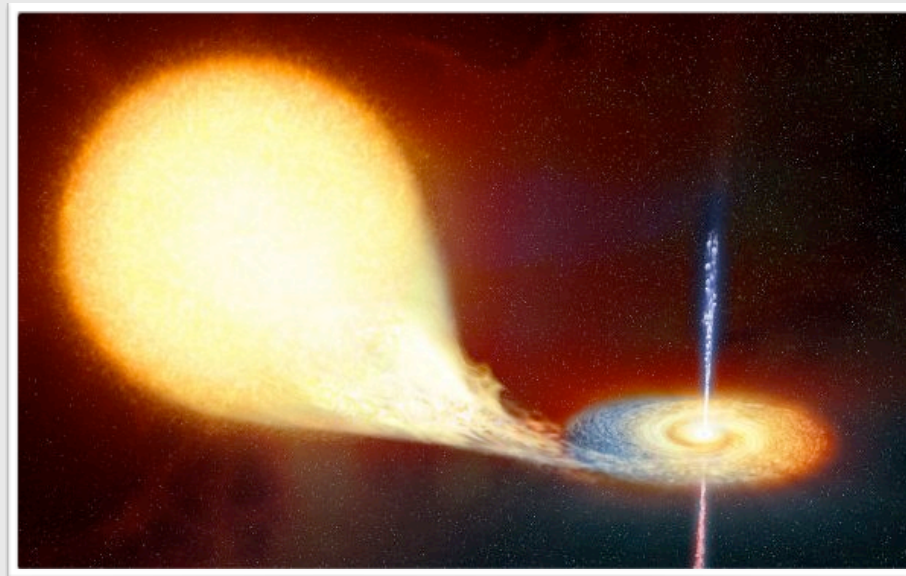
Pulsars
(Crab Pulsar)



Gamma ray
bursts

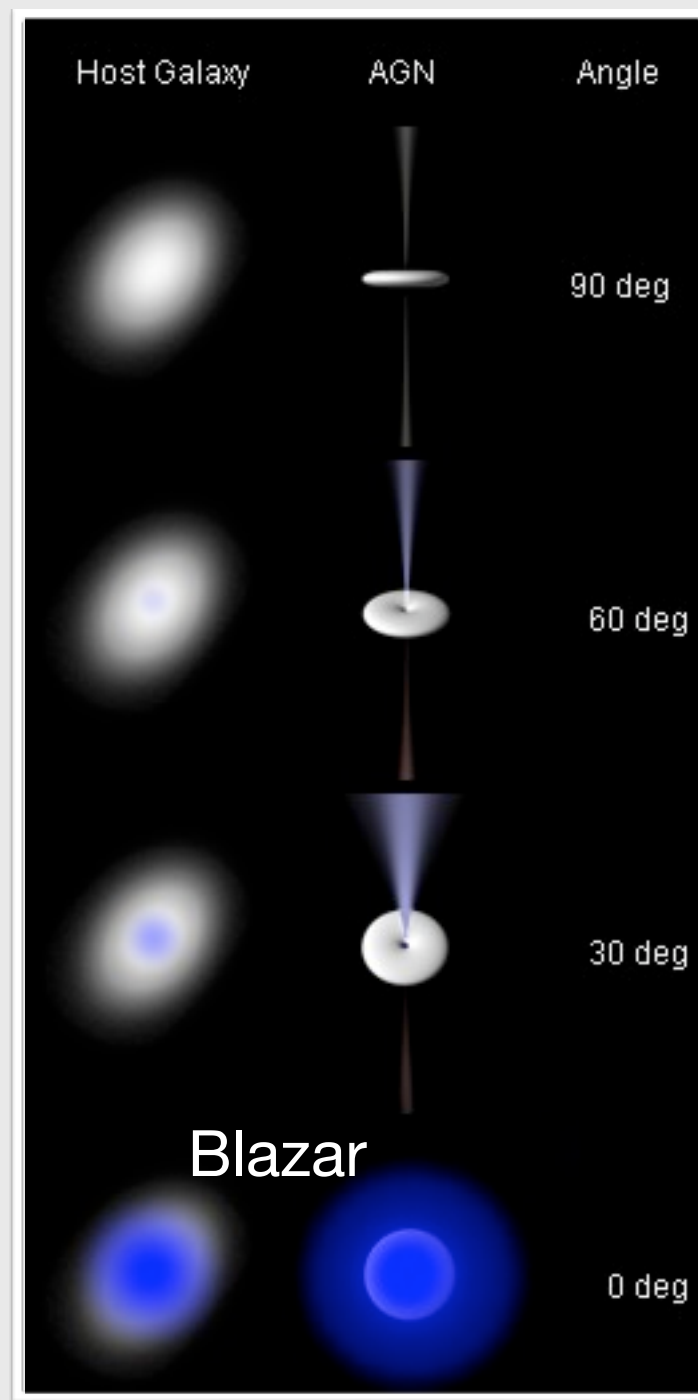


Active Galactic
Nuclei
(AGN)

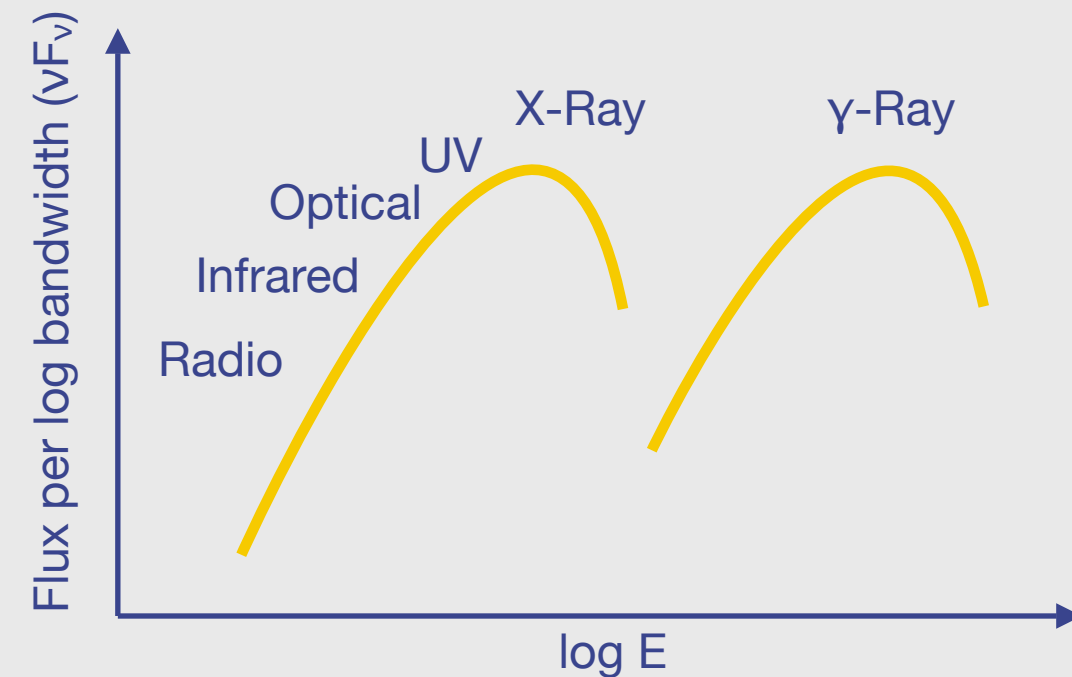


Microquasars
X-ray binaries

Active Galactic Nuclei (AGN)



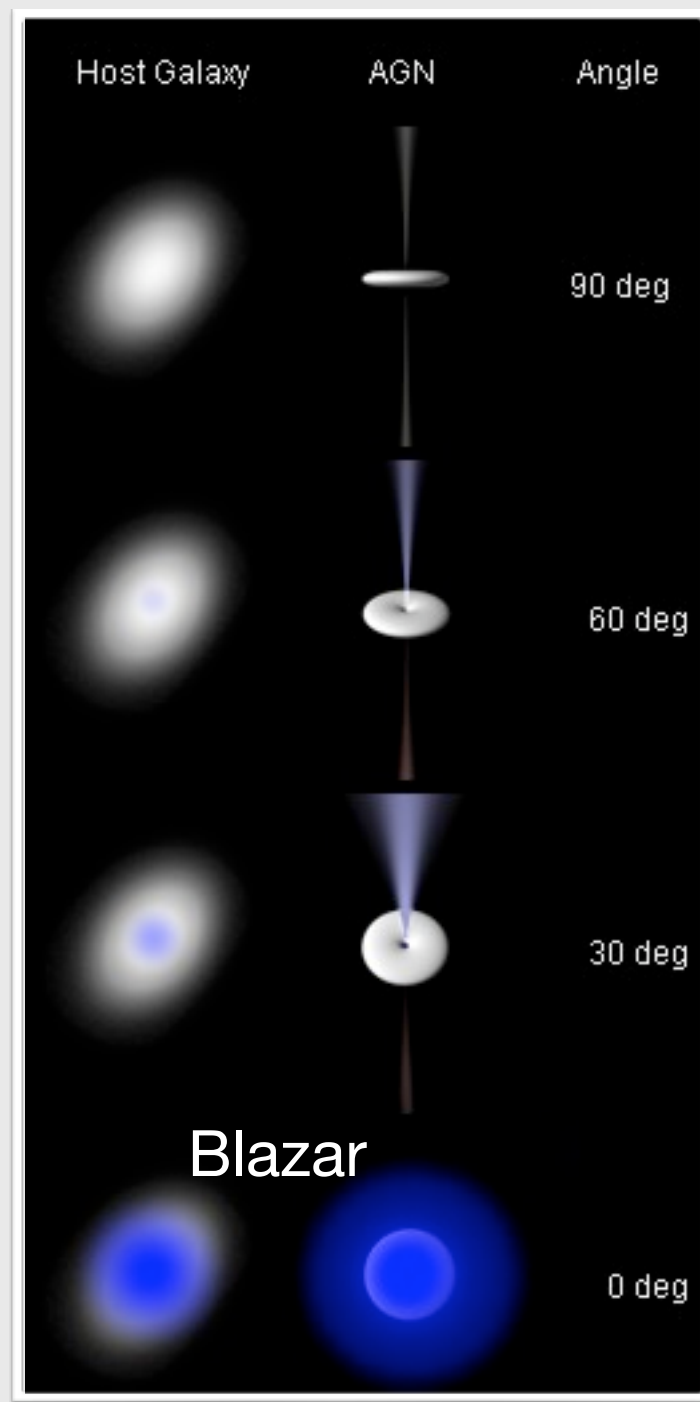
Continuous Spectral Energy Distribution (SED)



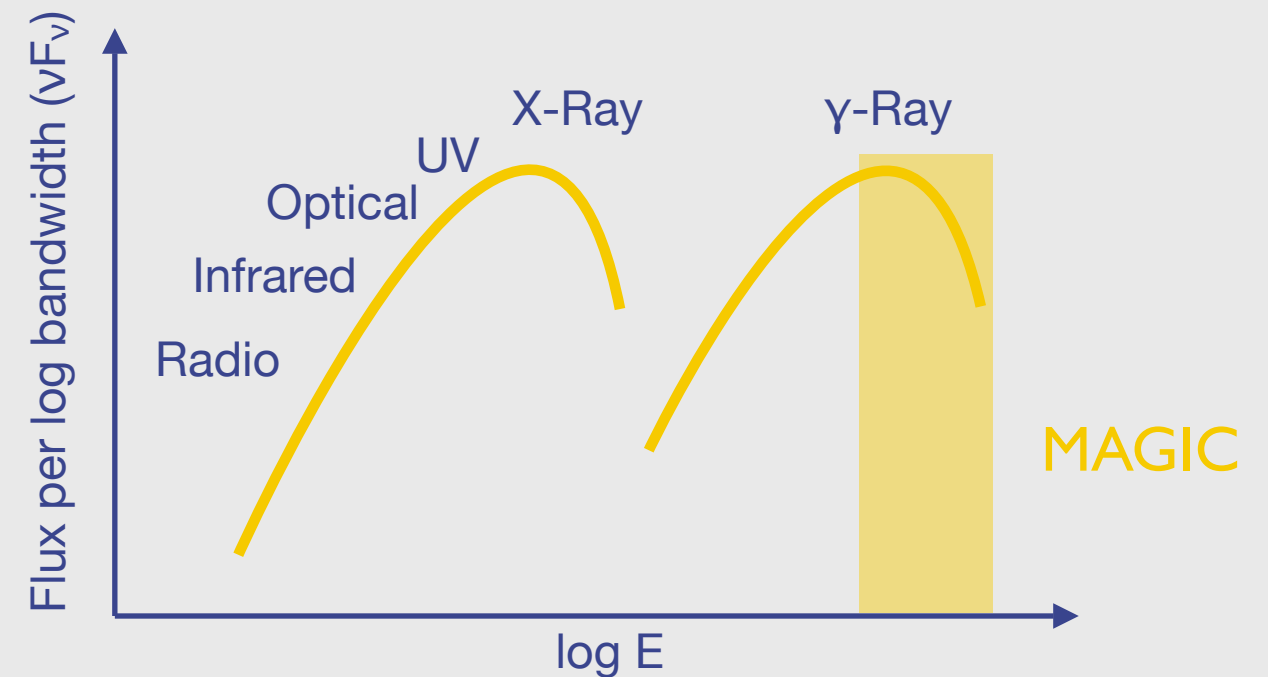
2 typical peaks in SED of blazars:

Origination is assumed to be from synchrotron radiation and inverse Compton up-scattering of synchrotron photons (SSC model).

Active Galactic Nuclei (AGN)

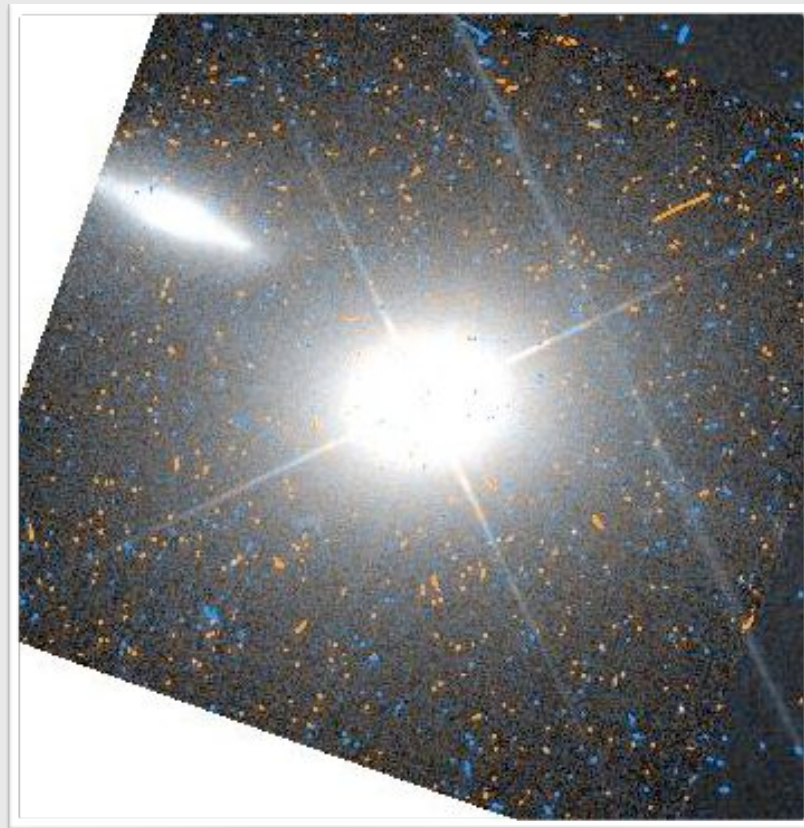


Continuous Spectral Energy Distribution (SED)



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Markarian (Mrk) 421

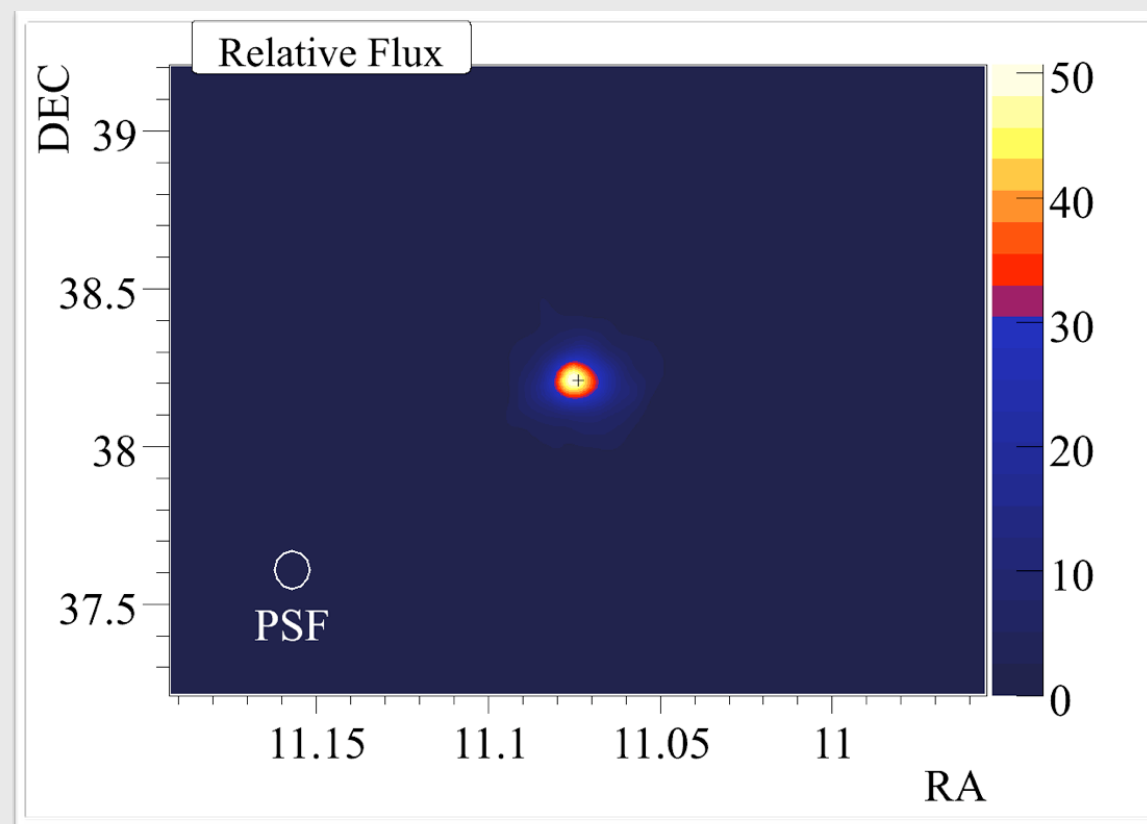


Credit: Hubble Telescope

- First observed systematically by Benjamin Markarian (1960s, systematic search for intense blue light with high UV continuum from centre of galaxies → Markarian catalogue)
- 400 million light years from earth (redshift 0.03, 120Mpc)
- One of the closest Blazars to earth, making it one of the brightest AGN in night sky
- Observed and detected in all wavelenghts (e.g. 1976 in X-rays...)
- First detected extragalactic VHE γ -ray source (1992, Whipple Telescope)
- Constant monitoring and observations since detection by various instruments

Markarian (Mrk) 421

Mrk 421 seen by MAGIC stereo in January 2010



- „Skyplot“
- Point source

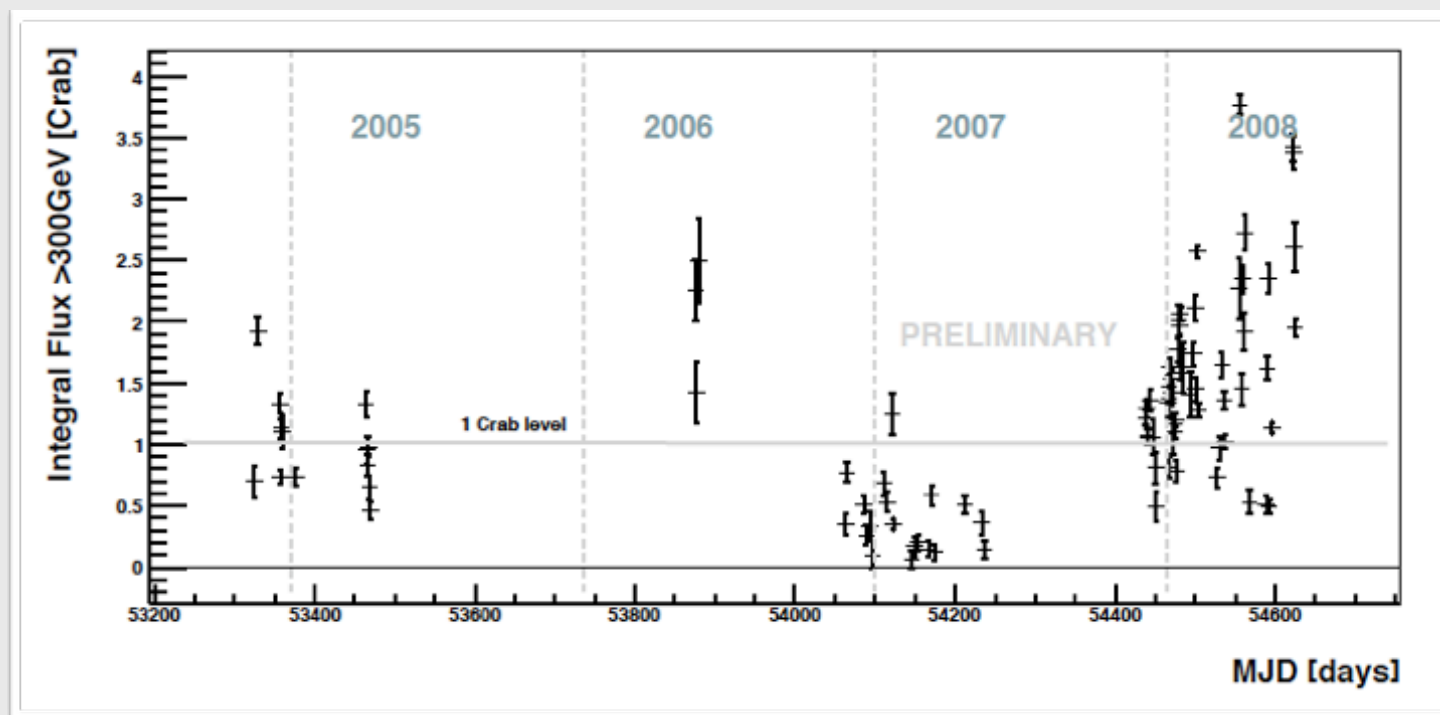
Markarian (Mrk) 421



Mrk 421 seen by MAGIC stereo in January 2010

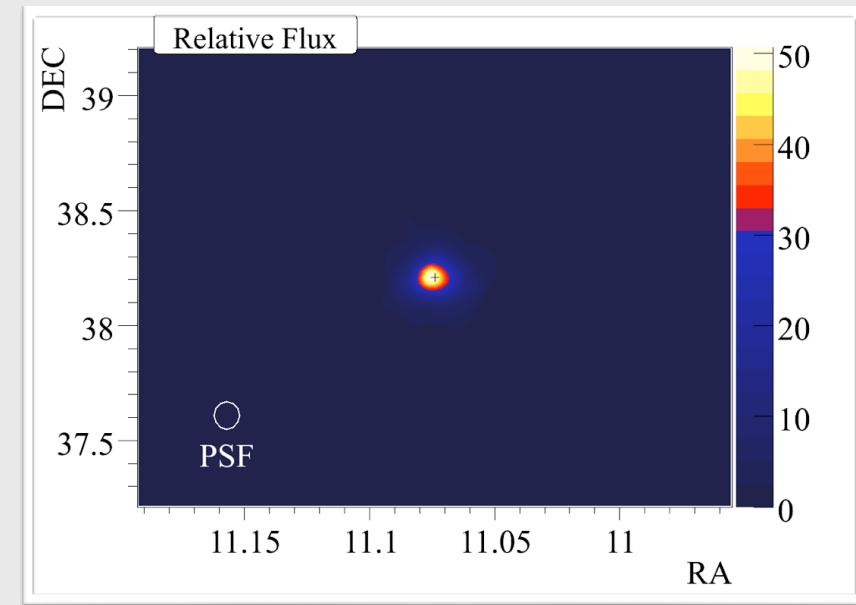
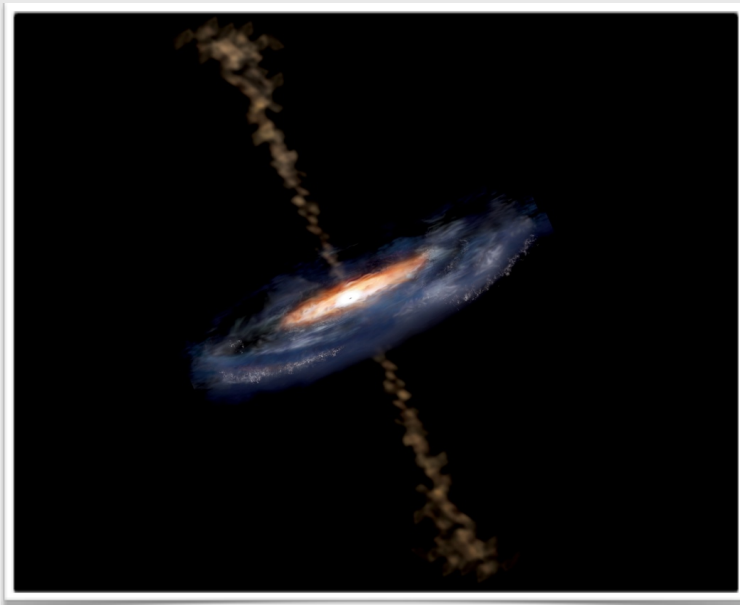
Markarian (Mrk) 421

Searching for variability („flares“)

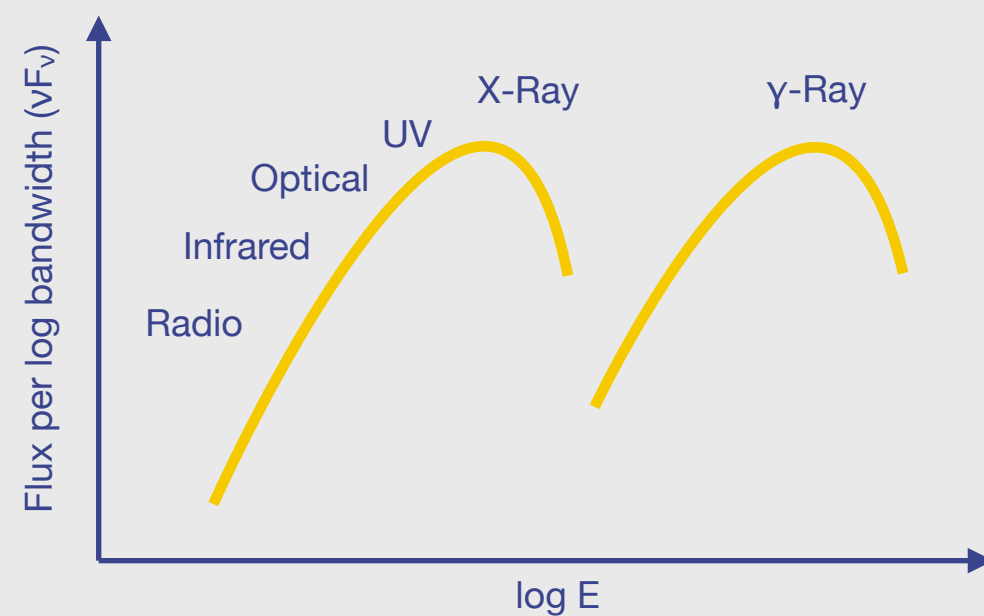


C.-C. Hsu et al, „Monitoring of Bright Blazars with MAGIC“, ICRC proceeding 2009

Summary



Continuous Spectral Energy Distribution (SED)



A large radio telescope dish is silhouetted against a bright sunset sky. The dish is a large, curved structure with a grid of support lines. Below the dish, a sea of white clouds stretches across the horizon. In the foreground, the dark silhouette of the telescope's support structure and a small observation platform with stairs are visible.

Thank you for your attention

www.magic.mppmu.mpg.de