

MAGIC Observations of Markarian 421



DPG Frühjahrstagung 2011 Karlsruhe

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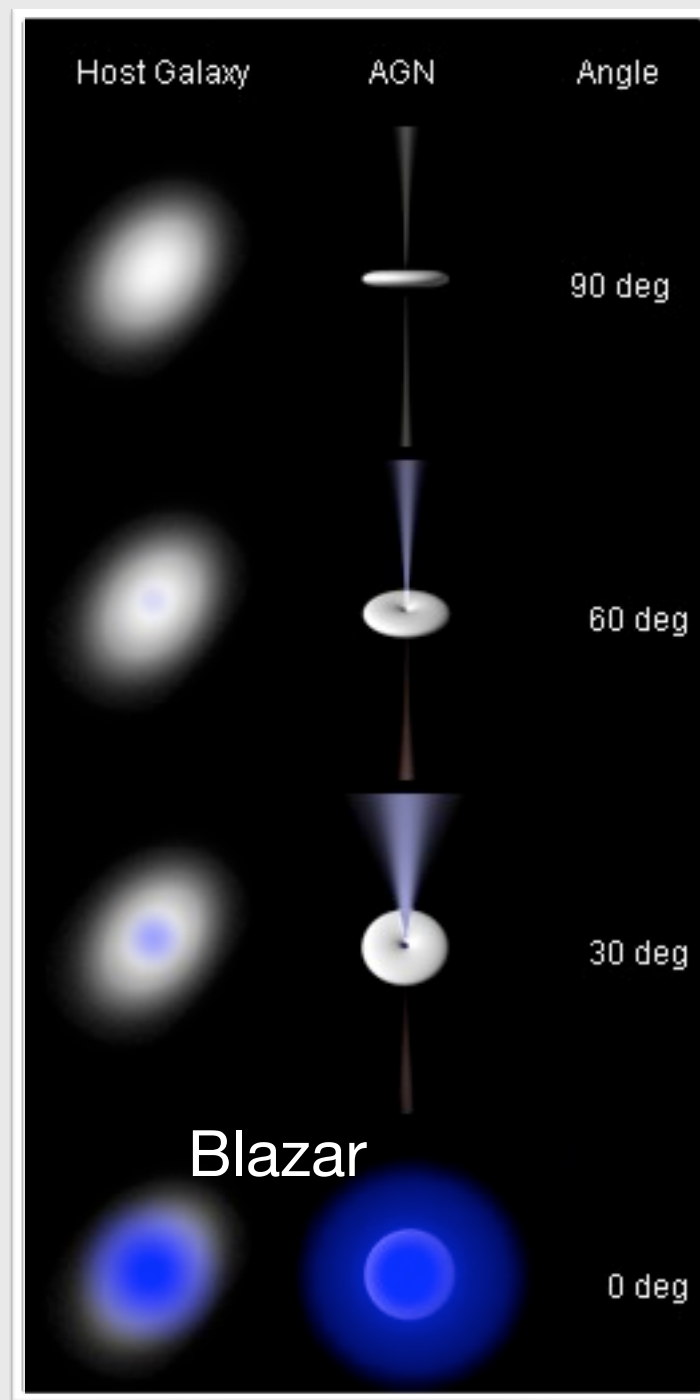
Rebecca Gozzini, DESY, Zeuthen

Konstancja Satalecka, DESY, Zeuthen



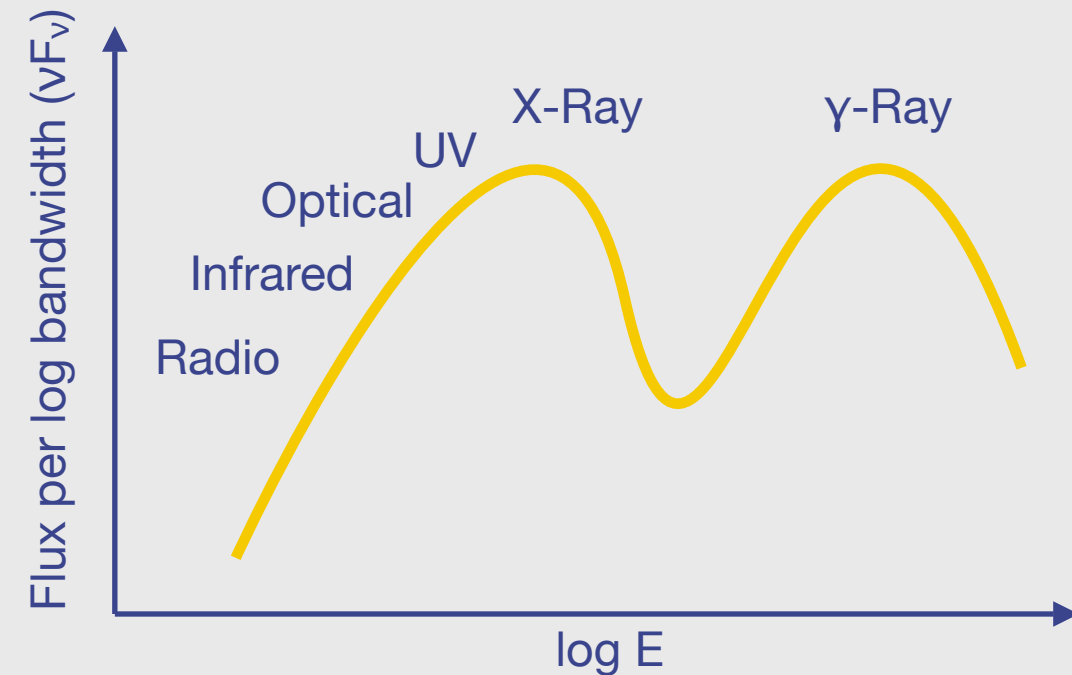
- Active Galactic Nuclei (AGN): Blazars
- Introduction to the MAGIC telescopes
- Recent results for Markarian (Mrk) 421

Active Galactic Nuclei (AGN)



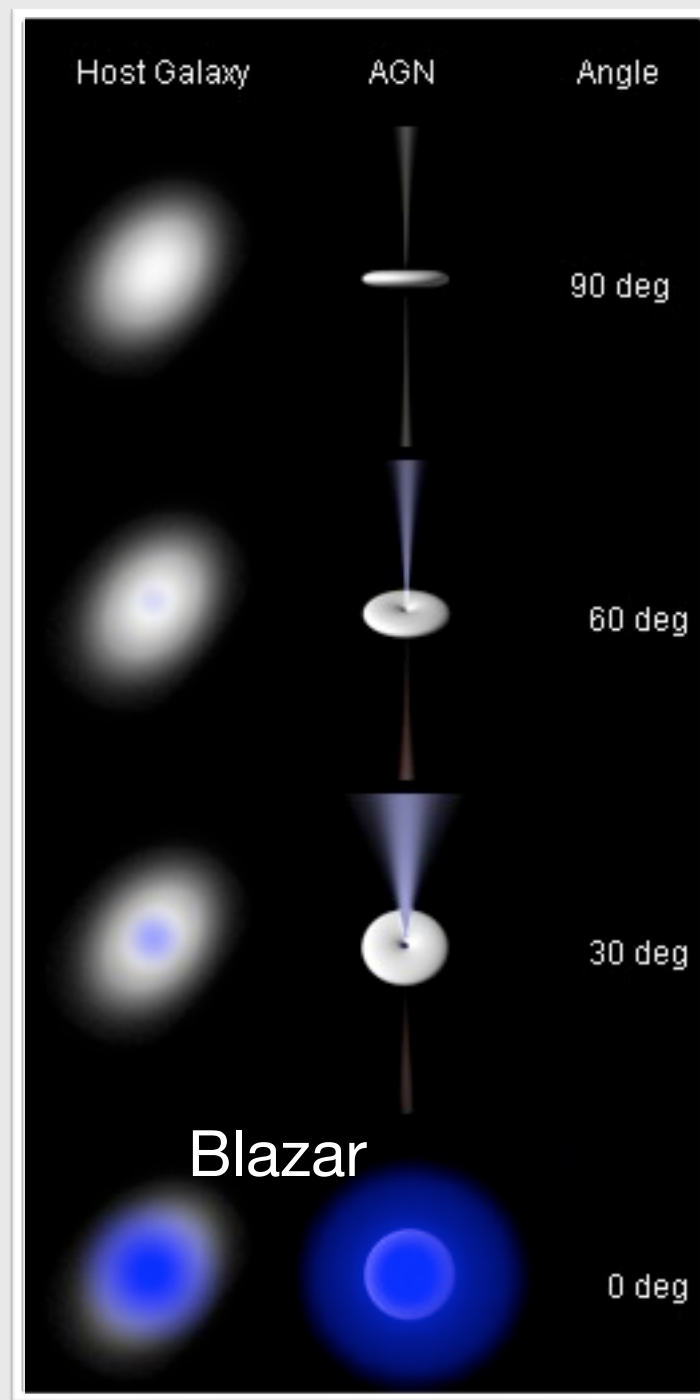
Credit: Ron Kollgaard

Continuous Spectral Energy Distribution (SED)



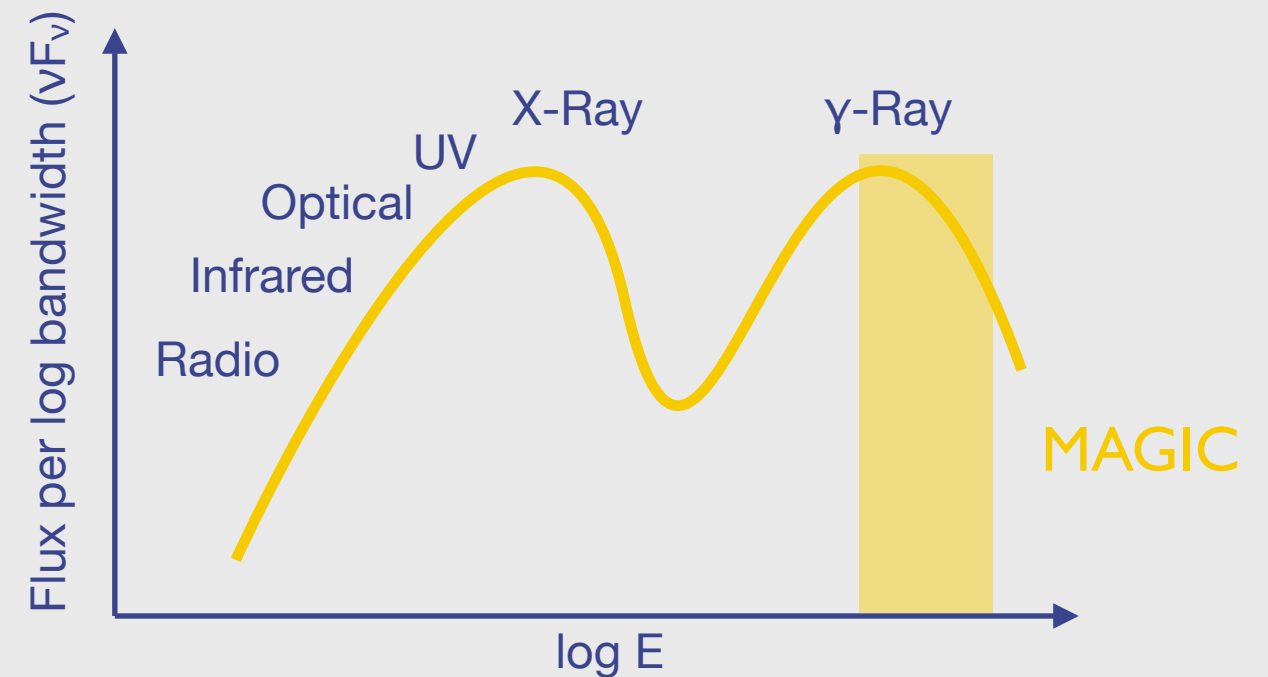
2 typical peaks in SED of blazars:
Origination is assumed to be from synchrotron radiation and inverse Compton up-scattering of synchrotron photons (SSC model).

Active Galactic Nuclei (AGN)



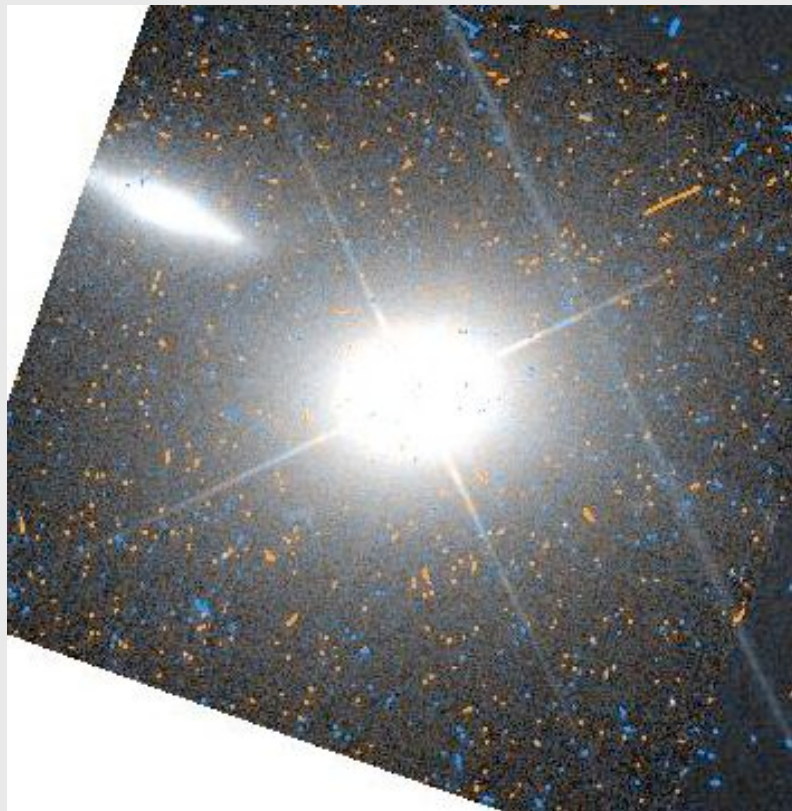
Credit: Ron Kollgaard

Continuous Spectral Energy Distribution (SED)



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Markarian (Mrk) 421



Credit: Hubble Telescope

- One of the closest Blazars to earth, making it one of the brightest AGN in night sky
- 400 million light years from earth (redshift 0.03, 120 Mpc)
- Detected and observed in all wavelenghts (1992 VHE γ -ray...)
- Constant monitoring and observations since detection by various instruments

The MAGIC telescopes



System of two IACT (Imaging Atmospheric Cerenkov telescopes)

International Collaboration:
 ≈ 150 scientists from 9 countries

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

Threshold ≈ 60 GeV

Each MAGIC telescope:

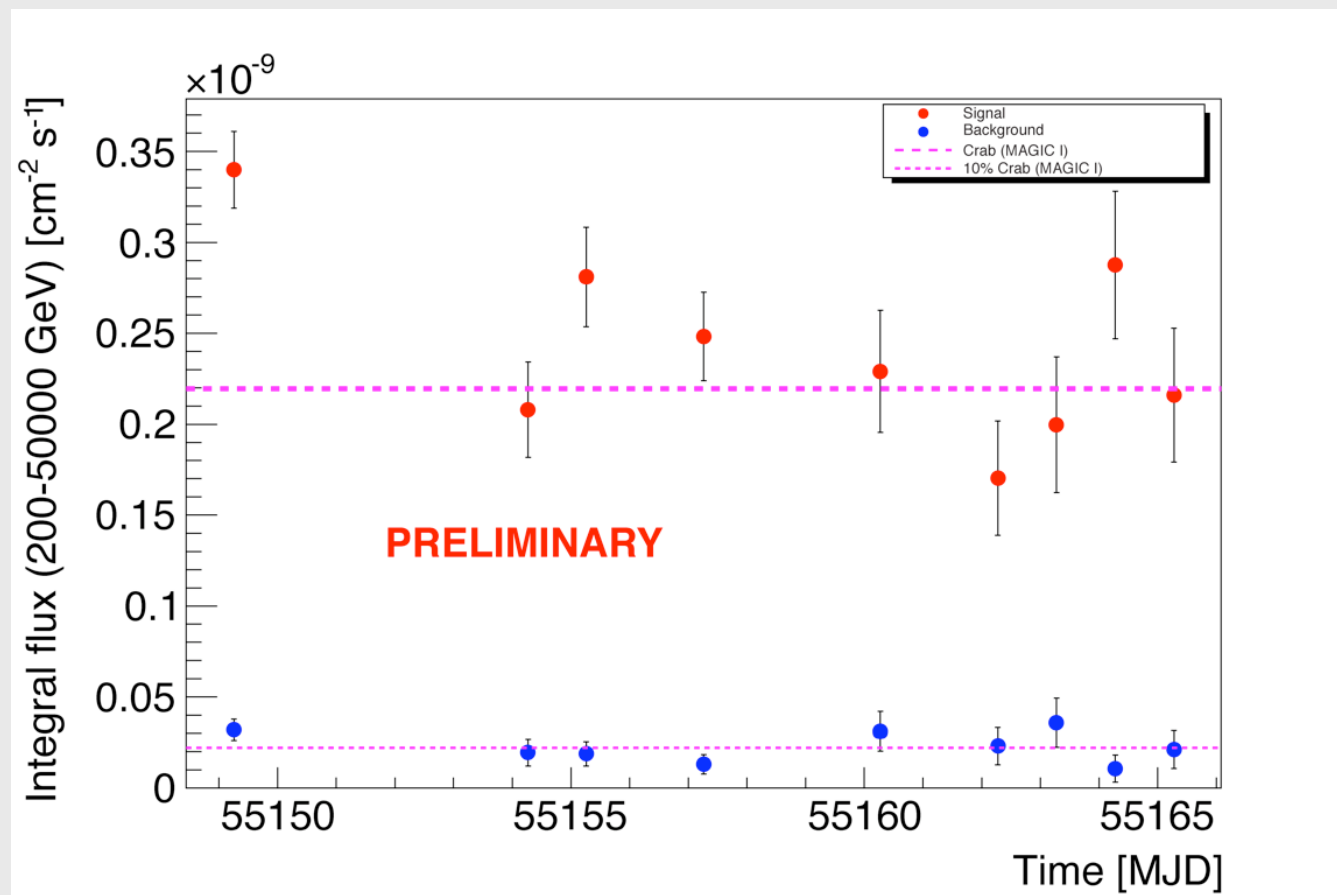
- 17m diameter mirror surface of 236 m²
(world largest)
- 60 tons
- 0.1° high resolution camera



Markarian (Mrk) 421

First stereo observations in November 2009

Lightcurve Mrk 421 Nov 2009



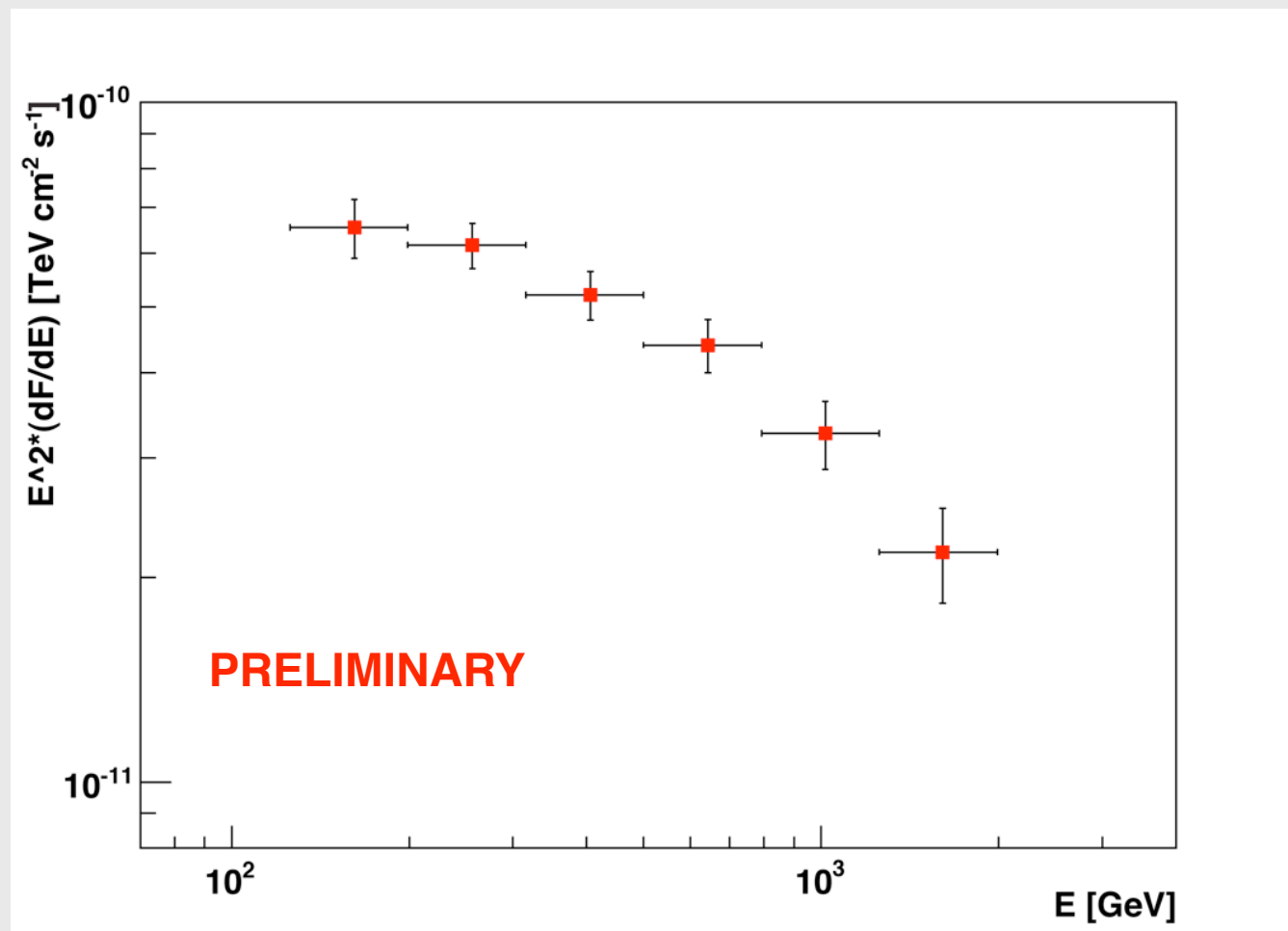
Day by day binning

- 13 days of data taking (Nov 13th to 30th)
- Daily observation $\approx$ 20 min (monitoring)
- After quality cuts: 9 days (Nov 14th to 30th)
- Flux level $\approx$ 1 crab
- Total effective observation time $\approx$ 2 h
- Significance level: 30σ
- Partial twilight conditions
- Zenith angle 16° - 37°

Markarian (Mrk) 421

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SED Mrk 421 Nov 2009

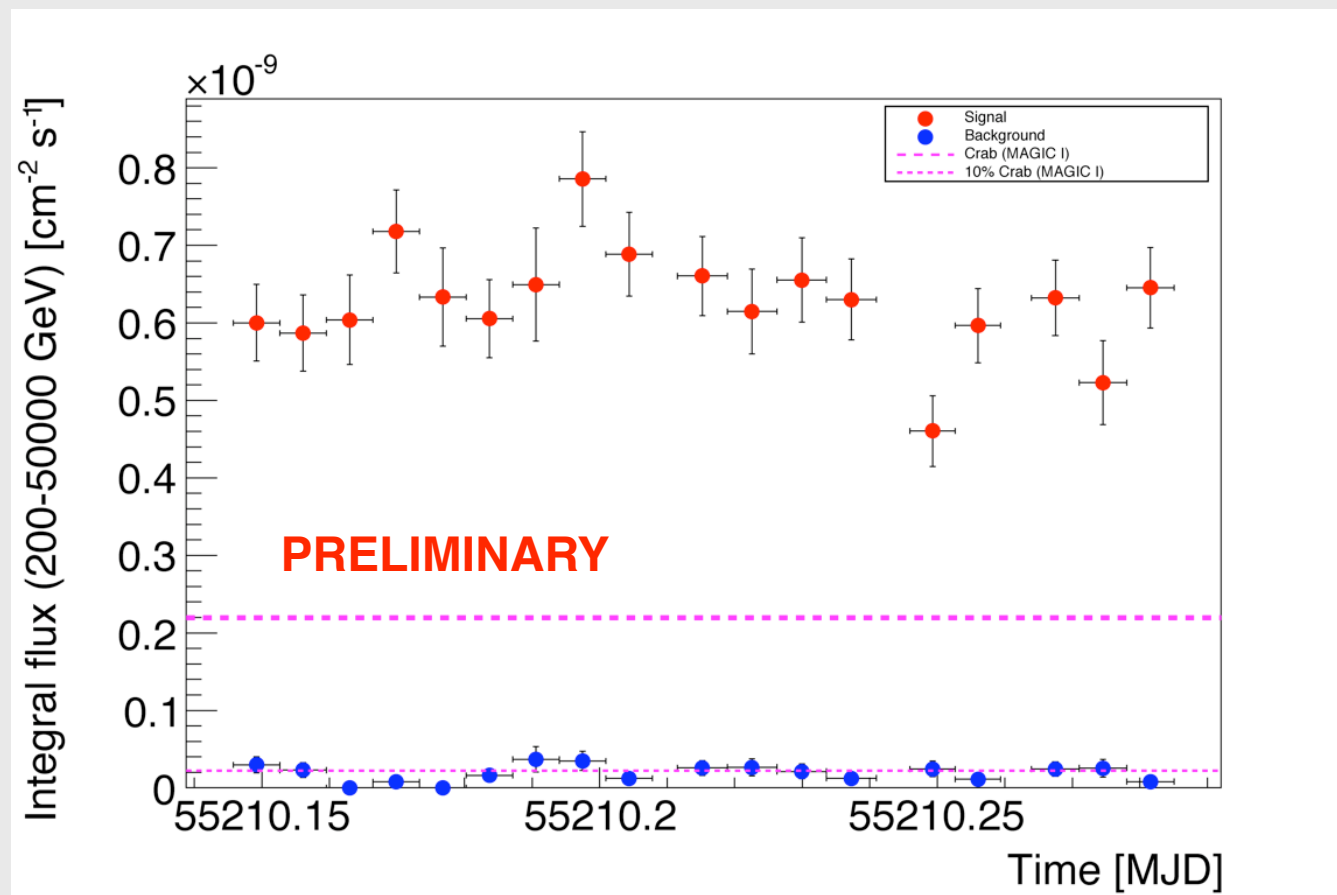


- Flux level ≈ 1 crab
- Total effective observation time ≈ 2 h
- Partially twilight condition
- Combined SED:
120 GeV - 2 TeV

Markarian (Mrk) 421

Stereo observations of flare January 14th 2010

Lightcurve Mrk 421 Jan 14th 2010



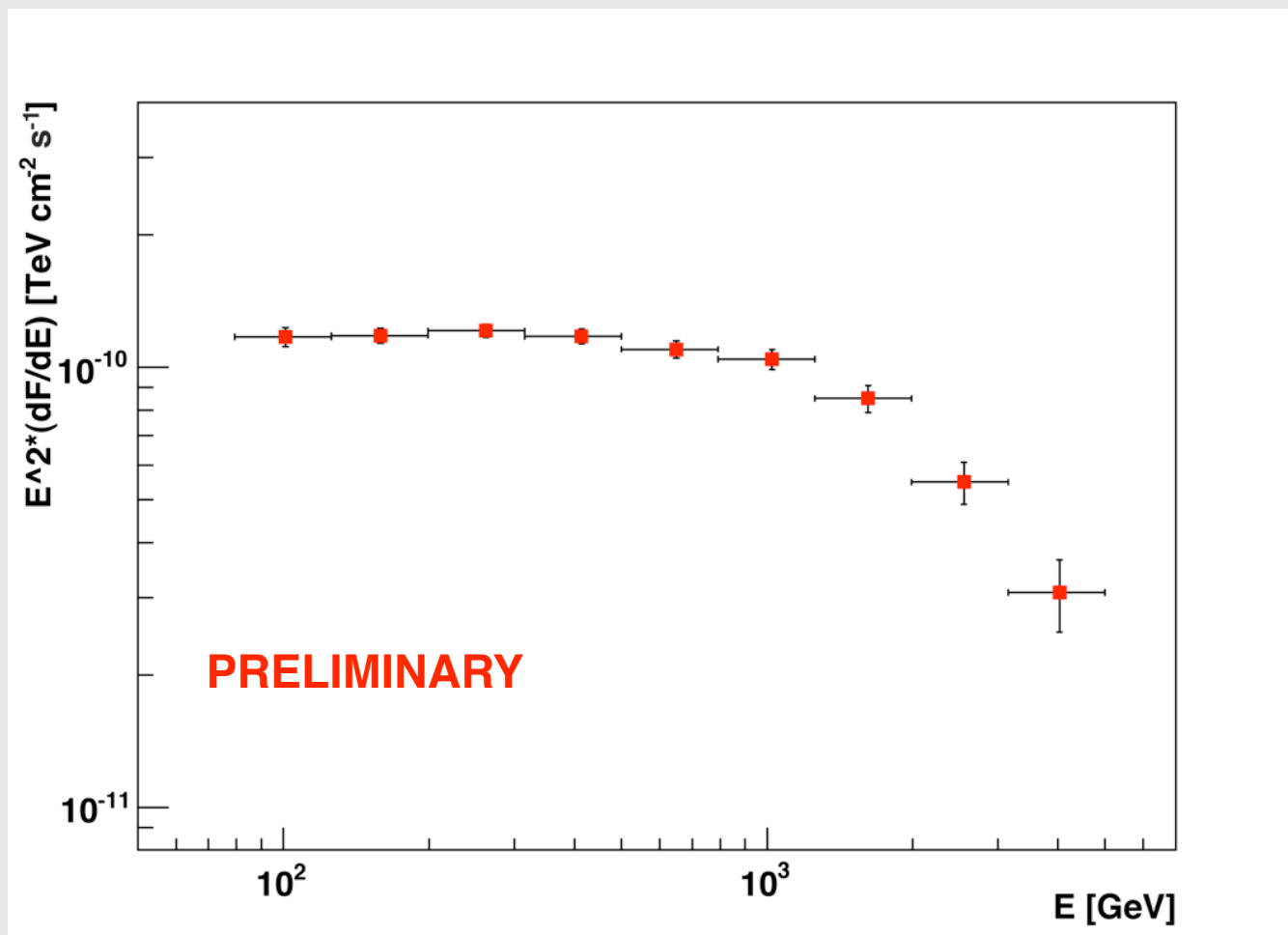
10min binning

- Flux level ≈ 3 crab
- Total effective observation time ≈ 2.3 h
- Significance level: 54σ
- Dark condition
- Zenith angle 8° - 28°

Markarian (Mrk) 421

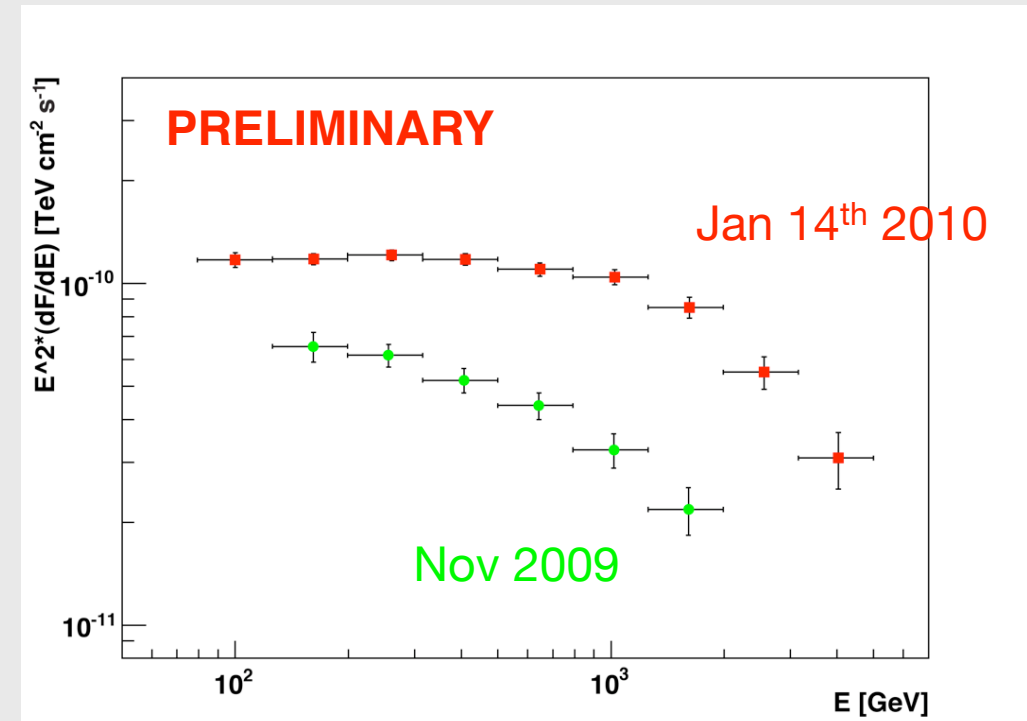
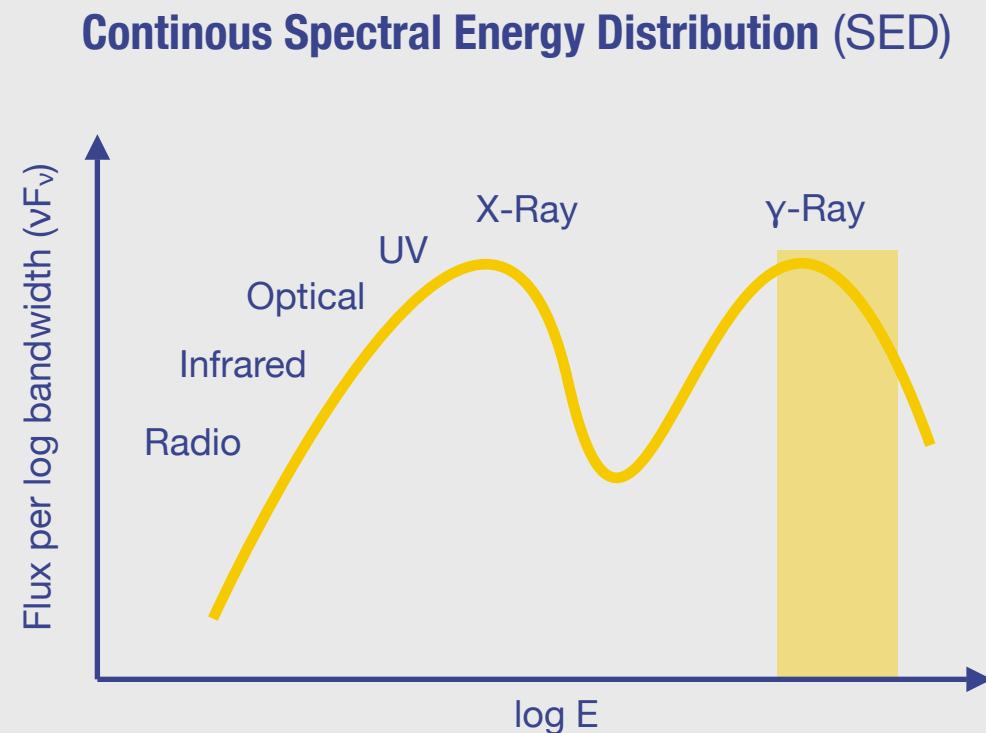
Stereo observations of flare January 14th 2010

SED Mrk 421 Jan 14th 2010



- Flux level ≈ 3 crab
- Total effective observation time ≈ 2.3 h
- Dark conditions
- SED:
80 GeV - 5 TeV

Summary and outlook



- Profound knowledge of spectral shape out of a few hours
- Improved insight into acceleration processes due to constraining spectral points

A large radio telescope dish, likely the Effelsberg 100m telescope, is silhouetted against a vibrant sunset sky. The dish is a large, parabolic structure with a grid of support cables. The sky transitions from a bright yellow-orange near the horizon to a deep blue at the top. Below the horizon, a thick layer of white clouds is visible. The foreground shows the dark silhouette of the telescope's base and surrounding infrastructure on a hill.

Thank you for your attention

www.magic.mppmu.mpg.de

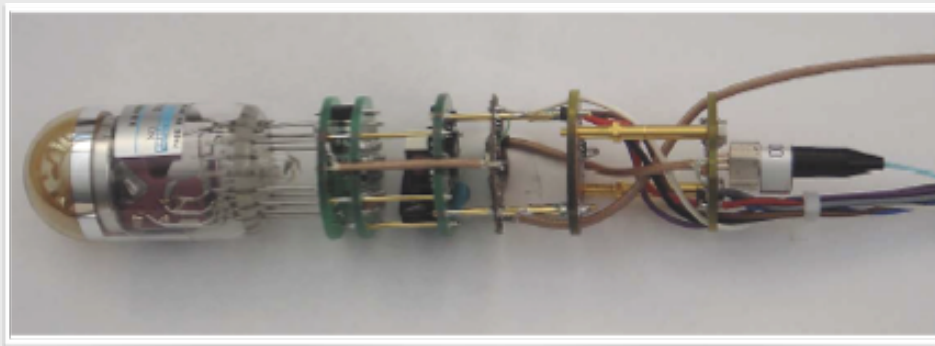
Backup slides



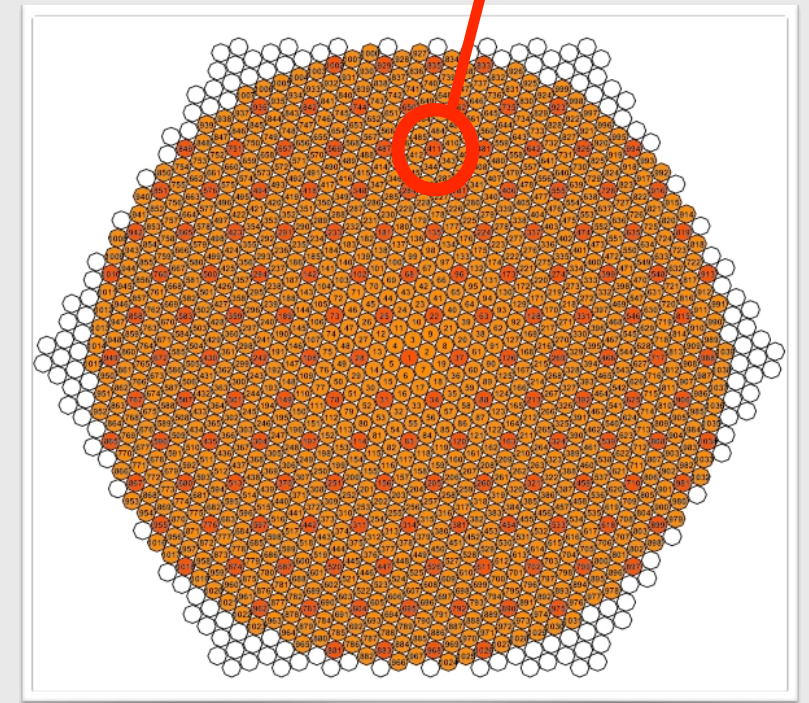
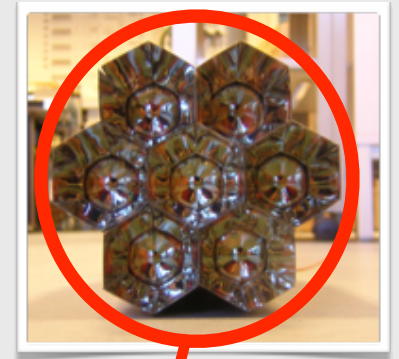
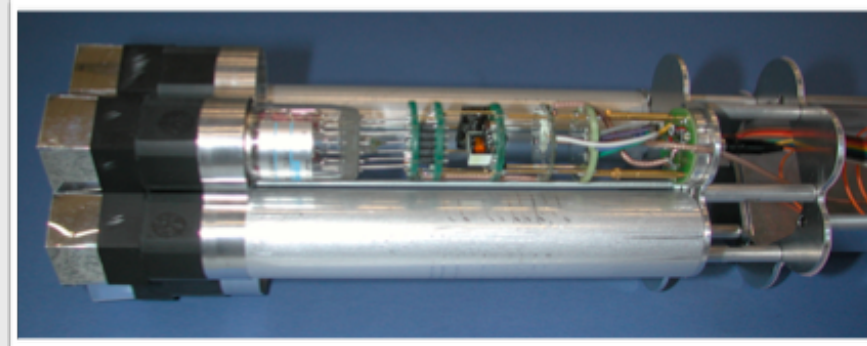
Backup slides

The MAGIC II camera

Hemispherical High QE PMT

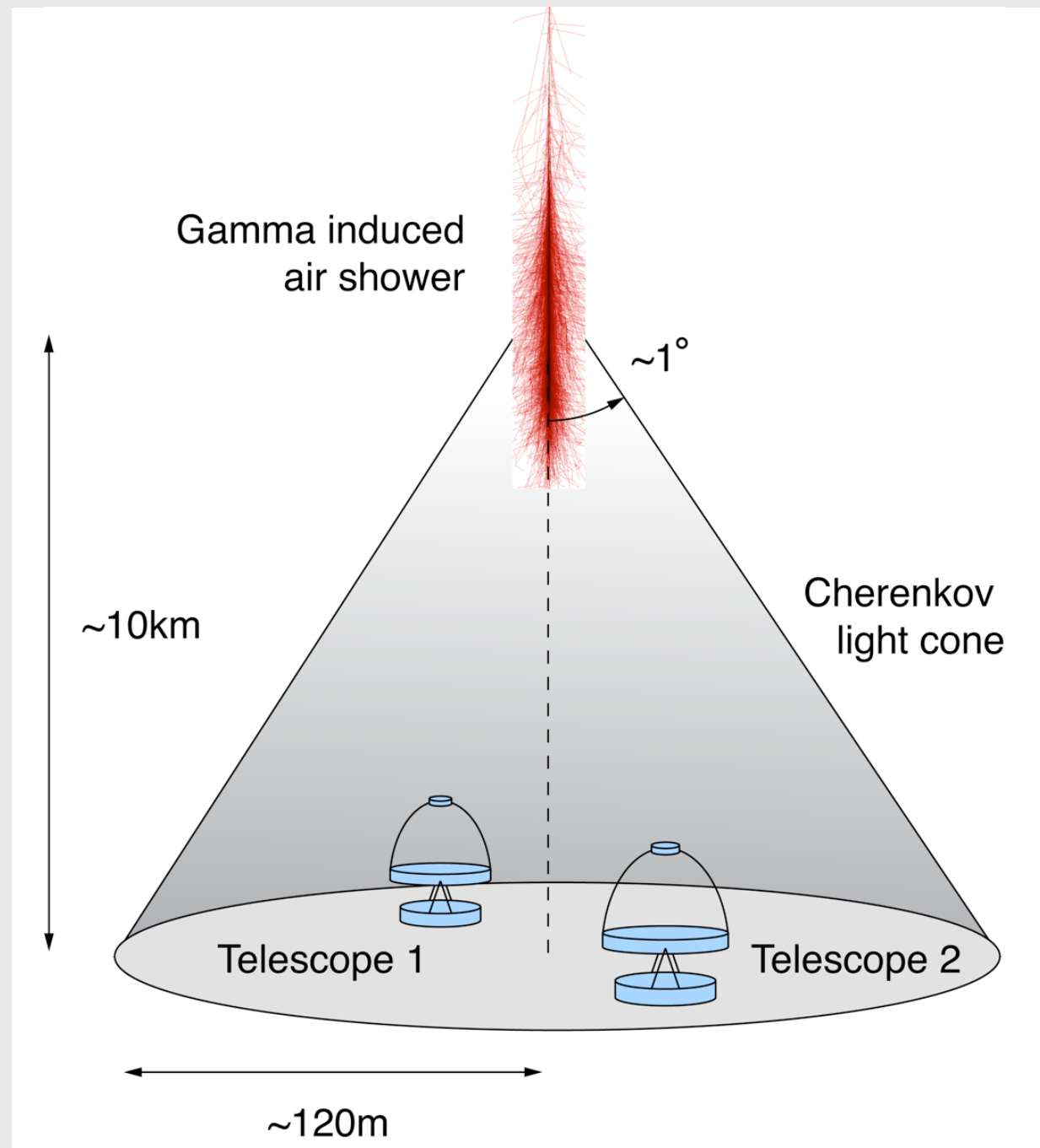


7 PMT grouped in a cluster

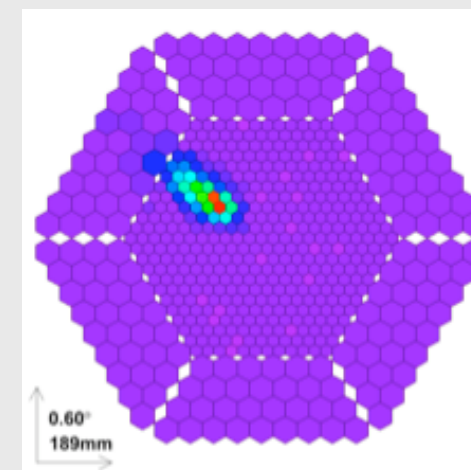


1039 PMT in total

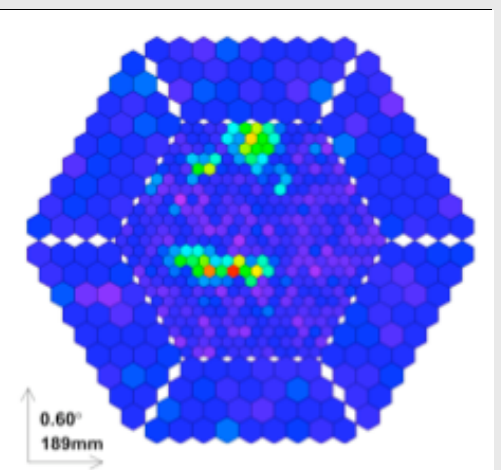
Imaging Air Cherenkov Technique



γ event

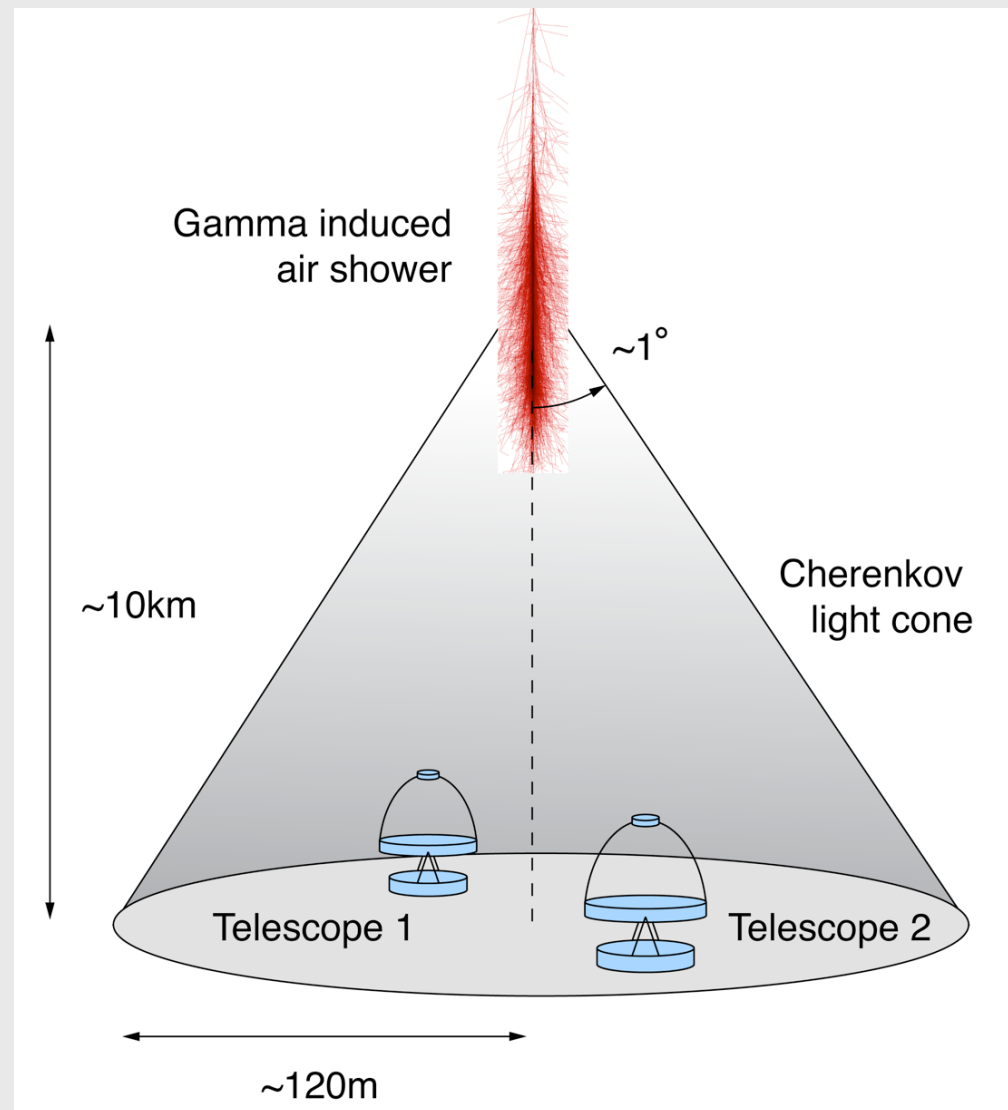


Hadron event

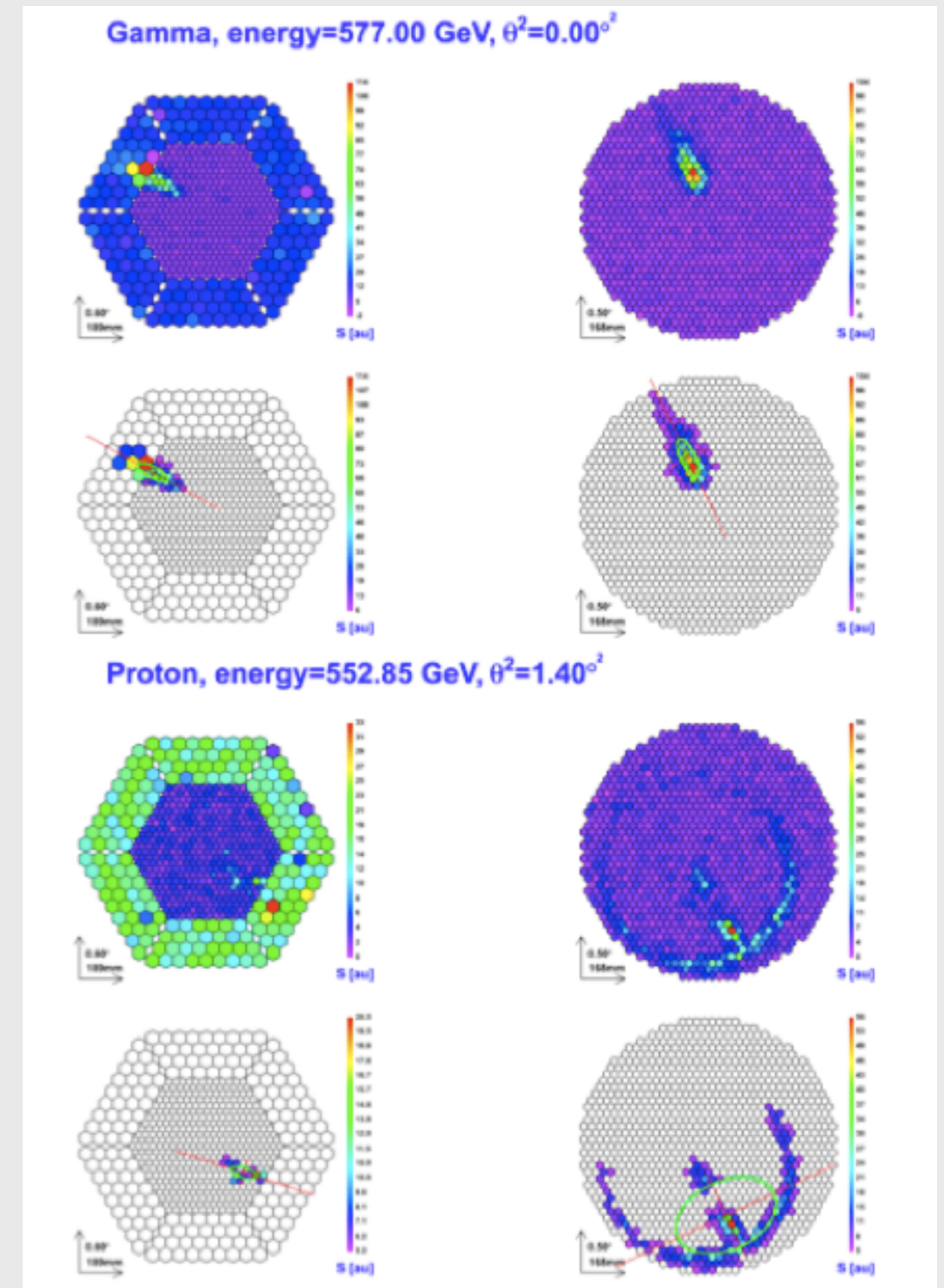


Hadrons (background) dominate over γ (signal) by a factor of several 100. They are rejected in the analysis.

Imaging Air Cherenkov Technique

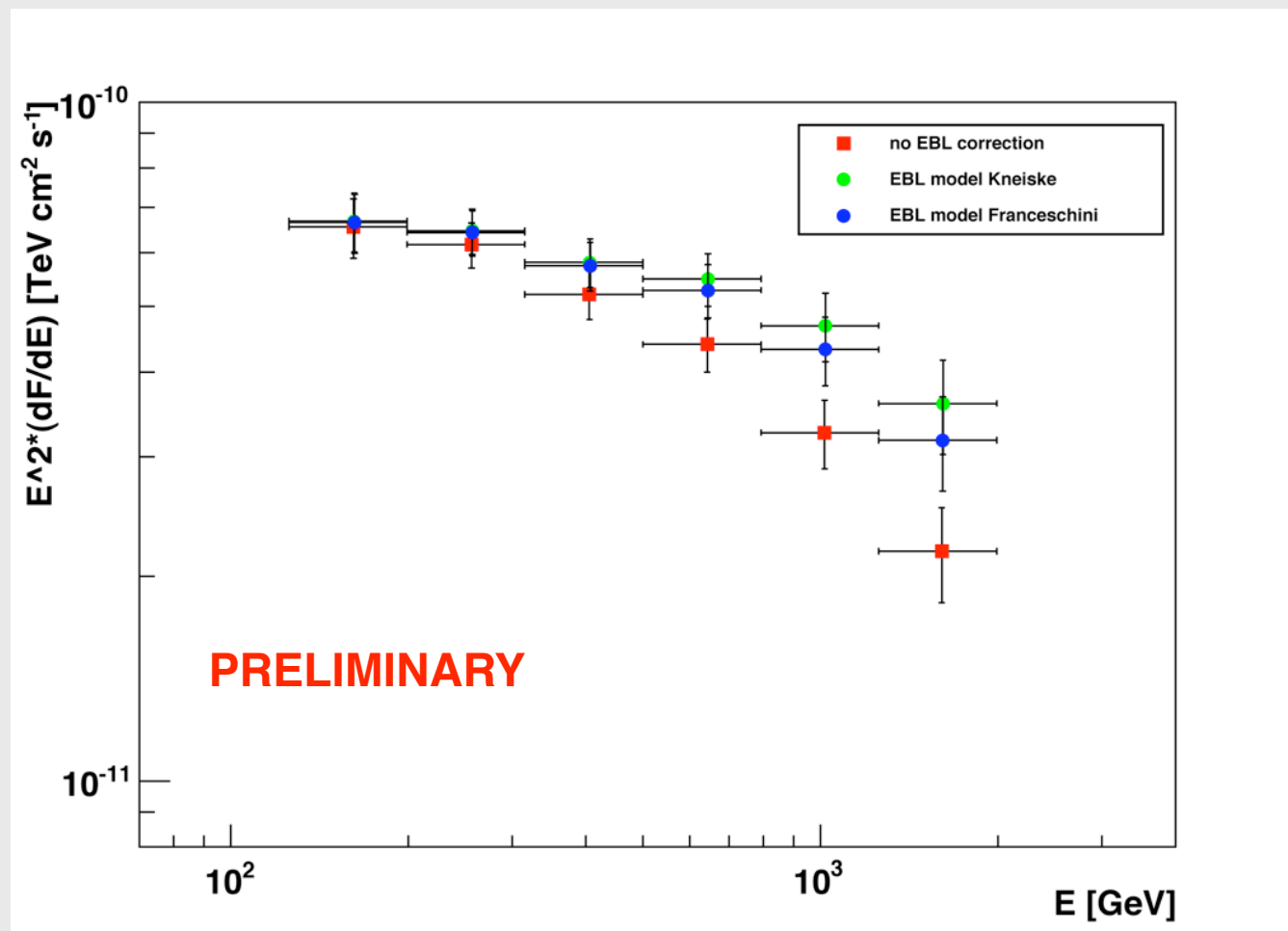


- 3D reconstruction of shower parameters
- Better source position determination
- Improved background reduction



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SED Mrk 421 Nov 2009



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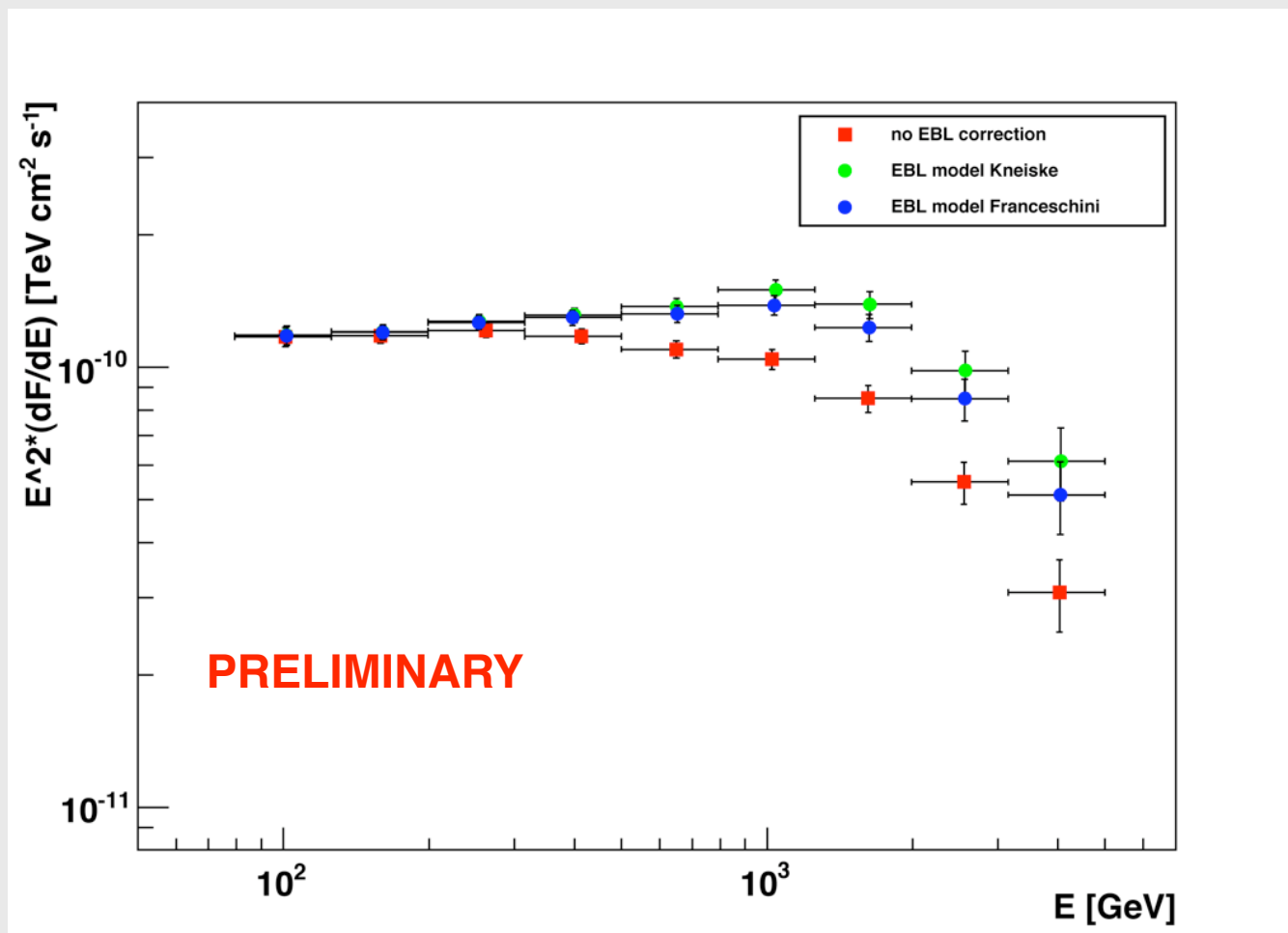
EBL correction:

- Kneiske model:
Kneise, T. M., Bretz, T., Mannheim, K. & Hartmann, D. H., A&A **413** 807 (2004)
- Franceschini model:
Franceschini, A., Rodighiero, G. & Vaccari, M., A&A **487** 83 (2008)

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