Abstract

The giant radio galaxy M 87 was observed at TeV energies with the Cherenkov telescopes of the H.E.S.S. collaboration (High Energy Steroscopic System). The observations have been performed in the year 2003 during the commissioning phase and in 2004 with the full 4 telescope setup. The observations were motivated by the measurement of the H.E.S.S. collaboration which reported a 4.7 sigma excess of TeV γ-rays from the direction of M87. The results of the H.E.S.S. observations indicating a possible variability of TeV γ-ray emission from M 87 (compared to the H.E.S.R. result) are presented.

M 87

M 87 is a giant radio galaxy located in the Virgo cluster of galaxies. It has been intensively studied in different wavelengths (radio, optical, x-rays, see Fig. 1).

- Distance: ~16 Mpc (z = 0.0043)
- Supermassive central black hole
- Jet angle to observer: 20-40 deg

M 87 is of particular interest for observations at TeV energies: The large jet angle makes it different from the so far observed TeV emitting AGN which are of the Blazar type. Various models exist to describe emission of GeV/TeV photons from M87:

- Leptonic models (i.e. Inverse Compton, 21 cm γ-ray production in large scale jets [Bai & Lee, ApJ, 549, L133 (2001)])
- Hadronic models, i.e. Synchrotron proton blazar model, cosmic ray mechanisms, etc. [Fichtel et al., Astrophysical Journal, 1993, 410, L173 (2000)]

M 87 has been observed at TeV energies in 1998 and 1999 for ~8h with HEGRA:

- Energy threshold: 730 GeV
- Measured excess: 4.1 sigma (4.7 sigma with a refined analysis; see Fig. 2)
- Flux: 3.3% of the flux of the Crab nebula

HEGRA TeV observations

M 87 has been observed at TeV energies in 2003 and 2004 with H.E.S.S. The results reported by the H.E.S.S. collaboration indicate a 4 sigma excess of TeV γ-rays from the direction of M87 (compared to the H.E.S.R. result) assuming a power-law with photon index Γ = 2.9. Systematic flux errors: ~20%. Indication of flux variability when comparing the H.E.S.S. and HEGRA results.

Conclusions

- Combined 2003/2004 H.E.S.S. data: excess >4 sigma from the direction of M87.
- The lightcurve indicates flux variability at TeV energies. The H.E.S.S. estimated flux correspond to ~40% (2003 data) resp. ~20% (2004 data) of the reported HEGRA flux of M 87 (see Fig. 5).
- Excess position: The mean position of the H.E.S.S. excess is compatible with the center of M87 (see Fig. 6).