BLAZAR OBSERVATIONS WITH THE ARGO−YBJ DETECTOR

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ABSTRACT. The ARGO−YBJ (Astrophysical Radiation with Ground-based Observatory at YangBaJing) experiment is a detector optimized for the study of atmospheric showers. It consists of a RPC (Resistive Plate Counters) carpet covering an area of ∼6500 m^2 and it will be located at the YangBaJing Laboratory (Tibet, China), 4300 m a.s.l., latitude 30.11^{o}N and longitude 90.53^{o}E. ARGO−YBJ will be devoted to a wide range of fundamental issues in cosmic ray and astroparticle physics, including γ-ray astronomy and blazar physics at energies between 50 GeV÷20 TeV. The ARGO−YBJ sensitivity for blazar observations is presented.

1. The ARGO−YBJ detector sensitivity

ARGO−YBJ is an air shower detector optimized to observe small-size showers. The experiment consists of a ∼71×74 m^2 core detector realized with a single layer of RPC (∼90% of active area), surrounded by an outer detector (∼30% of active area) for a total area of ∼100×100 m^2 (Bacci et al. 1998). The high altitude of the site and the continuity of the detector permit ARGO−YBJ to image with high efficiency and sensitivity atmospheric showers initiated by primaries of energies in the range 10 GeV÷20 TeV. The experiment location will provide a systematic and continuous monitoring of the Northern Hemisphere in the declination band $-10^o < \delta < 70^o$. The detector assembling will start in late 2000 and data taking with the first ∼750 m^2 of RPC in 2001.

The predicted sensitivity of ARGO−YBJ to γ-ray point sources is presented in Fig. 1, compared to that of other present and future experiments and to Whipple spectrum for the Crab Nebula (Hillas et al. 1998). The four blazars observed so far at TeV energies, *i.e.*, Mrk 421 (Punch et al. 1992), Mrk 501 (Quinn et al. 1996), 1ES 2344+514 (Catanese et al. 1998), and PKS 2155-304 (Chadwick et al. 1999), show integral fluxes above 1 TeV up to ∼10 times that of the Crab, while ARGO−YBJ sensitivity to unidentified sources is about 5% of Crab. Therefore the detector proves to be very good for measuring high energy γ-ray fluxes from blazars.

2. ARGO−YBJ observation times

Blazars are characterized by a rapid flux variability, down to the hour time scale. Therefore to study their variability a detector with sufficiently high sensitivity is necessary.

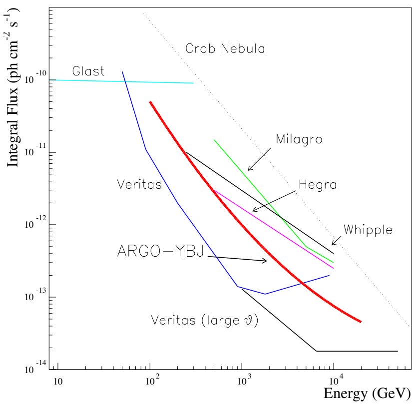

Fig. 1. The observation times for these 5σ sensitivities are: 50 hours in the case of air Cerenkov detectors (HEGRA, Veritas, Whipple) and 1 year in the case of satellite (GLAST) and particle shower detectors (ARGO−YBJ, Milagro).

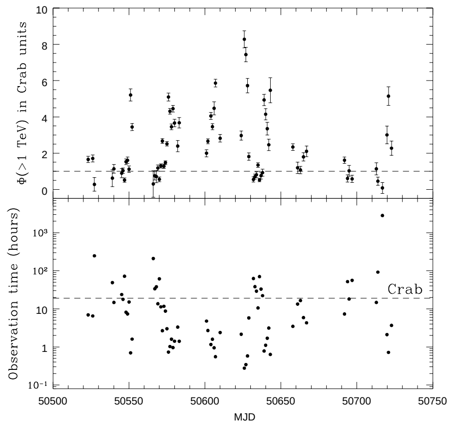

Fig. 2. Daily integral fluxes for the 1997 Mrk 501 outburst as seen by HEGRA, normalized to Crab flux (top), and relative expected observation times for achieving a 5σ detection with ARGO−YBJ (bottom). The dashed line refers to the Crab.

The ARGO−YBJ 5σ sensitivity reported in Fig. 1 is valid for a one year observation time. This would seem to be too long for the detection of flaring objects or variability studies. However it has to be remarked that the sensitivity scales as $t_{obs}^{0.5}$. In order to evaluate the ARGO−YBJ capabilities for variability studies, we considered the 1997 outburst of Mrk 501. Taking the daily data collected by the stereoscopic HEGRA air Cerenkov Telescope during the period March to October 1997 (Aharonian et al. 1999), we calculated the expected observation times for a 5σ detection by ARGO−YBJ. These are shown in Fig. 2. As can be seen, in the favourable cases of sources flaring up to a few Crab fluxes, a few hours of exposure are sufficient for a 5σ detection. For a 3σ signal, the observation time is a factor $(5/3)^2$ less.

References

Aharonian, F.A., et al.: 1999, *Astron. Astrophys.* **342**, 69.

Bacci, C., et al.: 1998, *Addendum to the ARGO Proposal*, unpublished, available at *http://www1.na.infn.it/wsubnucl/cosm/argo/argo.html*

Catanese, M., et al.: 1998, *Astrophys. J.* **501**, 616.

Chadwick, P.M., et al.: 1999, *Astrophys. J.* **513**, 161.

Hillas, A.M., et al.: 1998, *Astrophys. J.* **503**, 744.

Punch, M., et al.: 1992, *Nature* **358**, 477.

Quinn, J., et al.: 1996, *Astrophys. J. Lett.* **456**, L83.