# Search for 10 TeV Gamma-Rays from the Nearby AGNs with the Tibet Air Shower Array

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## 1. Introduction

The detection by EGRET[1] of gamma-rays from more than 50 active galactic nuclei (AGNs) allowed us to expect these objects to be the sources of extragalactic cosmic rays at very high energy. The TeV gamma-rays from nearby BL Lac objects of the AGNs examined were detected by the Whipple Observatory collaboration[2]. In this paper, we present the results given by the Tibet air shower array on the search for 10 TeV gamma-ray emission from 18 relatively nearby AGNs with redshifts of $z < 0.07$.

## 2. Experiment

The Tibet air shower array is located at Yangbajing (4300 m a.s.l., 606 g/cm$^2$, 90.52°$E$, 30.11°$N$) in Tibet, China[3]. This array allows us night and day to detect small air showers initiated by cosmic rays with the energy around 10 TeV. Each arrival direction is determined with an accuracy of about 1° in the energy around 10 TeV by using a fast timing method.

## 3. Analysis

We selected the data from the original data set by imposing suitable conditions, to obtain the showers with energy more than about 8 TeV[3]. An equi-zenithal scan method was used to search for a gamma-ray emission from each object. That is, a comparison of the number of events between into the source and into the background windows at the same zenith angle was made to examine an excess of signals from the source direction.

## 4. Results and Discussion

We used the data taken during the period from October 1995 through August 1996. The target AGNs and the results on the search for continuous emission are listed in Table 1. No excellent excess is found for steady emission of 10 TeV gamma-rays from any object. Flux upper limits at the



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90% confidence level for 10 TeV emission were estimated to be 0.32 for NGC 315, 0.35 for NGC 1275, 0.67 for Mkn 421, 1.42 for 3C 120.0, 0.85 for Mkn 501, 2.03 for Mkn 180 and 0.24 for 1Zw 187, respectively, in the unit of $10^{-12}$ $cm^{-2}$ $s^{-1}$, by using the simulation calculation in which a differential power-law spectrum with the form of $E^{-2}$ was assumed for each of AGNs.

Since November 1996, we are operating also the high-density detector-array. The statistics will be much improved in the near future.

Table 1. The target AGNs and the results.

| | | $\geq$ 10 TeV | | $\geq$ 30 TeV | |
|---|---|---|---|---|---|
| Source | $z$ | $N_b$ | $\sigma$ | $N_b$ | $\sigma$ |
| 0055+300 (NGC 315) | 0.017 | 171314 | -0.79 | 6605 | 1.32 |
| 0316+413 (NGC 1275) | 0.017 | 191790 | -0.41 | 6990 | 0.03 |
| 2201+044 | 0.028 | 104540 | -1.33 | 3946 | 0.04 |
| 1101+384 (Mkn 421) | 0.031 | 199570 | 0.69 | 7185 | 1.02 |
| 0430+052 (3C 120.0) | 0.033 | 109829 | 2.31 | 4135 | -1.09 |
| 1652+398 (Mkn 501) | 0.034 | 194437 | 1.73 | 7049 | -0.06 |
| 2344+514 | 0.044 | 156851 | -0.07 | 5885 | 1.41 |
| 1133+704 (Mkn 180) | 0.046 | 56721 | 2.41 | 2378 | 0.14 |
| 1959+650 | 0.047 | 83340 | 0.41 | 3378 | -0.18 |
| 1807+698 (3C371.0) | 0.051 | 57139 | -0.82 | 2378 | 1.11 |
| 1514+004 | 0.052 | 82455 | -0.66 | 3183 | 0.70 |
| 0402+379 | 0.055 | 197554 | -0.63 | 7122 | 0.75 |
| 1727+502 (1Zw 187) | 0.055 | 162801 | -0.70 | 6085 | -0.11 |
| 2321+419 | 0.059 | 189433 | 1.61 | 6884 | -0.43 |
| 0116+319 | 0.059 | 175649 | -1.55 | 7040 | 0.23 |
| 0802+243 (3C 192.0) | 0.060 | 189989 | 0.88 | 6845 | -0.09 |
| 1214+381 | 0.062 | 200168 | 0.68 | 7281 | -1.40 |
| 2200+420 (BL Lac) | 0.069 | 188779 | -1.23 | 6865 | -0.65 |

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