SEARCH FOR UHE GAMMA RAY SOURCES IN THE MAGELLANIC CLOUDS

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ABSTRACT. An experimental survey of ultra-high-energy γ–ray sources in the Magellanic Clouds is described. Results of the survey may be used to study the intergalactic magnetic field.

1. The JANZOS Experiment

The JANZOS collaboration operates an extensive air shower array (Bond *et al.* 1988a) and an array of three Cerenkov telescopes (Bond *et al.* 1988b) in the Black Birch Range in New Zealand. An experimental survey of UHE γ–ray sources in the Magellanic Clouds has been completed using a novel variation of the atmospheric Cerenkov technique. The Magellanic Clouds are observed at large zenith angles as they cross the Meridian on their lower transit below the South Celestial Pole. Cerenkov observations at large zenith angles have the advantage of a very large detection area but the threshold energy is also increased (Sommers & Elbert 1987) as shown in Fig. 1. The JANZOS collaboration has already used this technique to obtain the smallest upper bound on the UHE γ–ray flux from SN1987A (Bond *et al.* 1989).

The telescopes scan a 7° wide declination strip which allows most of the extent of the Magellanic Clouds to be observed. Analysis of the data is now underway and a systematic search for UHE γ–ray sources will be made.

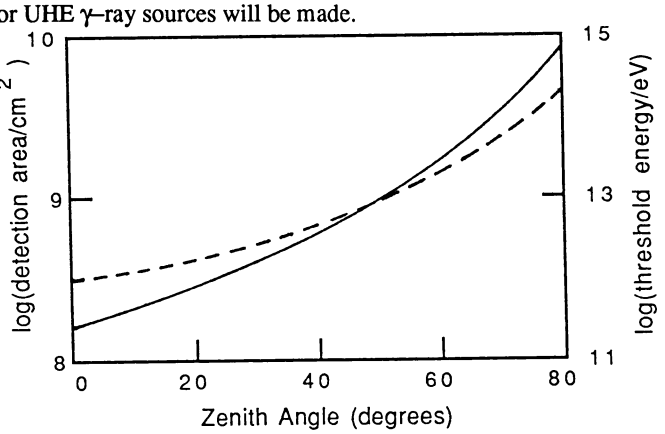

Figure 1. Detection area (solid line) and threshold energy (dashed line) for the JANZOS Cerenkov facility in terms of zenith angle.

R. Haynes and D. Milne (eds.), The Magellanic Clouds, 337–338.

2. Implications for studying the intergalactic magnetic field

The UHE flux from an extragalactic source is expected to be attenuated through interactions with the cosmic microwave background producing electron positron pairs (Gould & Schreder 1967). The flux can be significantly regenerated through inverse Compton scattering of the electrons or positrons on the CMB photons if the intergalactic magnetic field is sufficiently weak (Gould & Rephaeli 1978). These processes result in an absorption dip in UHE spectrum at around 1000 TeV whose depth depends critically on the magnetic field strength (Honda 1989). If the energy spectrum for a sufficiently strong UHE γ–ray source can be measured then confirmation of the absorption feature can lead to at least a *lower* limit on the intergalactic magnetic field strength. The large zenith angle Cerenkov technique, with its high sensitivity, may be a promising method of achieving this. To detect the absorption dip using the JANZOS large zenith angle Cerenkov technique we need a source in the Magellanic Clouds with a γ–ray luminosity greater than 10^{38} erg s^{-1} at energies greater than 1000 TeV.

3. References

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