
Astronomical Objects in the Direction of a Possible Southern EeV Cosmic Ray Source

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Abstract

There is apparently an excess of cosmic ray events from some southern hemisphere directions in the energy range roughly 1-3 EeV. This observation was made by Hayashida et al. (1999) and confirmed by examining data from the SUGAR array (Bellido et al. 2001). The SUGAR data identified a possible source direction a few degrees from the galactic centre. We have examined that general direction for any unusual or potential high energy sources which might become targets for southern VHE gamma-ray telescopes.

1. Introduction

Data from the AGASA group (Hayashida et al. 1999) show a broad southern excess in EeV cosmic ray arrival directions towards the galactic centre region and SUGAR data (Bellido et al. 2001) show an excess close to (but not coincident with) the galactic centre. These data appear to be mutually supportive but, at this stage, neither is at a significance level which is completely secure.

The SUGAR data identifies a source region centred on RA 18^h18^m , dec -22° (J2000 coordinates) with a central spread of about 4° . This region is about 10° from the galactic centre and to the south of the galactic plane. The AGASA spectral data suggest that the beam may contain a significant neutron component from a distance comparable with that of the galactic centre. Propagation of cosmic rays from such a source has been discussed by Clay (2000). We have examined the SUGAR region for any unusual or otherwise potential VHE gamma-ray sources.

2. Results

An examination of NVSS maps of an extended region around the SUGAR direction at 1420MHz (<http://www.cv.nrao.edu/nvss/>) shows the galactic plane prominent in the north-east and four apparent supernova remnants. The most prominent of these is 1814-24 (Dickel and Milne 1976), also known as G7.7-3.7 (Dubner et al. 1996). Diffuse radio emission fills this remnant and it has a large mean radio polarisation of 10% of the total intensity. Perhaps the most intriguing remnant-like object in the map is at $18^h34^m, -21^\circ$ (J2000). This appears to be an old shell with an outer bubble region extending to a diameter of 2° . It contains EGRET source GEV J1832-2128 (Lamb and Maccomb 1997). The object happens to also contain a gravitational lens in its direction (Jauncey et al. 1991, Lehar et al. 2000). In a search region as large as this, there are many further objects which are catalogued and it is not clear which objects should be of particular interest. For instance, the NASA extragalactic database (NED, <http://nedwww.ipac.caltech.edu/>) lists 176 radio sources.

We have looked for any large scale structure with COMPTEL data and have searched for any unusual nearby objects which may have an association with high energy astrophysics. An examination of COMPTEL data over a large $30^\circ \times 30^\circ$ region (<http://skyview.gsfc.nasa.gov/cgi-bin/direct.pl>) shows two strong gamma-ray sources which are in the plane of the galaxy, and symmetrical when viewed from the SUGAR source position. This could suggest that a large-scale shell surrounds the source and intersects the galactic plane at those two points.

There is a remarkable source at the edge of the SUGAR region, this is SAX J1819.3 2525 (V4641 Sgr). It is a microquasar, an X-ray nova with relativistic (superluminal) radio jets in a black hole binary system. It is at an estimated distance of 0.5kpc. It had a strong, well documented, outburst in September 1999 (Revnivtsev et al. 2002) which reached a level of more than 10 Crabs for RXTE and has flared again recently (May/June 2002 - see: <http://vsnet.kuastro.kyoto-u.ac.jp/vsnet/Xray/v4641sgr02.html>)

3. Conclusion

The SUGAR source region, searched for using a prescription based on an apparent excess of EeV events seen by the AGASA array, contains a number of candidate astronomical sources for cosmic ray acceleration. Sources which may be of particular interest are a microquasar, a supernova shell containing diffuse polarised radio emission, and an unusual region containing an EGRET source.

4. References

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