Whipple observations of 1ES1959+650: an Update

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Abstract

Strong flares of TeV gamma-ray emission up to a level of $\sim$ 5 Crab were detected by the Whipple 10 m atmospheric Čerenkov telescope from the BL Lacertae object 1ES1959+650 during May - July 2002. We report here the results of follow up observations during 2002 - 2003.

1. Introduction

1ES1959+650 is a high frequency peak BL Lac object (HBL) at a redshift $z = 0.048$. It was first suggested as a candidate for TeV emission by Stecker, de Jager and Salamon [10] and noted more recently by Costamante and Ghisellini [1]. Initial weak detections by the Utah Seven Telescope Array [8] and HEGRA instruments [5] made this object a prime candidate for ground-based Čerenkov telescopes during 2002 and observations during May - July were rewarded with the detection of a period of strong TeV flare activity, reaching a flux level of $\sim$ 5 Crab [3,4]. This detection also triggered contemporaneous target of opportunity measurements at $\sim$ 10 keV by the pointed instruments on board RXTE [6] as well as observations at other wavelengths [9]. Observations with the Whipple 10 m telescope are halted during the summer months due to adverse weather conditions. In this paper we summarise the Whipple observations of 1ES1959+650 including previously unreported observations since September 2002.

pp. 2619–2622

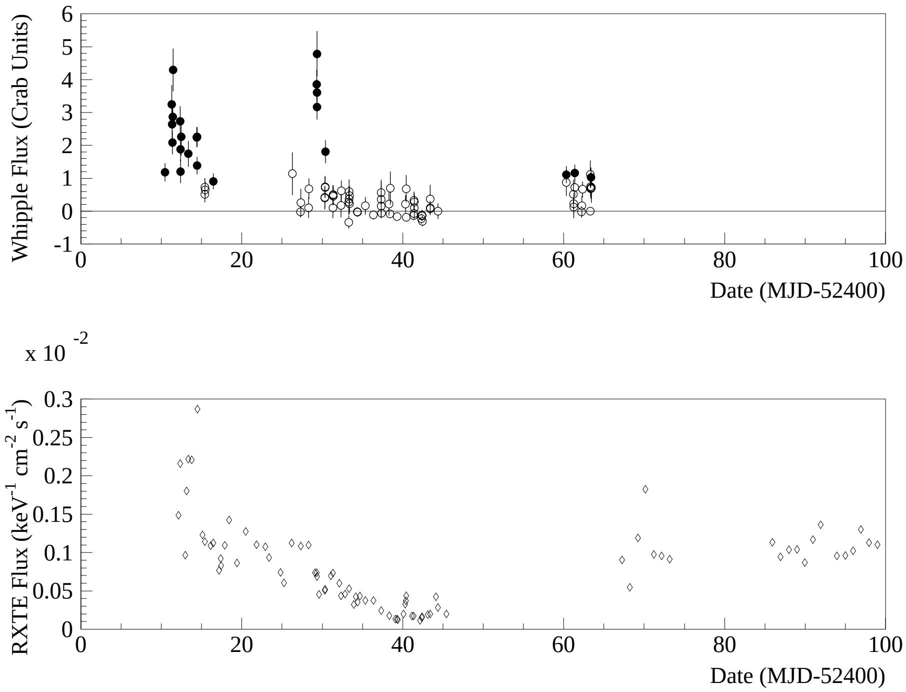

Fig. 1. The Whipple (top) and RXTE (bottom) light curves for 1ES1959+650 in May-July 2002. The filled Whipple points correspond to $> 3\ \sigma$ detections. The RXTE data are from [6].

2. Instrument Status

The configuration of the Whipple 10 m gamma-ray telescope is described in detail in [2]. Briefly, the telescope consists of a 10 m reflector and a 490 pixel photomultiplier tube (PMT) camera. For the analysis presented here only the high resolution (0.12° spacing) central 379 PMT pixels have been used. The larger, outer 111 pixels were removed from the camera in January 2003. Using standard *Supercuts* criteria to select gamma-ray events and reject the background of hadronic cosmic rays on the basis of the shape of the image in the camera, allows us to detect the Crab Nebula with a statistical significance of 6 σ in 1 hour.

3. Observations and Analysis

Figure 1 shows the detailed light curves for the May - July 2002 observations for both Whipple and RXTE data. The Whipple fluxes have been corrected for source elevation and atmospheric changes using the method of LeBohec and Holder [7]. A flare is visible at both wavelengths around MJD 52410 - 15, however on MJD 52429 (June 4th) there was a clear example of a TeV gamma-ray

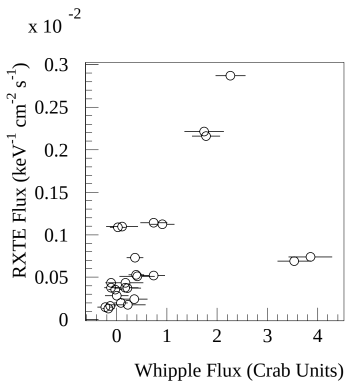

Fig. 2. The Whipple and RXTE fluxes. Only observations which overlap in time have been used.

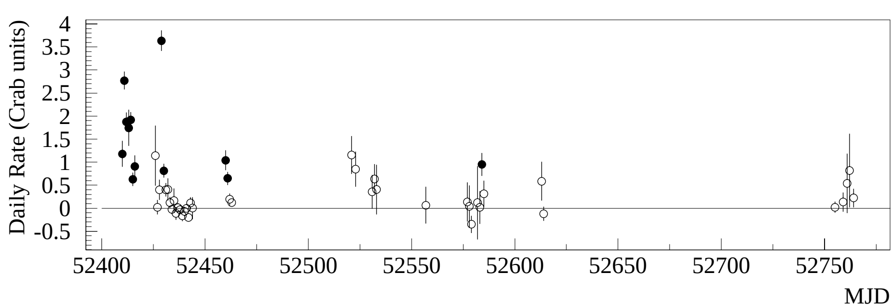

Fig. 3. The daily averaged gamma-ray flux for all Whipple observations. Filled points correspond to $> 3\ \sigma$ detections.

flare with no X-ray counterpart [6]. This flare corresponds to the most rapid flux change in gamma-rays, with a doubling timescale of 7 hours. This is further illustrated in Figure 2, where the X-ray flux is plotted against the gamma-ray flux for all observations where there was overlapping coverage. The "orphan" gamma-ray flare is in the bottom right of the plot.

Figure 3 shows the daily average light curve for all Whipple observations of 1ES1959+650, including 11.2 hours of observations from September 2002 to May 2003. The source has been relatively quiescent since September 2002, with only one day's observations (MJD 52584) revealing a significant signal at $> 3\ \sigma$.

4. Discussion

Figure 4 shows the $2-10$ keV flux from 1ES1959+650 as measured by the All Sky Monitor (ASM) on board RXTE, averaged over bins of two weeks. The

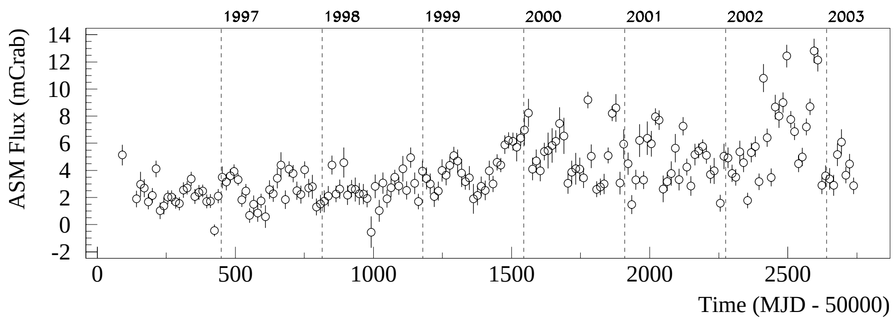

Fig. 4. The $2-10$ keV flux from 1ES1959+650 as measured by ASM in two week bins (quick-look results provided by the ASM/RXTE team).

most active (and variable) period occured in 2002 when the bright gamma-ray flares were observed. Observations with the Whipple telescope are ongoing and full results for 2003 will be reported at the conference. The intriguing detection of a bright gamma-ray flare without an X-ray counterpart is difficult to explain under the currently favoured one-zone synchrotron self-Compton models for high energy emission from BL Lacs. Further observations and detailed spectral analysis may help to clarify the picture.

5. Acknowledgements

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6. References

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