

Search for pulsed TeV gamma-rays from Crab pulsar with the TACTIC Imaging gamma-ray Telescope

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Abstract. The TACTIC Imaging Element has observed Crab Nebula/pulsar for a total of about 40 hours during Jan.- Mar. 2001. Preliminary results do not show any evidence of the 33 ms pulsations from the pulsar direction at an energy threshold of 1 TeV. The 99.9% confidence level upper limit for pulsed emission has been derived to be $\leq 22\%$ of the steady flux from the Crab Nebula.

1. Introduction

The Crab Nebula is an established steady source of photons from 60 GeV to 50 TeV (De Naurois et al., 2002), but it has not been detected as a pulsed TeV gamma-ray source (Lessard, et al., 2000). However, preliminary results from the PACT array at Pachmarhi, indicate the detection of a pulsed main peak at ≥ 1.5 TeV from the pulsar (Vishwanath et al 2001). Further, the EGRET experiment has detected pulsed photon emission up to 10 GeV (Ramanamurthy et al.1995) from it, but more data on the source is needed to settle the question of TeV pulsed emission and its models testing against the observational results.

2. Observations and results

The Imaging Element (IE) of the TACTIC array has been operating with various camera configurations at Mt. Abu (24.6° N, 72.7° E, 1400 m asl), for a few years now (Bhatt, et al., 2002). It has successfully detected the TeV gamma-ray standard candle source Crab

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Nebula with a sensitivity level of $\sim 6.3 \sigma$ in 40 hours at an energy ≥ 1 TeV (Bhatt, et al., 2002).

For the pulsar study, arrival times of all events were barycentered by using JPL DE200 ephemeris. Crab pulsar variables (frequency and its derivative) were taken from the (Jodrell Bank) Crab ephemeris to assign an absolute phase to each event. The resulting light curve is shown in Figure 1 and no evidence for pulsed emission is found with the events randomly distributed in all 10 phase bins. An upper limit on the pulsed emission from the pulsar has been estimated to be $\leq 22\%$ (1.48×10^{-12} photons $cm^{-2} sec^{-1}$) of the steady gamma-ray emission (detected with the IE) from the Crab Nebula by using the method of Helene (Helene, 1983). This value is consistent with the reported energy dependence of unpulsed to total ratio (Ramanamurthy et al 1995). Further, the flux reported by Vishwanath et al (2001) stands below the sensitivity level of the IE of the TACTIC telescope, therefore, there is a consistency between these two results. Upper limit obtained with the TACTIC experiment is also in agreement with the results reported by the different experiments (De Naurois et al., 2002).

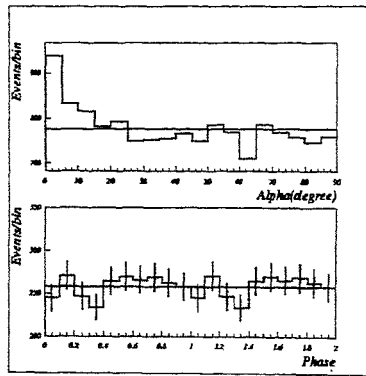


Figure 1. (Top), Alpha distribution of events recorded from the Crab direction after standard cuts and (bottom) ten bin light curve for events with $\alpha \leq 15$ deg.

References

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