

SEARCH FOR PERIODIC MODULATION IN GAMMA-RAY EMISSIONS AT TEV ENERGIES FROM BLAZARS WITH HAWC

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The High Altitude Water Cherenkov (HAWC) observatory has a wide instantaneous field of view of 2 sr and a duty cycle >95 %, which allows it to scan 2/3 of the sky every day. These capabilities make HAWC an ideal instrument for monitoring the variability of blazars at TeV energies. A preliminary study based on simulations for detecting possible periodic modulation from a blazar is presented.

The HAWC observatory is an array of 300 Water Cherenkov Detectors designed for measuring extensive air showers produced by gamma rays with energies between 100 GeV and 100 TeV. It is located at 4100 m above sea level on the slope of Sierra Negra volcano, in central Mexico (Smith 2015). Since November 2014 the observatory has been monitoring the activity of the gamma-ray sources Crab Nebula, Markarian 421 and Markarian 501, producing integrated flux light curves (LC) binned in sidereal days (Lauer 2016). These LC show a steady flux for the Crab Nebula and day-scale variations from Markarian 421 and Markarian 501. Inspired by the finding from the Fermi Collaboration of evidence of periodic modulation in the blazar PG 1553+113 (Ackerman 2015), we started to explore the feasibility of detecting periodic modulation in gamma-ray emissions at very high energy from blazars. For this we produce LC from an region in the sky where there is no gamma ray emissions (Figure 1 a). Then we simulated a source with a LC that follows the shape of a cycloid, in order to resemble the overall shape of the LC observed by Fermi-LAT from PG 1553+113. Then we replace about 1/3 of the data points in the LC from the empty region with the simulated LC accounting for the points around the maximum amplitude (red points in Figure 1 b). A scan using different amplitudes was performed with maximum corresponding to 0.1 to 1 times the Crab Nebula flux at 1 TeV, in steps of 0.1. In order to evaluate how strong the modulation should be to be detectable

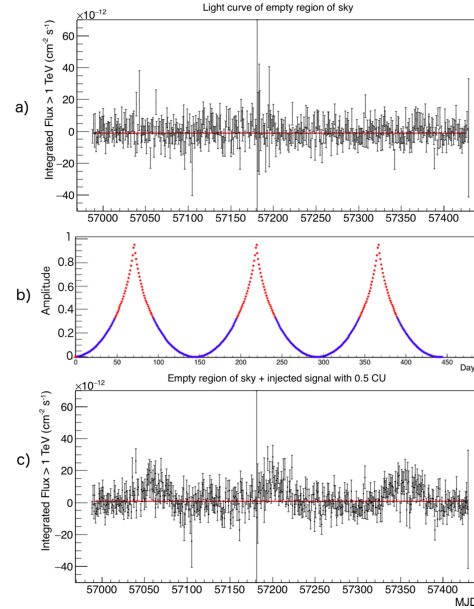


Fig. 1. LC from empty region a) Simulated LC b) Combined LC c). Red lines are fits to constant flux.

by HAWC, a fit to a constant flux was performed to each LC using the 5σ rule as detection limit (P value less than 2.9×10^{-7}). We found that a modulation with maximum of 0.5 C.U., or greater, would be detectable with HAWC (Figure 1 c). The period of these modulation is found using a Lomb-Scargle periodogram. Improvements in the data analysis are being implemented therefore it is expected that more AGNs will be monitored increasing the possibility of finding periodic modulations.

REFERENCES

- Ackerman, M., et al. 2015, ApJ, 813, L41
- Lauer, J. R., for the HAWC Collaboration 2016, AIP Conference Proceedings, 1792, 070013
- Smith, A. J., for the HAWC Collaboration 2015, arXiv: 1508.05826

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