Looking for TeV Binary Candidates with HAWC
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The Milky Way contains hundreds of binary systems which are known to emit in radio and X-rays, but only a handful of binaries have been observed to produce very high-energy gamma rays. In addition, the emission mechanisms which produce the gamma rays in the few known sources are not well understood. To improve the statistics of binary sources in the TeV band, the High-Altitude Water Cherenkov Gamma-ray Observatory, or HAWC, has begun to carry out a simultaneous survey of many TeV binary candidates in the Northern Hemisphere between 100 GeV and 100 TeV.

**Gamma-Ray Binaries**

Gamma-ray binaries are compact objects which orbit massive stars. It is thought that gamma rays are produced when relativistic particles from the compact object encounter the companion star, or when the compact object accretes material from its massive companion.

To date, 3 γ-ray binaries have been observed in the Northern Hemisphere: LS 5039, HESS J0632+057, and LS I +61° 303. Due to its high uptime and wide field of view, HAWC is well-suited to carry out an unbiased survey of binary systems in the northern sky.

**Expected Sensitivity to Periodic Emission**

Below is the Lomb-Scargle periodogram for 1000 simulated transits of a sinusoidally-varying source with a 4-day period, 5% of the Crab flux >1 TeV (high state), and zenith angle 15°. Given the current γ-hadron separation power of HAWC, it will take 3 years to observe orbital modulation of γ rays from such a source at the 5σ level.

**Observations of LS I +61° 303 in Its Flaring State**

In October and November 2014, LS I +61° 303 exhibited a significant multi-week flare. HAWC was under construction during part of this period but operated continuously after November 26.

While LS I +61° 303 is located at an unfavorable declination for measurements with HAWC, we observe this location every day and produced a light curve binned into 7-day increments [3]. The orange and yellow bands indicate the 68% and 95% intervals of the background expected at the position of this source. No variability or counts above background were observed during this period.

Now that construction of HAWC is complete, the observatory provides daily monitoring of Galactic and extragalactic objects for flares [4], including 30 TeV γ-ray binary candidates. With the current analysis, we expect to observe the known sources LS 5039 and HESS J0832+057 at 5σ within 12-18 months. Flares observed by HAWC will be reported to IACTs for follow-up observations.

**References**

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