High priority HATNet transiting planet candidates and eclipsing binaries in the K2 campaign 0 field

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Background The HATNet project is a 2-station network of automated, small and wide field telescopes. HATNet has been operational for 10 years, and has been a major contributor to the discovery of transiting extrasolar planets (TEPs) around bright stars. The ∼50 HAT planets constitute roughly one fourth of the known population with accurate ($\lesssim 10\%$) mass determinations.

The HATNet data stream is searched for TEPs using a state-of-the-art pipeline. Many software components that were originally developed for HATNet have become widely used by the community, e.g. the Box Least Square (BLS, Kovács et al. 2002) transit search algorithm, the Trend Filtering Algorithm (TFA; Kovács et al. 2005), External Parameter Decorrelation (EPD; Bakos et al. 2011), among others. The HATNet pipeline is demonstratedly robust and efficient, yielding high quality TEP candidates with high *a priori* probability of being real detections. Note that there has been a strong connection between HATNet and Kepler, e.g. HATNet observations prior to the launch of *Kepler* yielded two confirmed planets in the Kepler field; HAT-P-7b, arguably the first hot Jupiter on a retrograde orbit, and HAT-P-11b, the first transiting Neptune discovered by a ground-based transit search.

The reliability of HATNet candidate selection has been further improved by exploiting synergies between HATNet and Kepler. Using *simultaneous* observations of *Kepler's* field by the two projects, and leveraging the excellent photometric precision of *Kepler*, the HAT search algorithms have been "trained" to maximize the recovery of real transits, and minimize the number of false alarms. We now routinely recover Neptune-sized planetary transits from HATNet data on the Kepler field, *without* the Kepler data, but using the Kepler data to check the validity of the detections.

The Proposed Research Program HATNet has been observing the sky for a decade, and covered some 29% of the celestial sphere. It is not surprising, but still fortunate, that there is a significant overlap between existing HATNet fields and Kepler's proposed K2 campaign 0 field. We searched these HATNet fields using the fine-tuned transit search pipeline (employing a machine learning technique), which has been recently trained on Kepler's original field. A significant number of TEP candidates have been found in the K2 field. Each target was then subject to thorough visual inspection, and blend analysis, checking the variability of near-by sources. The TEP candidates reach down to Neptune sized planets. There is a high probability that these stars have TEPs, and thus every effort should be made that they are included in Kepler's K2 target list. **We propose to observe these 33 high quality HATNet TEP candidates in the K2 field**. All candidates have a number of transits falling in the ∼ 80 day time-span of Kepler.

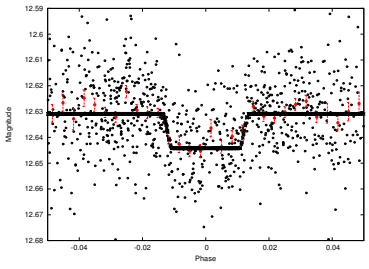

Fig. 1: A Saturn-radius TEP candidate in the K2 field.

In addition, 43 eclipsing binaries were recovered, which we added to our proposed list as a separate category. These are interesting for a number of reasons: i) they can be the sources of transit like variations in other future K2 light curves, ii) they are astrophysically interesting systems on their own, iii) they may harbor circumbinary planets.