A Decade Long Transit Search for Proxima Cen b

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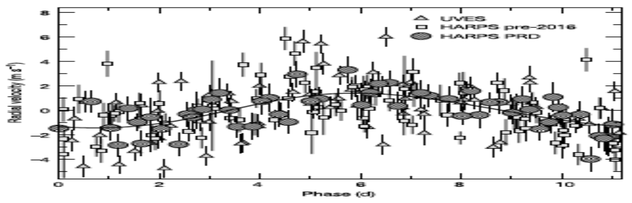
Abstract

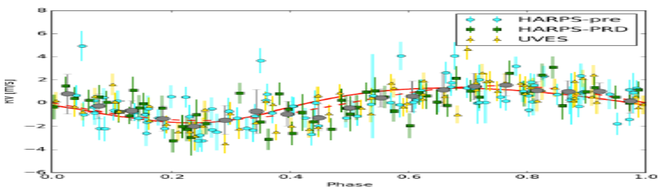
Anglade-Escudé et al. 2016[1] reported the radial velocity (RV) discovery of a small planet (minimum mass of 1.3 M_{Earth}) orbiting our closest star, Proxima Centauri, with a period of ~ 11.2 days. Damasso et al. 2017[2] reanalyzed the RV data and found a similar period, but a slightly lower minimum mass of 1.21 M_{Earth}. Kipping et al. 2016[3] searched HAT-South photometry and 43.5 days of MOST space telescope photometry and found no significant evidence of a transiting planet around Proxima Centauri. Using the SKYNET robotic telescope network and other telescopes, we have obtained ~ 230 nights of ground-based time series photometric observations of Proxima Centauri over the time period of 2006 to 2017. We have combined our datasets and are in the process of running the Box Least Squares VARTOOLS[6] algorithm to search for periodic events over the range of ~ 1 to 30 days. In this work, we present the data reduction and analysis methods used and our preliminary results.

Previous Studies

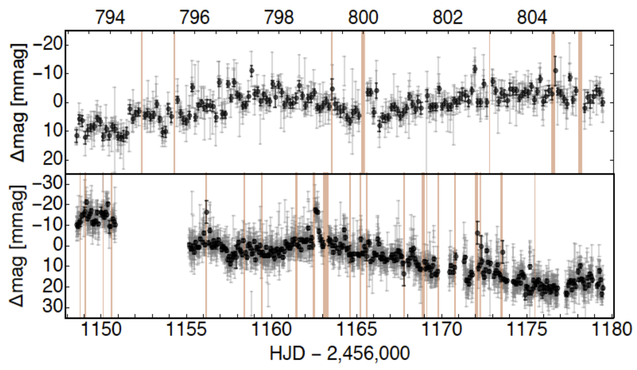
Anglada-Escudé et al. 2016: 11.186 Days Phase Folded Light Curve



Damasso et al. 2017: 11.1855 Days Phase Folded Light Curve



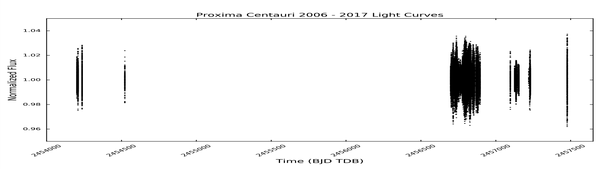
MOST Space Telescope
2014 (top) and 2015(bottom)

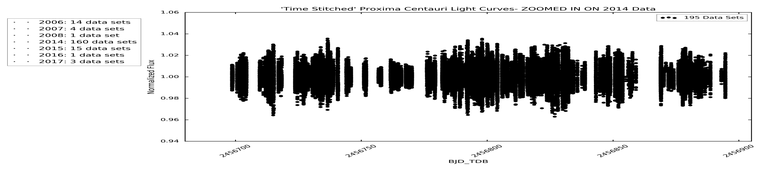


HAT-South Ground Telescope
2014 Light Curve

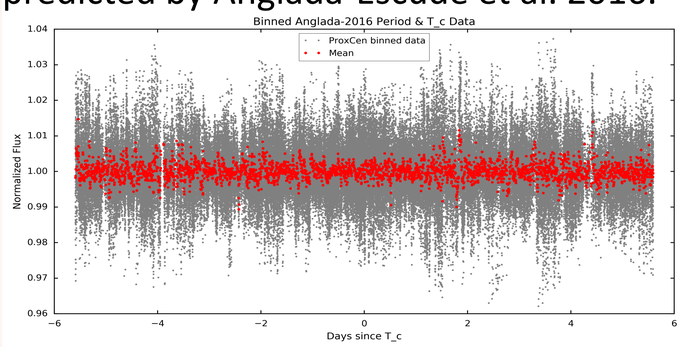
Analysis Of Our New Data

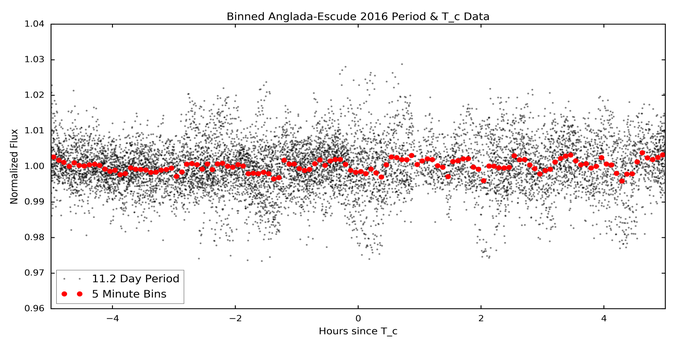
We used AstroImageJ[4] to extract differential photometry from our observations, perform simple linear airmass and time detrending, and iteratively 3-sigma clip the data to remove flares and outlier data points. In a follow-up paper, we will investigate more sophisticated detrending and flare removal techniques.





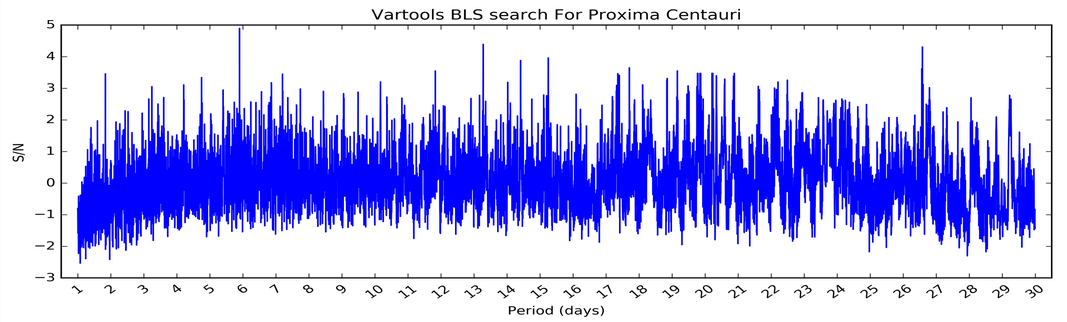
Here we phase fold our photometric data using the Anglada-Escudé et al. 2016 11.186 day period.
Left: The full period. Right: The same data expanded around the transit center time predicted by Anglada-Escudé et al. 2016.



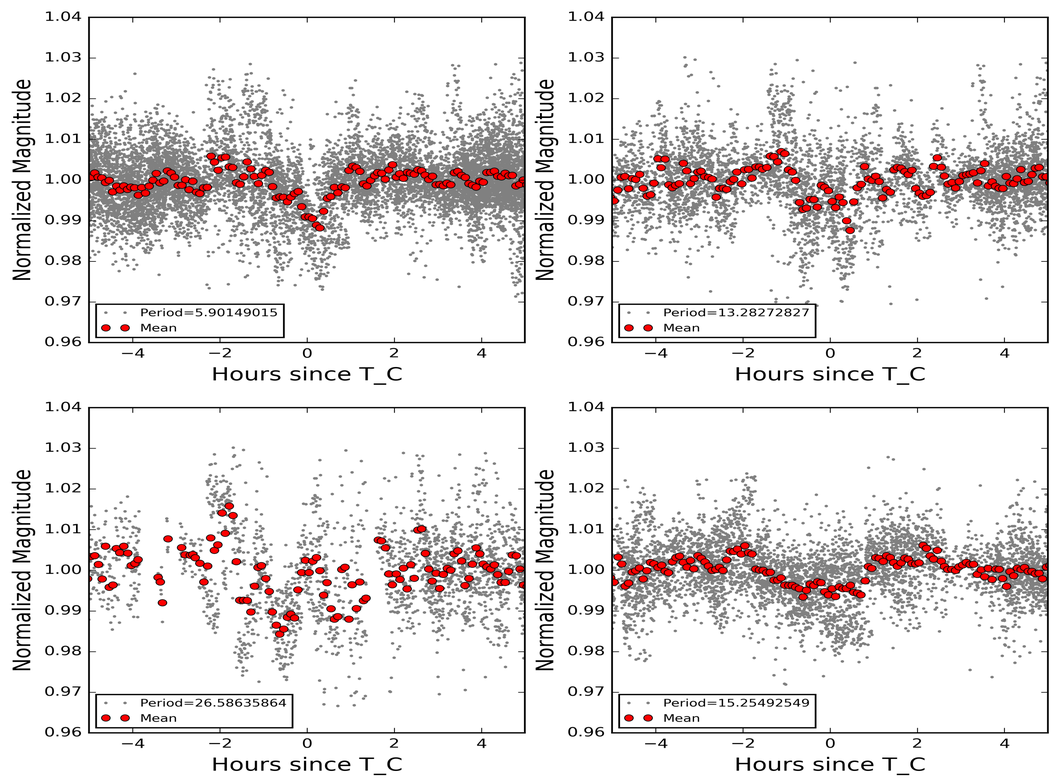


Preliminary Results

To explore other possible periodic signals in the data, a Box-Least Square[5] algorithmic search (VARTOOLS) was applied. We show the results of phase folding our light curve data at 4 of the strongest peaks in the figures below the periodogram. We are still in the process of refining our photometric results and have not yet explored the significance of any of the periodic events. The expected signal of Proxima Centauri b is about 5-10 mmag in depth and has a 1-2 hour transit duration.



Proxima Centauri Phase Folded from BLS Period outputs



Acknowledgments and References

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Angala-Escudé et al. 2016[1], Damasso et al. 2017[2], Kipping et al. 2016[3]
Collins et al. 2014[4], Kovács et al. 2002[5], Hartman et al. 2016[6]