A Very Low Mass Star in an Extreme Mass Ratio Eclipsing Binary from NGTS

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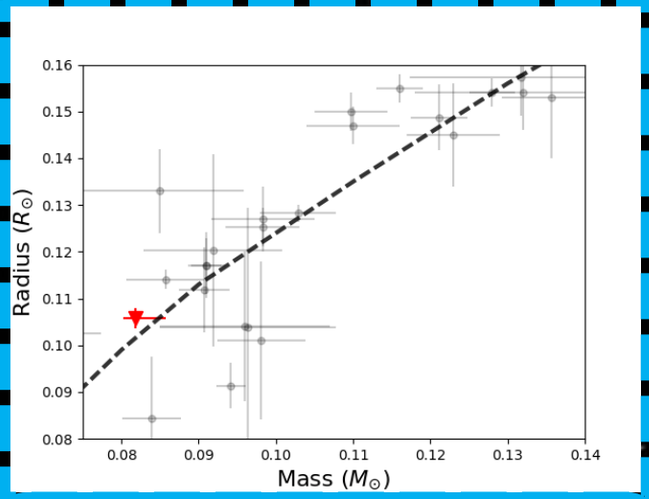
Overview:

- We discovered an extreme mass ratio M-dwarf binary with NGTS
- One star is a large early M-dwarf, whereas the other is just above the hydrogen burning limit
- The most extreme mass ratio of any known M-M binary, posing interesting questions for stellar formation and evolution mechanisms

Observations:

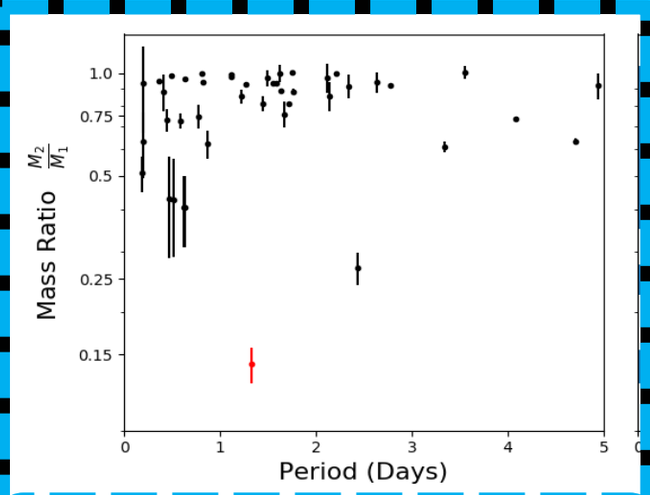
- NGTS -> The system was first observed by the Next Generation Transit Survey in 2016 for 156 nights
- TESS -> The system was by TESS in sector 8 of the primary mission at 30 minute cadence
- SAAO -> Two eclipses were observed in I and g' band using the South African Astronomical Observatory 1m telescope
- HARPS -> The mass of the system was measured using six radial velocity measurements from the HARPS spectrograph



Mass Radius relationship for low mass stars. NGTS J0930-18 (Red) is one of the smallest stars with precise mass-radius measurements.

NGTS J0930-18 System Properties

Parameter	Value
Period	$1.3326^{+1.3\times10^{-6}}_{-9\times10^{-7}}\ Days$
Semi-Major Axis	$0.02195^{+0.00040}_{-0.00064} AU$
Inclination	$89.914^{+0.085}_{-0.671}\ Degrees$
R_{pri}	$0.584^{+0.0094}_{-0.0103}\ R_\odot$
M_{Pri}	$0.580^{+0.0092}_{-0.0063}\ M_\odot$
R_{Sec}	$1.052^{+0.023}_{-0.021}\ R_{Jup}$
M_{sec}	$85.70^{+4.2}_{-1.5}\ M_{Jup}$
Mass Ratio	$0.1407^{+0.0065}_{-0.0017}$

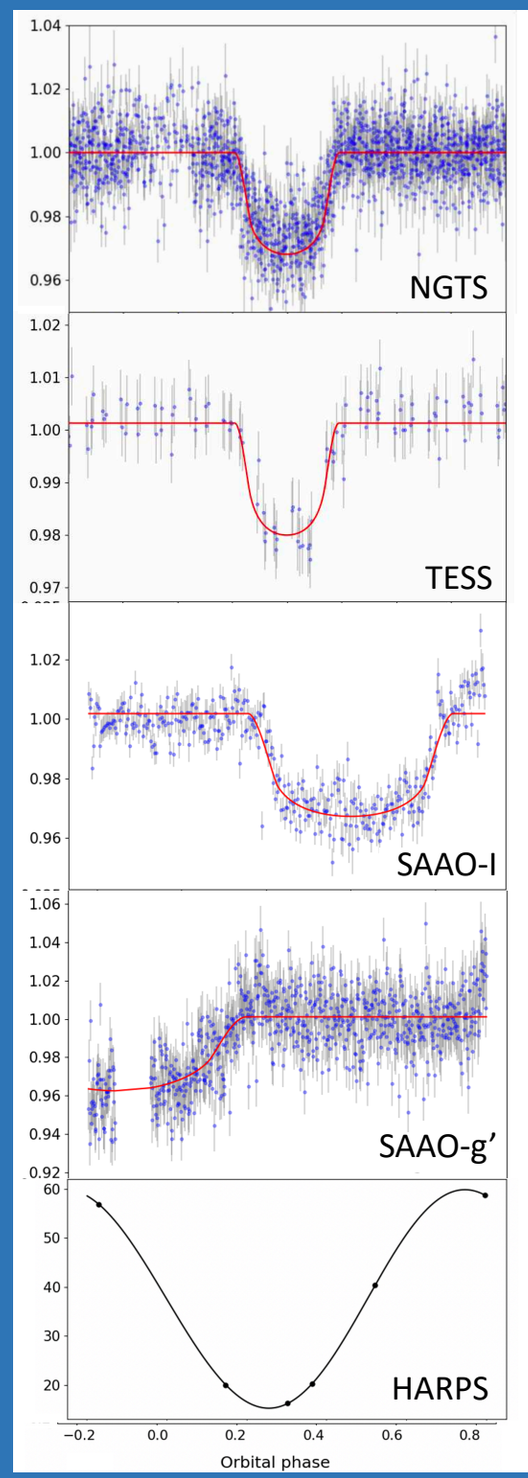


Mass ratios of known M-dwarf binary Systems. Shown in red, this has the lowest mass ratio of any known eclipsing M-dwarf binary

Summary:

- Unlike the vast majority of M-dwarf binaries that have components of almost equal mass, NGTS J0930-18 consists of a high mass early M-dwarf and a low mass companion close to the hydrogen burning limit.
  - This poses interesting questions for the formation and evolution of binary systems, as these are biased towards forming equal mass systems
- With a mass of 85.7 M_{jup} this system is one of only a extremely low mass stars to have its mass and radius precisely measured directly from photometry and RVs.
  - This is particularly important due to the growing number of planetary systems being discovered around low mass stars.
- Discovering and characterizing eclipsing binaries containing these very low mass stars is extremely important for both stellar and exoplanet physics. NGTS is well suited to finding these systems and will continue to fill out this sparsely populated area of parameter space.

arXiv Link - https://arxiv.org/pdf/2008.07354.pdf Contact : ja466@le.ac.uk



Photometry and radial velocities for NGTS J0930-18B