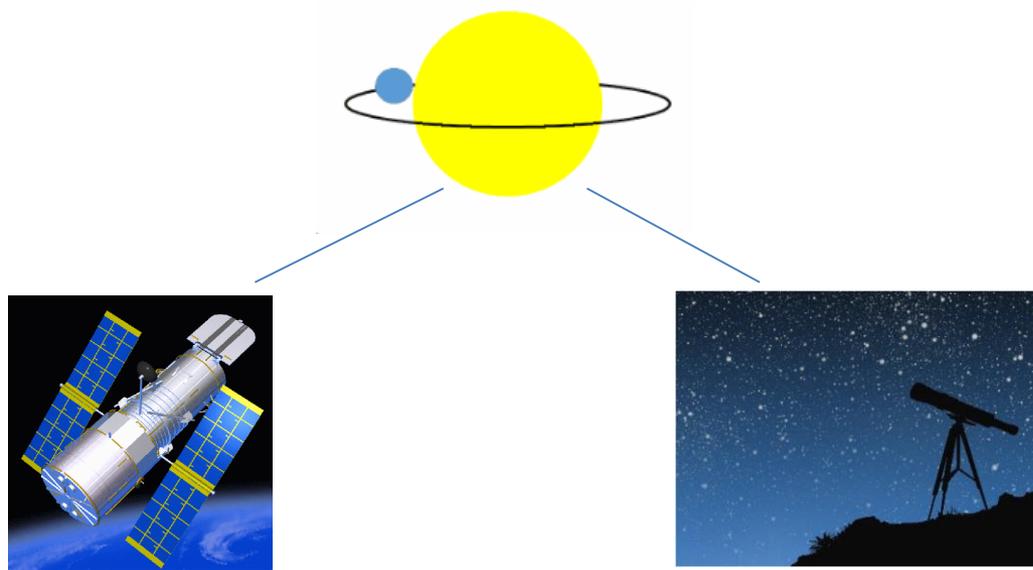


Hubble Exoplanet Pro/Am Collaboration

November 13, 2015



Hubble Science Team

World-wide Network of
Amateur Astronomers

by

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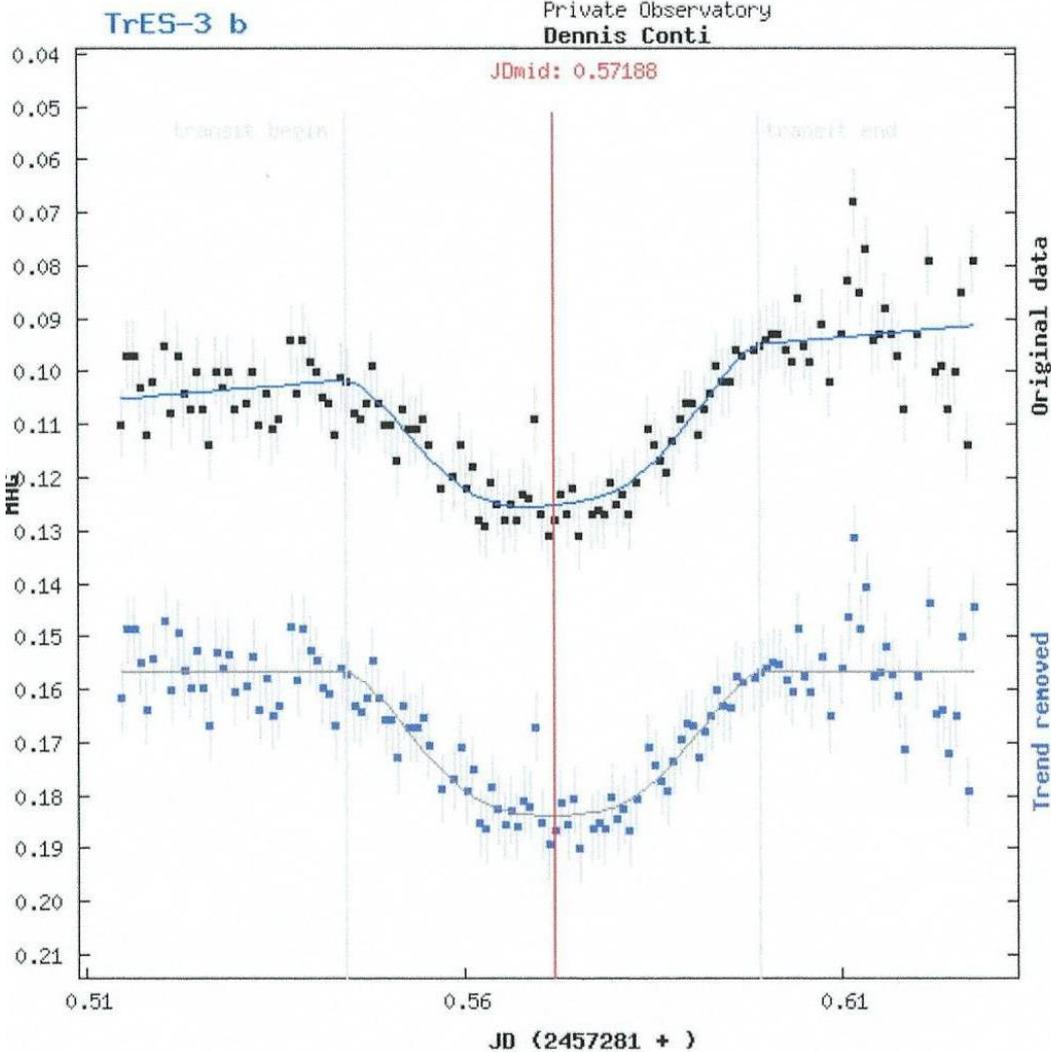
Project Background

- An approved Hubble Space Telescope (HST) survey of 15 exoplanets will take place throughout 2016
- The survey's purpose is to obtain key science data regarding the atmosphere of some 15 exoplanets prior to the James Webb Space Telescope (JWST)
- The project's Principal Investigator is noted planetary scientist Dr. Drake Deming
- Approach:
 - Hubble's Wide Field Camera 3 will use spatial scanning and a grating prism (grism) to obtain spectroscopy measurements in the 1.4 micron band
 - Each exoplanet will be visited one or more times

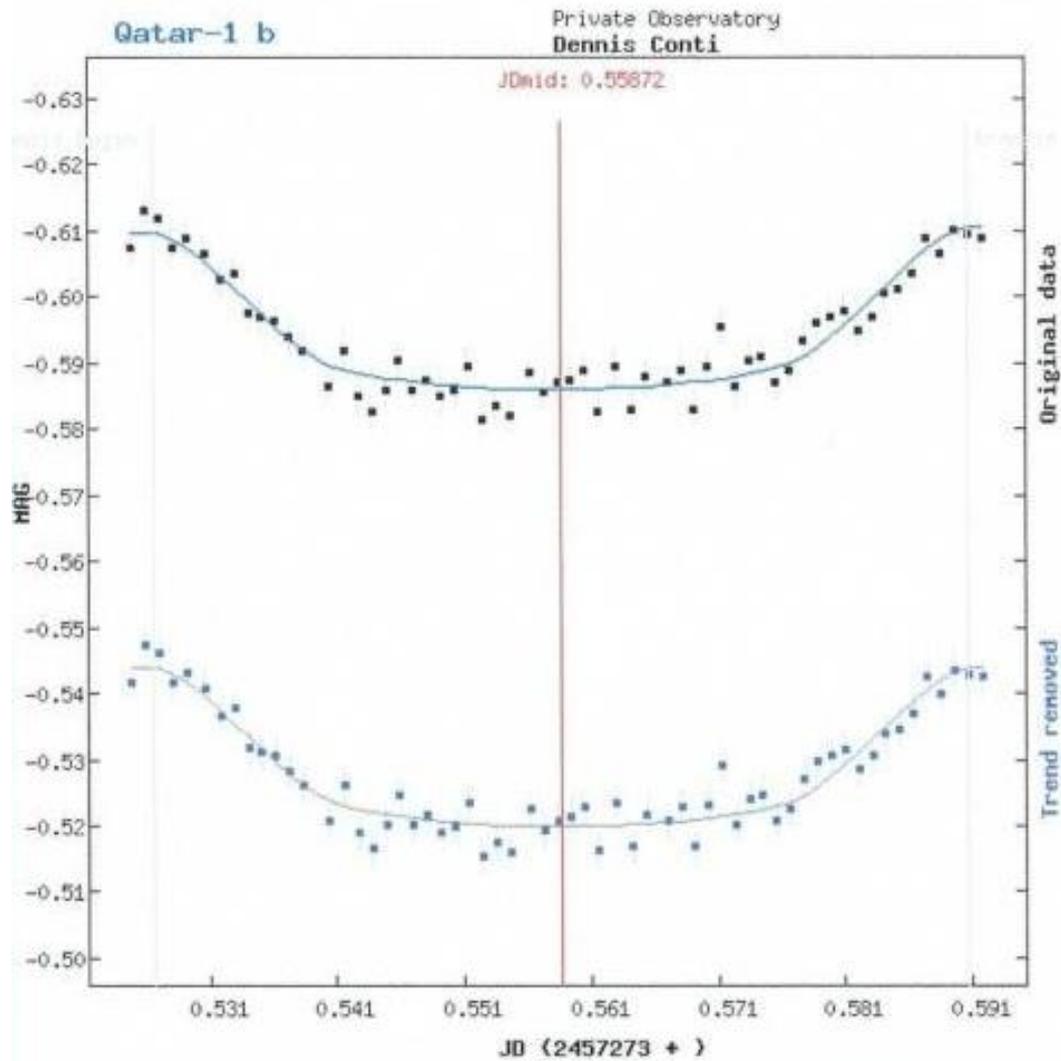
Amateur Astronomer Collaboration

- The purpose of this collaboration is to:
 1. Help the Hubble science team better refine the ephemeris of the target exoplanets.
 2. Determine any unusual activity such as star spots or flares on the target planet's host star.
 3. Develop a framework and a world-wide network of advanced amateur astronomers for other such collaborations.
- The ability of amateur astronomers to develop highly accurate light curves of transiting exoplanets is now well-established, especially of “hot Jupiters.”

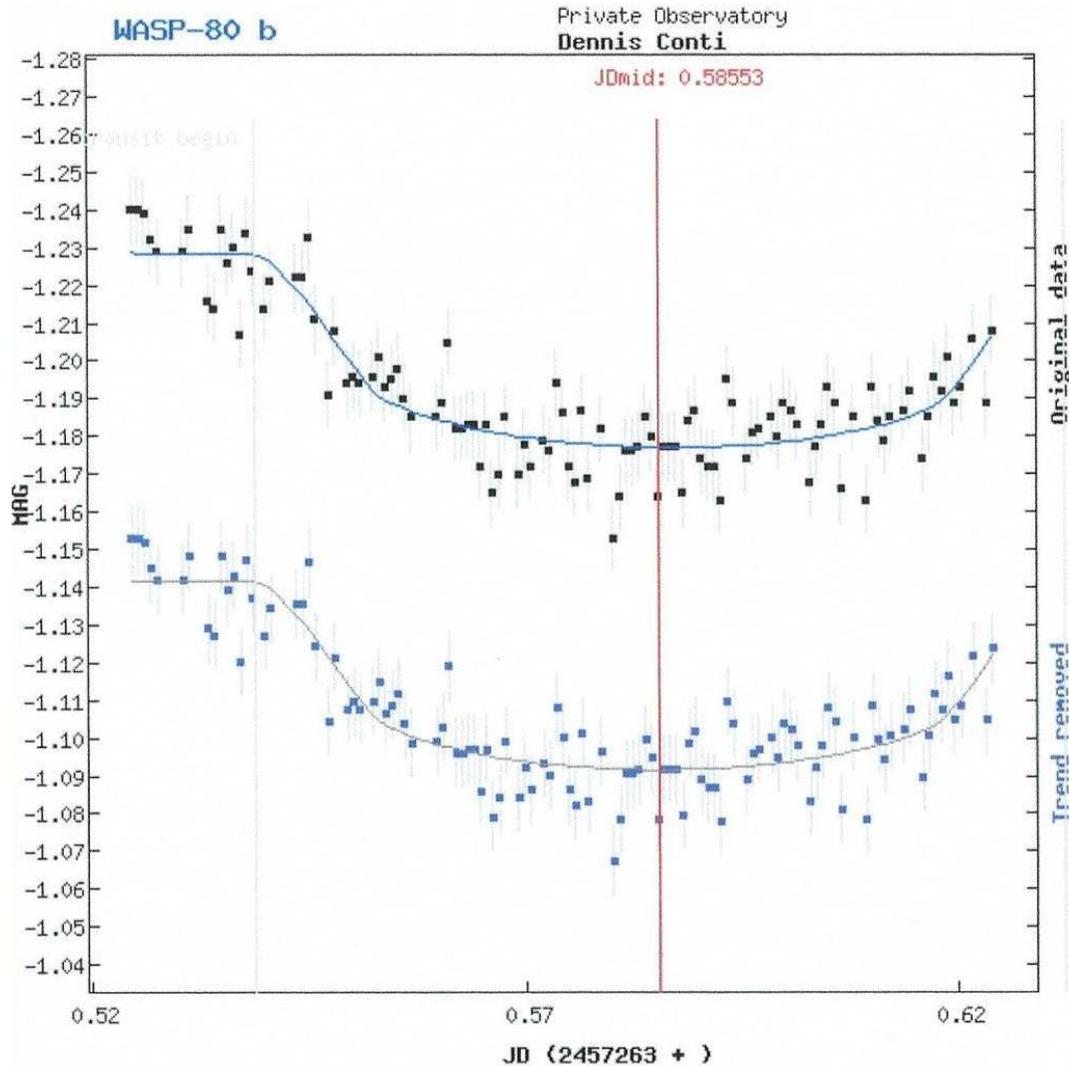
Tres-3b Light Curve



Qatar-1b Light Curve



Wasp-80b Light Curve



Note:
Images were taken
within 25° of a
full moon!

Approach

- Amateur astronomers will develop light curves in the visible spectrum for the same planetary transits that Hubble will be measuring in the near-infrared
- The goal is to make such observations at the same time as, or as close in time as possible to, each of Hubble's observations
- Standard differential photometry techniques will be used
- Ground-based observation sites are needed world-wide to match Hubble's observation windows
- Simultaneous ground-based observations are desired in order to eliminate local instrumental effects or weather constraints on observing times

Challenges

- The ability to conduct such a collaboration that provides meaningful “science” to the HST team with consideration for the varying complement of amateur instrumentation, locations, and experience
- Requires that a Standard Methodology be developed so that participating observers will use common and well-established techniques to:
 - image,
 - calibrate,
 - conduct photometric measurements,
 - and create accurate light curves.

Status

- A Standard Methodology document is in final review by the Hubble science team
- In addition to comments from participating amateur astronomers, acknowledgement is given to the following other sources:
 - The Handbook of Astronomical Image Processing, Second Edition, Richard Berry and James Burnell
 - Exoplanet Observing for Amateurs, Second Edition, Bruce Gary
 - AAVSO publications: Guide to CCD Photometry, CCD Observing Manual, DSLR Observing Manual
- Optimal ground-based locations have been determined to match Hubble's potential observation windows
- A world-wide network of amateur astronomers is being established and is well underway
- Most participating amateur astronomers already have exoplanet or variable star observing experience
- Access is also available to robotic telescope sites in New Mexico, California, Spain, and Australia

Location (To-Date) of Participating Observation Sites



Other amateur astronomers are encouraged to participate!