The Role of Amateur Astronomers in Exoplanet Research

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Overview

• What roles do amateur astronomers play in exoplanet research?

• How do we do exoplanet observations?

• What does the future hold?

(See paper in the SAS Proceedings for details on background, best practices, techniques, etc.)
Q: Which stars host one or more planets?

A: Most of them!
Roles of Amateur Astronomers

1. Confirm Exoplanet Candidates

2. Refine Exoplanet Ephemeris

3. Discover New!

4. Help characterize other “Exo-Objects”
Exoplanet Detection Methods

- **Transit Method:**
  - the dominant method used by amateur astronomers

- **Radial Velocity Method**

- **Microlensing**

- **Direct Imaging**
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Examples of Pro/Am Collaborations

- KELT Follow-up Network
- Hubble Near-Infrared Study of 15 Exoplanet Atmospheres
- Study of WD1145+017
Sample Observations
WASP-12b on UT2016-01-06

Conti (V, 45 sec)

- rel_flux_T1 (normalized)
- rel_flux_T1 (AIRMASS detrended with transit fit) (RMS=0.00397) (normalized)
- rel_flux_T1 Transit Model (P=1.09, (R_p/R_*)^2=0.0127, a/R_*=3.2, i=90.0, T_c=2457393.601228, [u1=0.39], [u2=0.3])
- rel_flux_T1 Residuals (RMS=0.00397) (chi^2/dof=2.09)
- rel_flux_C2 (AIRMASS detrended) (RMS=0.00366) (normalized) x(0.5) (bin size = 2)
- rel_flux_C3 (AIRMASS detrended) (RMS=0.00343) (normalized) x(0.5) (bin size = 2)
- rel_flux_C4 (AIRMASS detrended) (RMS=0.00428) (normalized) x(0.5) (bin size = 2)
- AIRMASS (arbitrarily scaled and shifted)
- tot_C_cnts (arbitrarily scaled and shifted)
WD-1145+017 Observations

3/30  4/6  4/12  4/15  4/17

Courtesy of Mario Motta
Observational Considerations

• Use virtually the same equipment as for deep sky imaging

However:

• Need accurate timing

• Want minimal image movement on the CCD detector

• Need to stay within the linearity of the CCD detector

• Need FWHM to span multiple pixels
Summary

• Amateur astronomers are able to conduct exoplanet transit observations with amazing accuracy

• Their contribution to exoplanet research continues to be of value to professional astronomers

• The need for such observations in the near future will continue to grow

• Amateur astronomers’ contribution to exoplanet research beyond just the transit method is promising
Resources

- www.aavso.org/exoplanet-section
- www.astrodennis.com
  - “A Practical Guide to Exoplanet Observing”
  - Worksheets
  - Other presentations, tutorials