

Advances in Exoplanet Observing by Amateur Astronomers

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Advances in the Last 12 Months

- Amateur astronomer participation in key pro/am collaborations
- Evolution of best practices and exoplanet modeling software
- Increasing involvement of educational institutions in exoplanet observing
- Testing by amateur astronomers of techniques to overcome barriers to direct exoplanet imaging
- Major progress toward an AAVSO Exoplanet Database

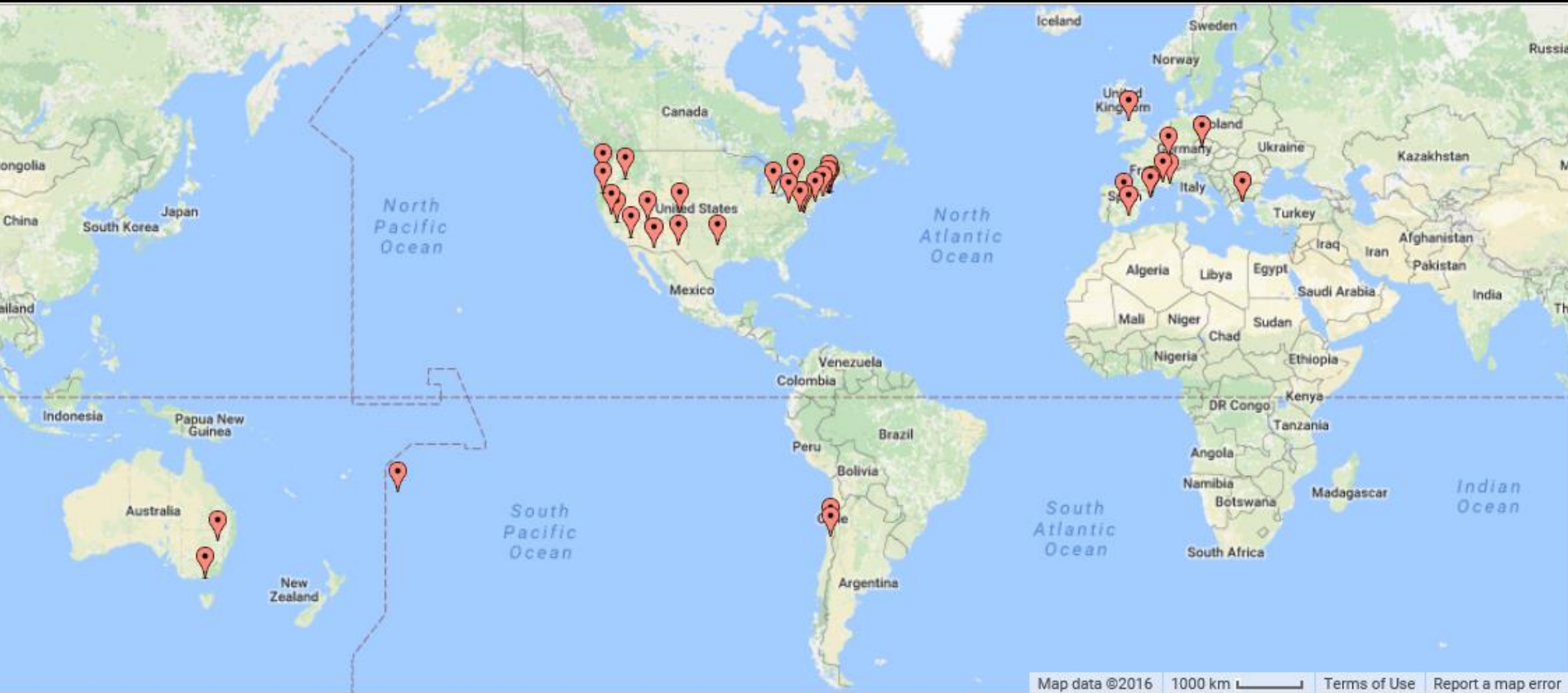
Pro/Am Collaborations in 2016

- Confirm new exoplanets – the KELT Follow-Up Network
- Refine information about known exoplanets – the Hubble collaboration
- Help characterize disintegrating planetesimals –
WD1145+017

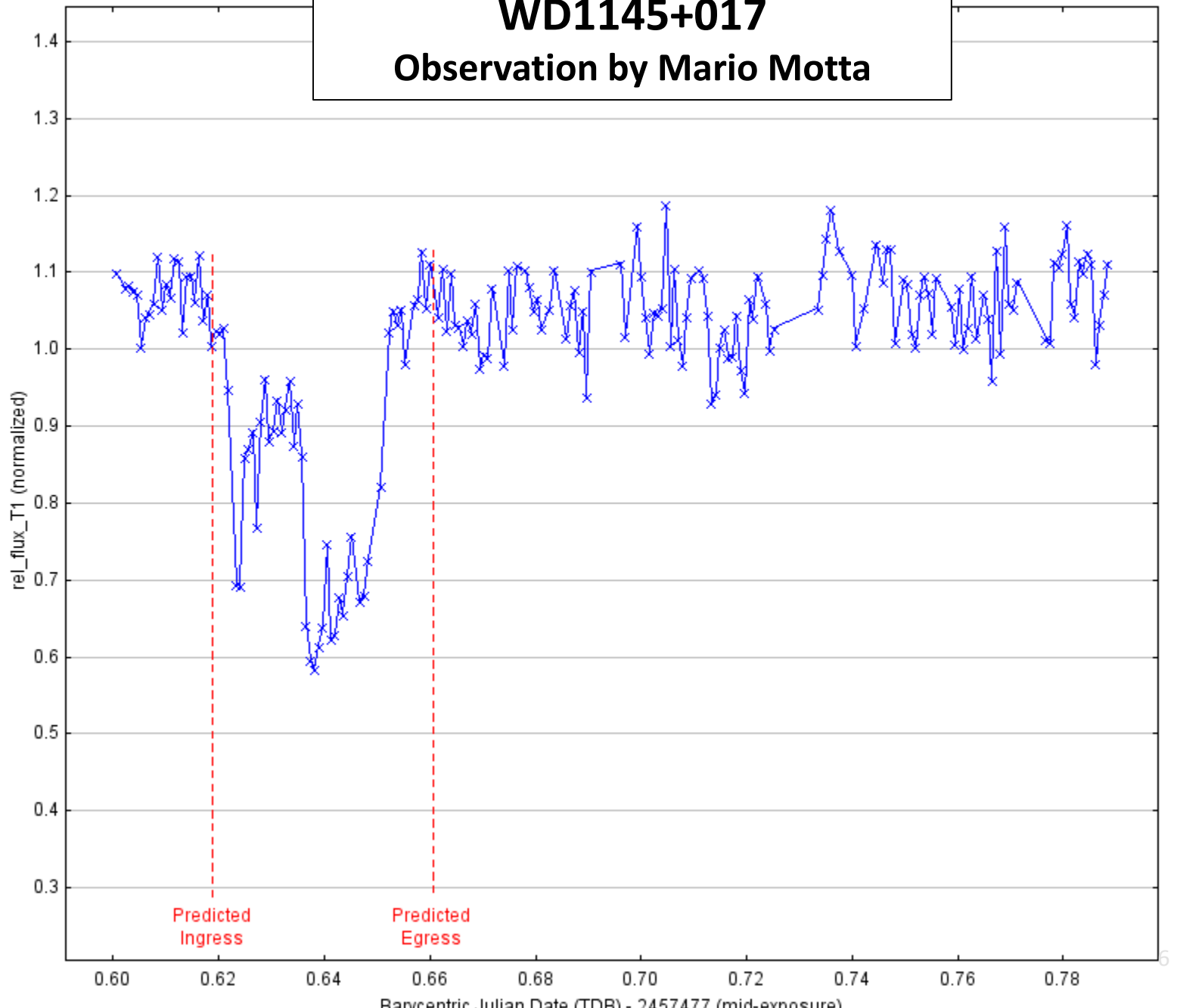
The Hubble Collaboration

- Purpose of the Hubble program: “...define the degree to which clouds occur in exoplanetary atmospheres...”
- During 2016, 15 exoplanets to be observed in the near infrared, for a total of 23 visits (some targets visited multiple times)
- Role of amateurs: conduct exoplanet transit observations in the optical band to help refine the ephemeris of the 15 targets
- Status:
 - 21 out of 23 Hubble visits completed
 - 60 high-quality, full transit observations completed by amateur astronomers

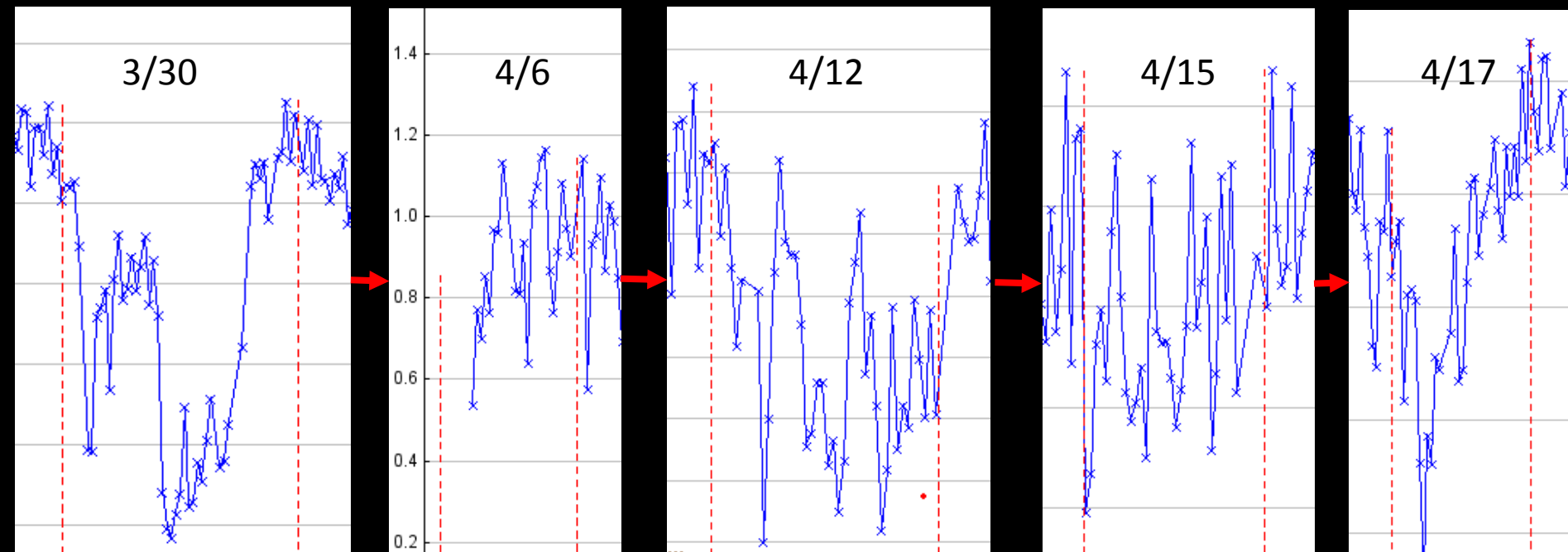
Hubble Collaboration World-Wide Network of Observers



A Disintegrating Planetesimal: WD1145+017 Observation by Mario Motta



WD1145+017 Observations



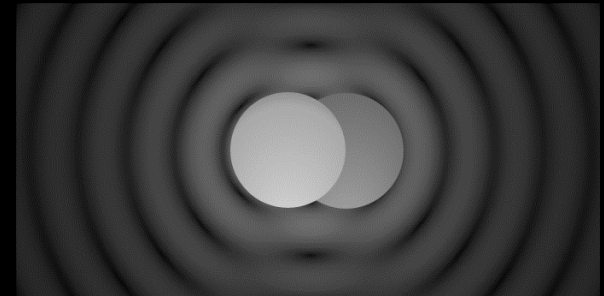
Courtesy of Mario Motta

Evolution of Best Practices and Supporting Software

- Development of a step-by-step “Practical Guide to Exoplanet Observing” - <http://astrodennis.com>
- General acceptance of AstrolmageJ as de-facto standard for exoplanet transit analysis (all-in-one software: from calibration to exoplanet modeling)
- Training in exoplanet observing provided to educational institutions and amateur astronomy clubs

Barriers to Direct Exoplanet Imaging

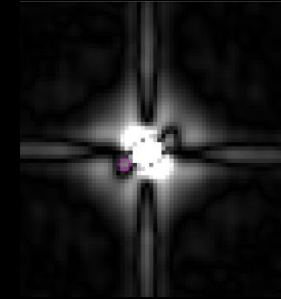
- Seeing limitations:
due to atmospheric turbulence
- Diffraction limitations:
due to overlapping Airy disk patterns
- Differential magnitude limitations:
due to extreme difference in magnitudes between host star and exoplanet



By Spencer Bliven - Own work, Public Domain,
<https://commons.wikimedia.org/w/index.php?curid=31456019>

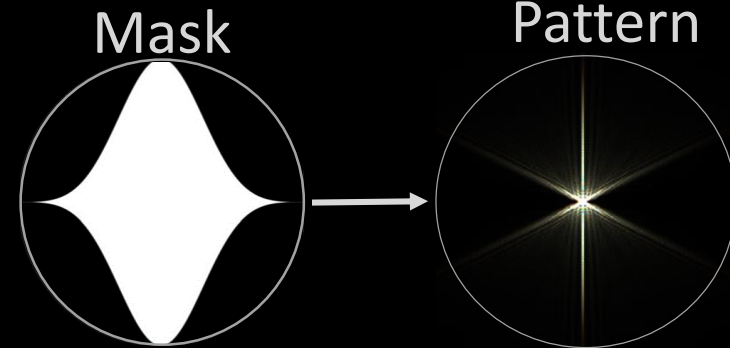
Possible Solutions Being Tested

- Seeing limitations:
 - speckle interferometry

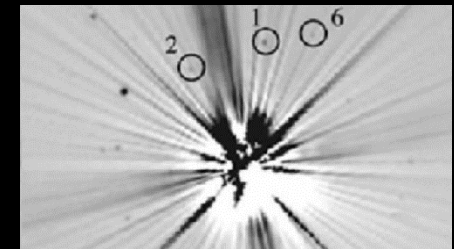


Diffraction
Pattern

- Diffraction limitations:
 - shaped aperture masks



- Differential magnitude limitations:
 - infrared cameras
 - charge injection devices



Development of an AAVSO Exoplanet Database

- Goal:
 - develop a (relational) database for exoplanet observations that can be accessed by the professional community
- Objectives:
 - support a variety of existing and new exoplanet properties (e.g., multi-planetary systems, circumbinary systems, other exo-objects)
 - allow use of AAVSO's Light Curve Generator
- Status:
 - database design complete
 - reviewed by Joey Rodriguez of TESS follow-up team
 - beta version near completion

Summary

- The need for follow-up observations by amateur astronomers will continue to grow with upcoming space-based surveys (TESS, JWST)
- Amateur astronomers will continue to explore techniques for direct exoplanet imaging/detection
- The AAVSO Exoplanet Database should prove to be a valuable resource for the professional community
- Exoplanet observing appears now to have entered the mainstream of amateur astronomy!