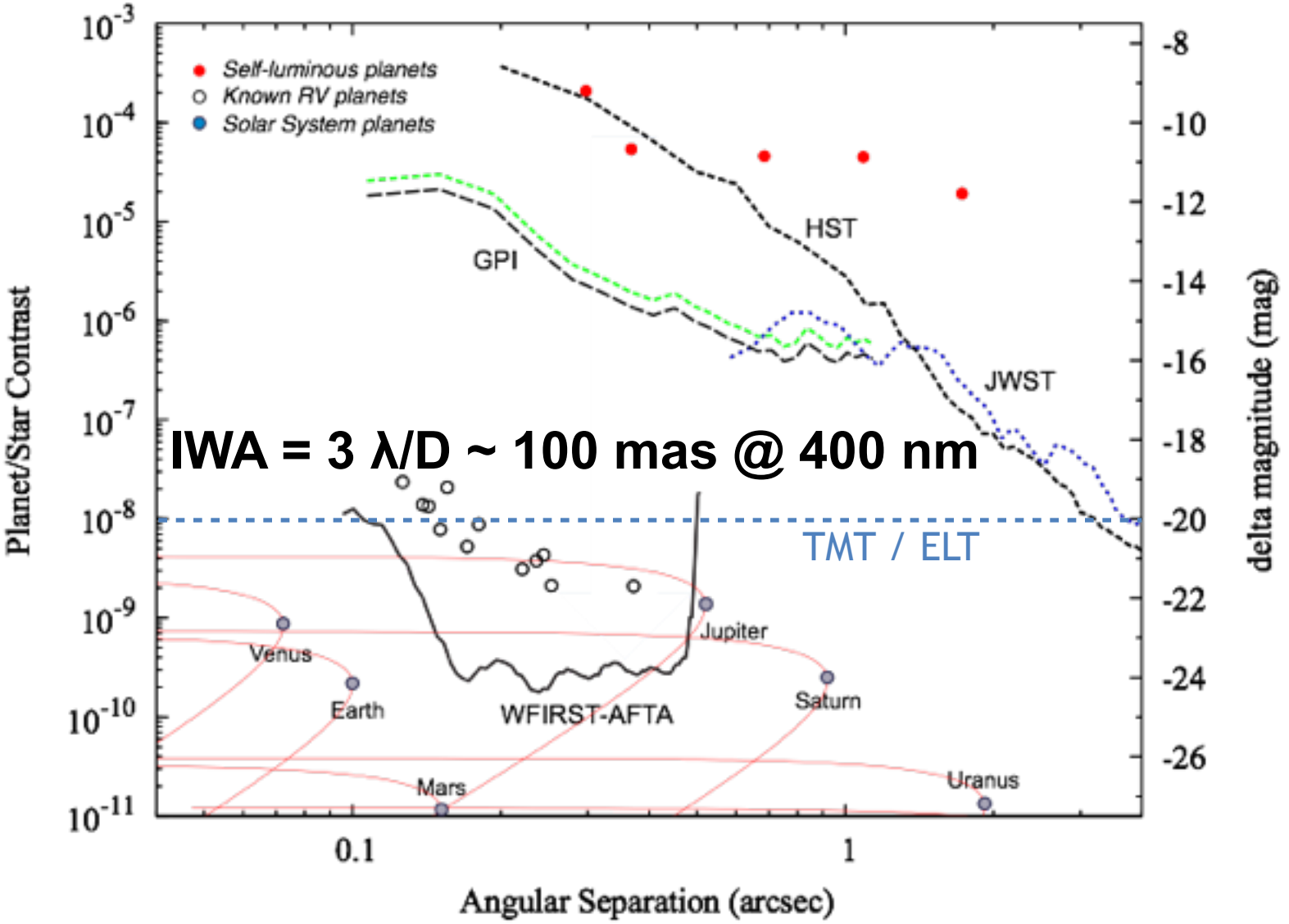
EXOPLANETS SPLINTER SESSION: PERFORMANCE & SCIENCE PREPARATION

Tuesday Nov 18, 2014

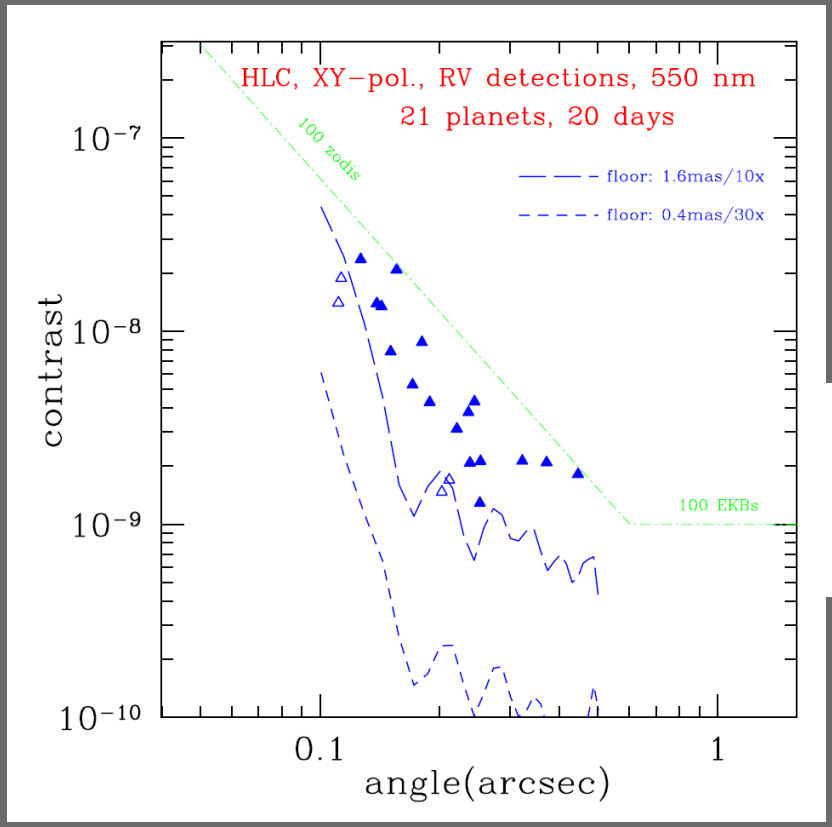
Rapporteurs: Aki Roberge (NASA GSFC) & Matthew Penny (Ohio State)

Speaker	Title
Neil Zimmerman	Opportunities and Challenges with Coronagraphy on WFIRST/AFTA
Mike McElwain	The Promises and Challenges of Multiplex Spectroscopy for Exoplanet Science
Ilya Poberezhskiy	WFIRST Coronagraph Technology Development: Recent Testbed Results and Plan to TRL5
Doug Lisman	Mission, Telescope and Starshade Requirements for L2 Operation
Tiffany Glassman	Demonstration of Starshade Technologies
Avi Shporer	Exoplanet synergies between WFIRST and Gaia
Jennifer Yee	Precursor Science for WFIRST's Microlensing Program
Dave Bennett	The Promise of High Precision Photometry and Astrometry for Microlensing from Space
Aparna Bhattacharya	Developing the WFIRST Exoplanet Mass Measurement Method with HST Observations
Calen Henderson	K2 and Spitzer: Paving the Way for Microlensing with WFIRST

Complement ground-based, 30-meter class observatories

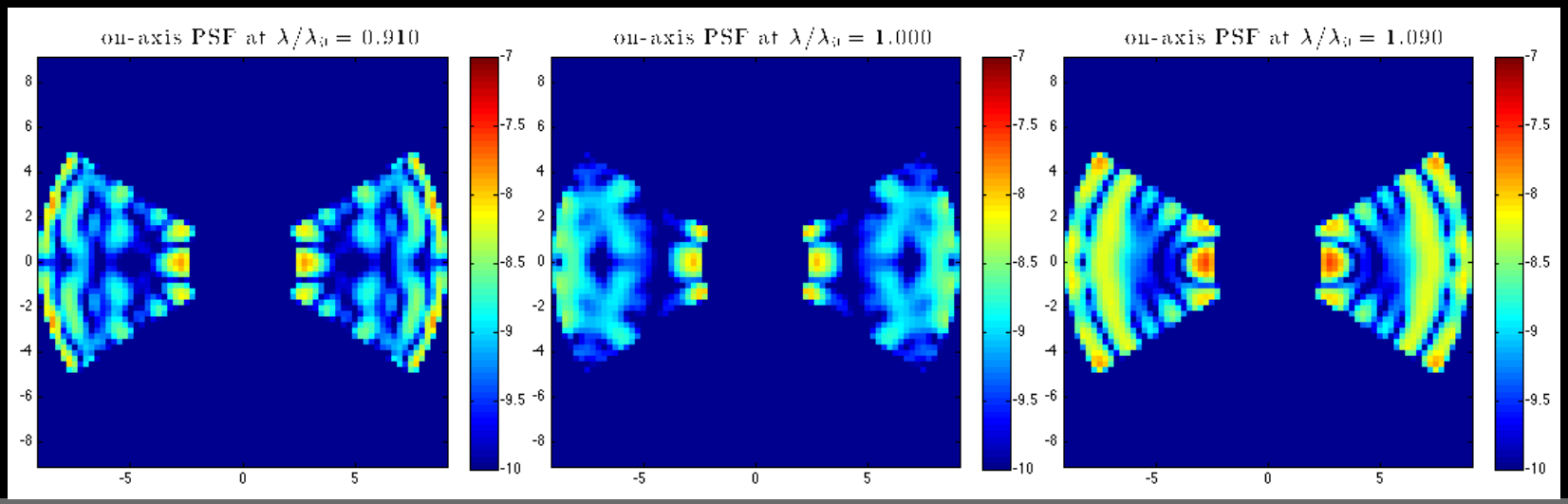


Zimmerman
WFIRST Coronagraphy Goals & Challenges



Science yield of Hybrid Lyot Coronagraph in broadband imaging mode

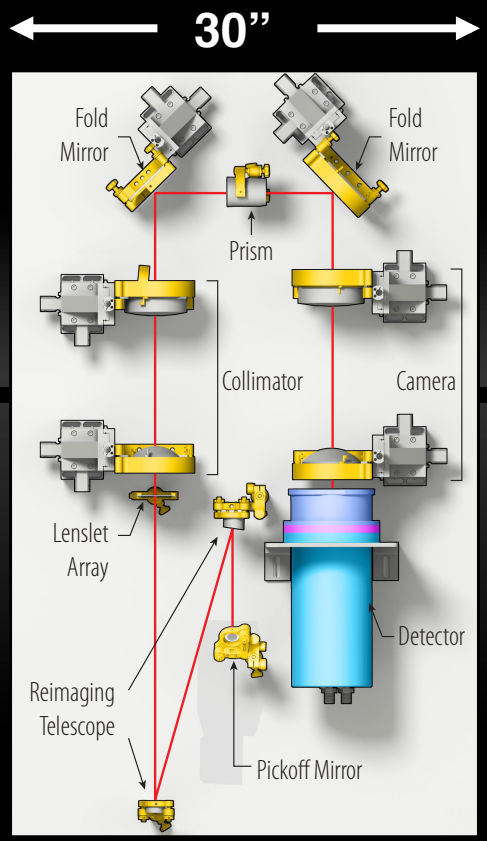
Shaped Pupil Contrast



McElwain

PISCES: IFS Demonstration at the HCIT

- Raise TRL of an exoplanet science camera for flight
- Advance TRL of the HCIT system
- Diagnostic tool for HCIT chromatic performance
- Improve WFS&C algorithms
- Flight-like data reduction & analysis
- Enable realistic post-processing demonstrations



High Contrast Lenslet-based IFS’s will be TRL 5 before FY18

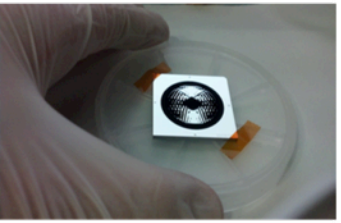
Coronagraph Mask and Testbed Status

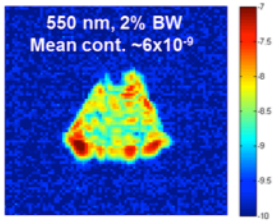
Poberezhskiy

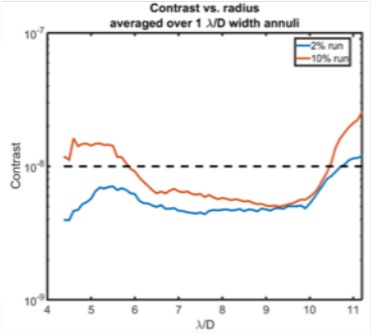
- **Maturing WFIRST coronagraph to TRL 5 by 9/30/2016**
- **Have demonstrated high contrast with AFTA pupil**
- **Early results are very promising for speckle stability in the dark hole and expected post-processing gain**

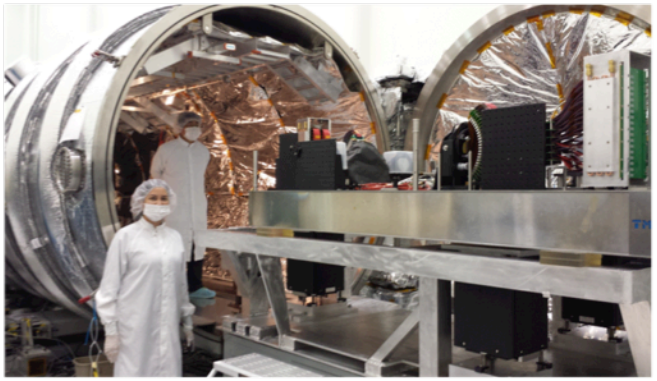
Reflective shaped pupil mask

- Black Si on Al mirror coating fabricated at JPL's MDL and Caltech's KNI – passed Tech. Milestone 1
- High contrast demonstrated in SPC testbed – passed Tech. Milestone 2



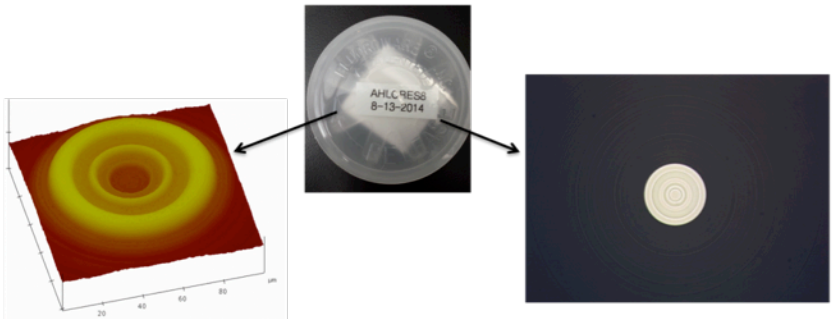






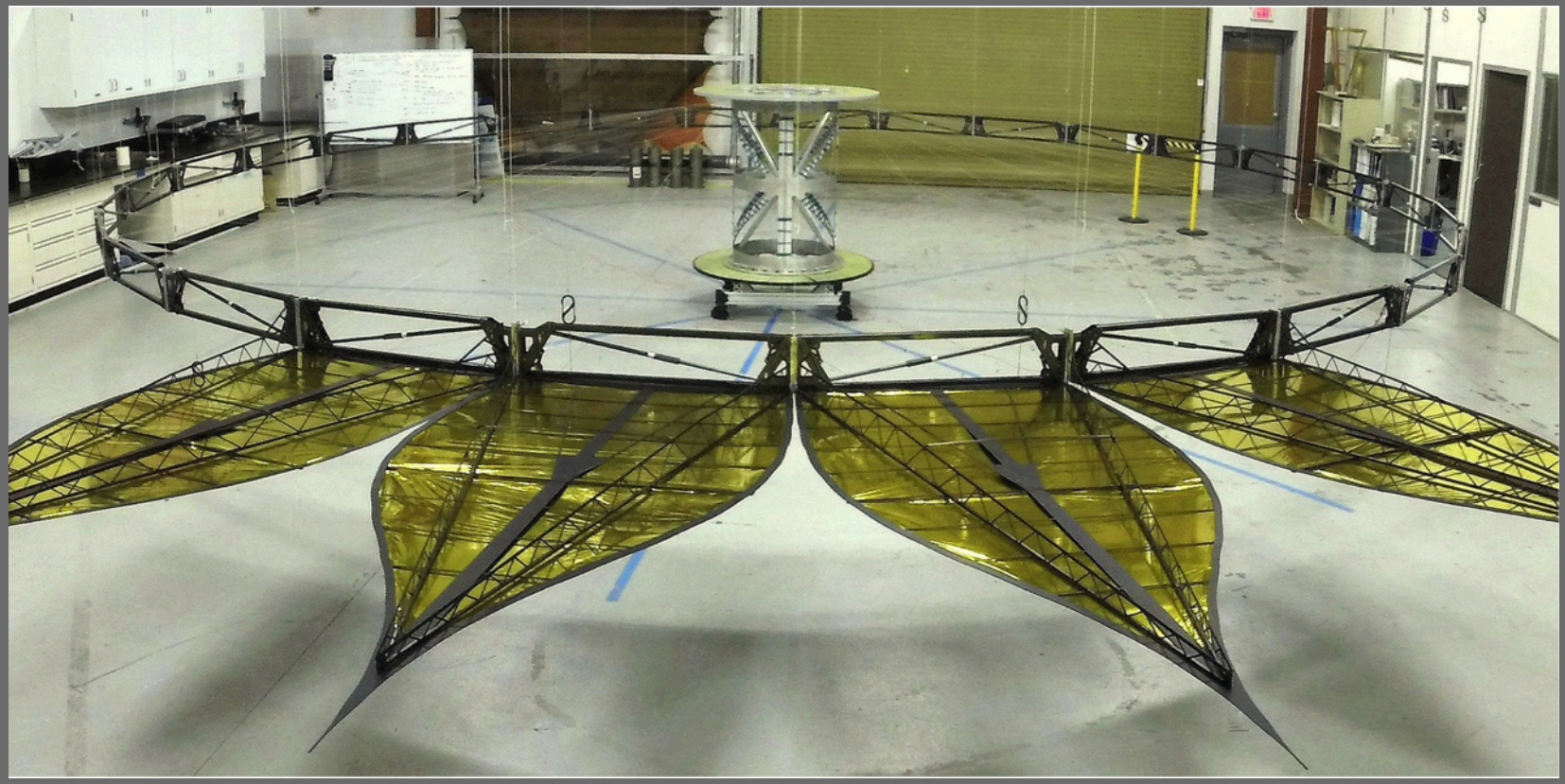
Transmissive hybrid Lyot mask

- Circular mask fabricated and characterized
- HLC testbed commissioned and performing nulling runs toward Tech. Milestone 4 due 2/28/2015



10m diameter inner disk and 3.5m long petals assembled by undergraduate students at JPL in summer of 2014

Lisman Starshade for WFIRST



Starshade-Ready Package	WFIRST
Out-of band guide camera for alignment	Coronagraph camera
IFS for science	Coronagraph IFS
Inter-spacecraft radio communication	Need to add

Field Testing 2014

Glassman
Starshade technology

NORTHROP GRUMMAN

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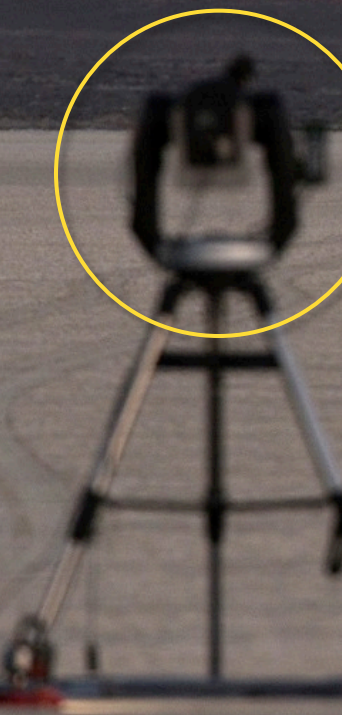

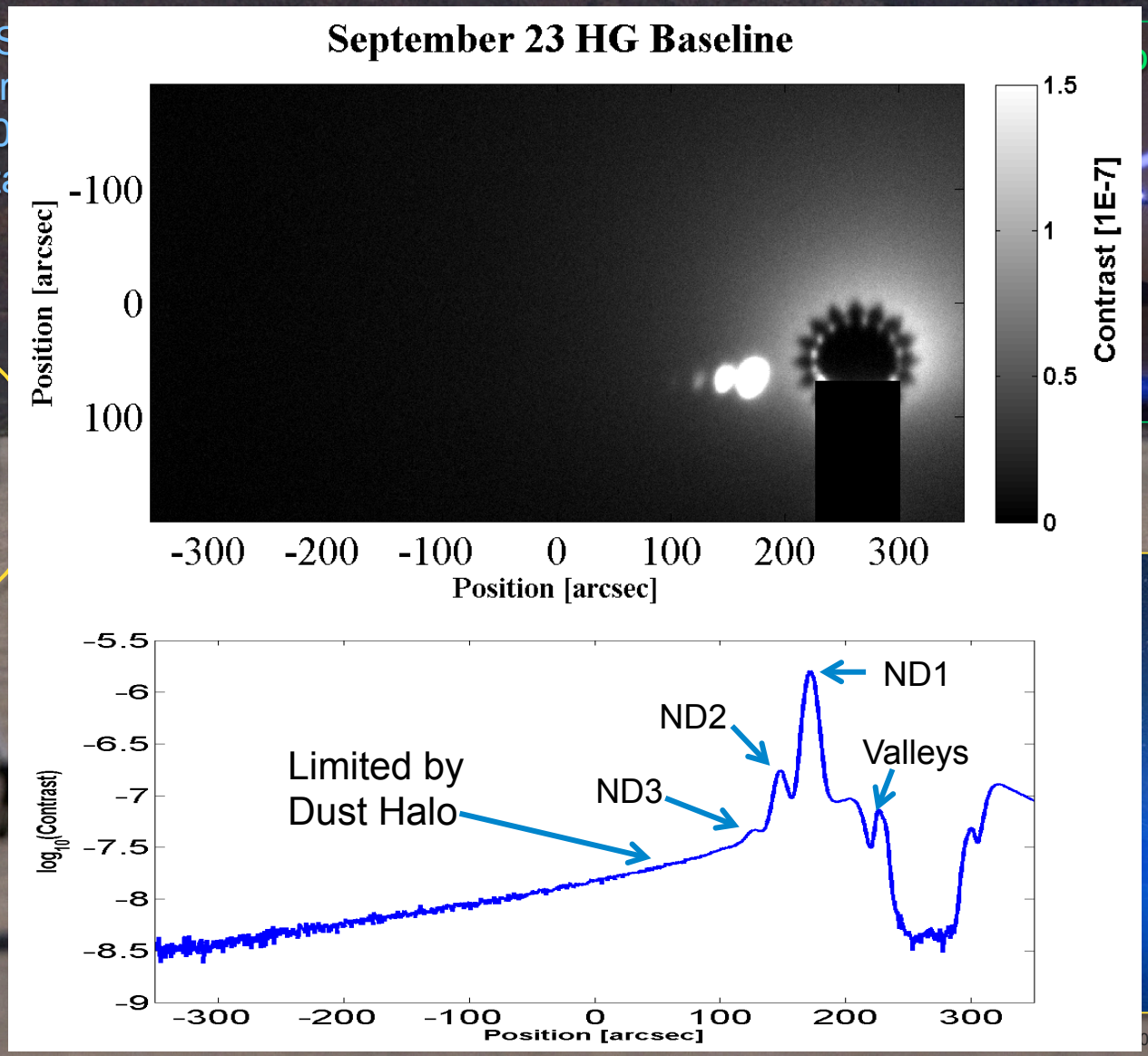

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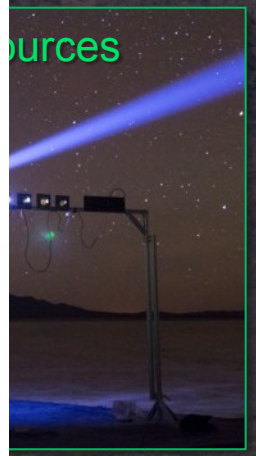
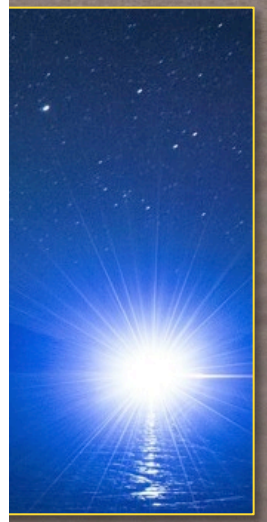
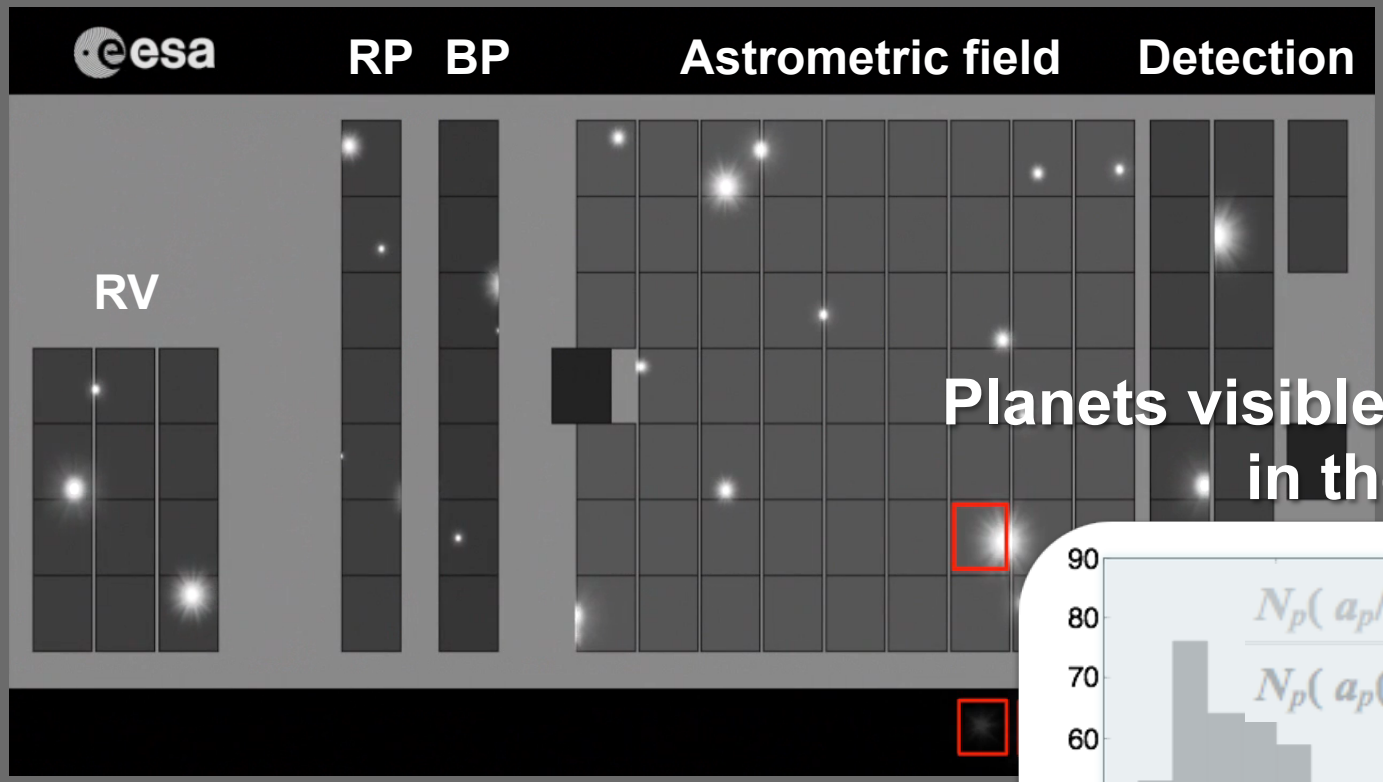
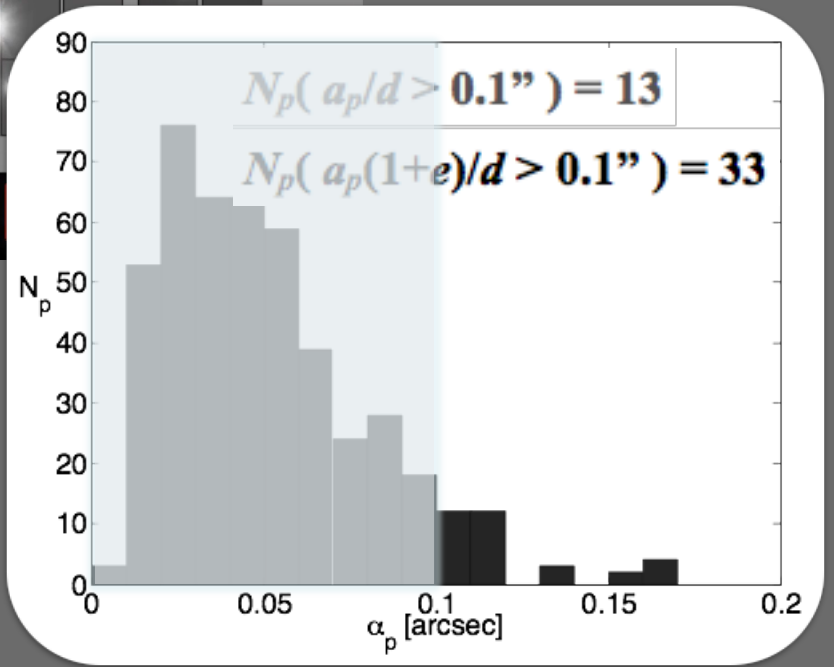






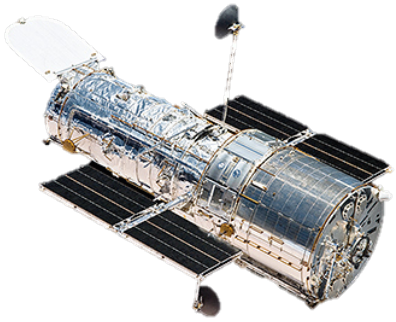
Planets visible to coronagraph in the blue



21,000 high-mass (1 – 15 M_J), long-period planets discovered

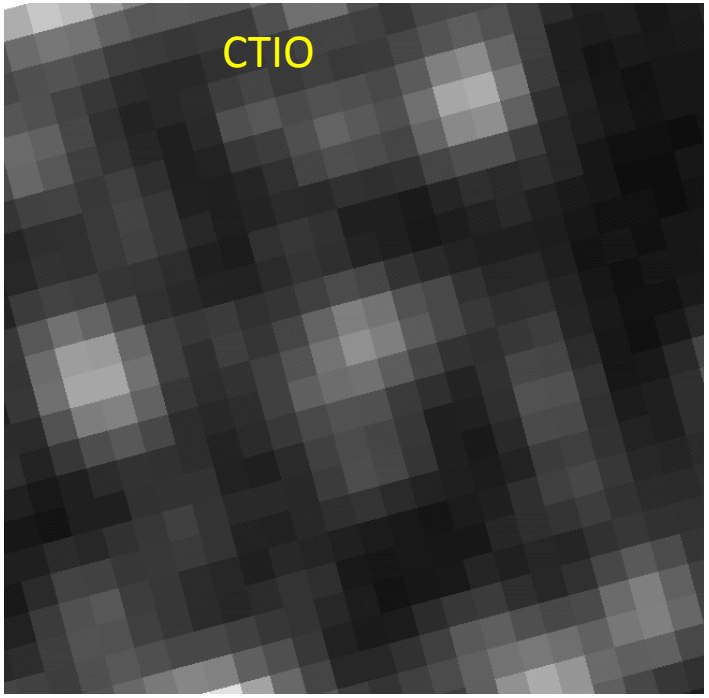
Gaia will provide inclinations for ~ all imageable RV planets

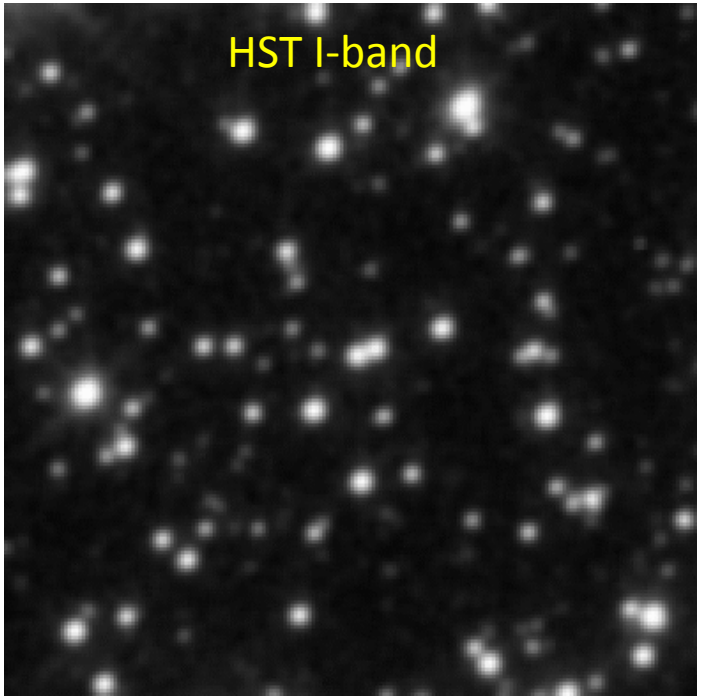
Yee: Precursor Science for *WFIRST*'s Microlensing Program

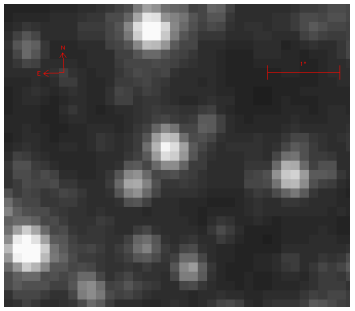


- Directly support WFIRST science and reduce its scientific risk:
  - –Early, optical, HST imaging of the WFIRST field
  - – A preparatory, ground-based, microlensing survey in the near-IR
- Develop techniques for measuring (planet) masses:
  - –Satellite parallax observations using Spitzer, Kepler, and TESS
  - –HST or AO flux measurements of lenses in ground-based microlensing events
  - –Measurements of microlens astrometry for black holes
  - – SAG 11 Report: arXiv:1409.2759

Bennett: WFIRST Exoplanet Mass Measurement Method







HST J-band

- Relies upon light curve data + high angular resolution imaging and astrometry

High precision photometry (~1 mmag) needed with overlapping images

Most stars are not completely blended, but the images overlap.

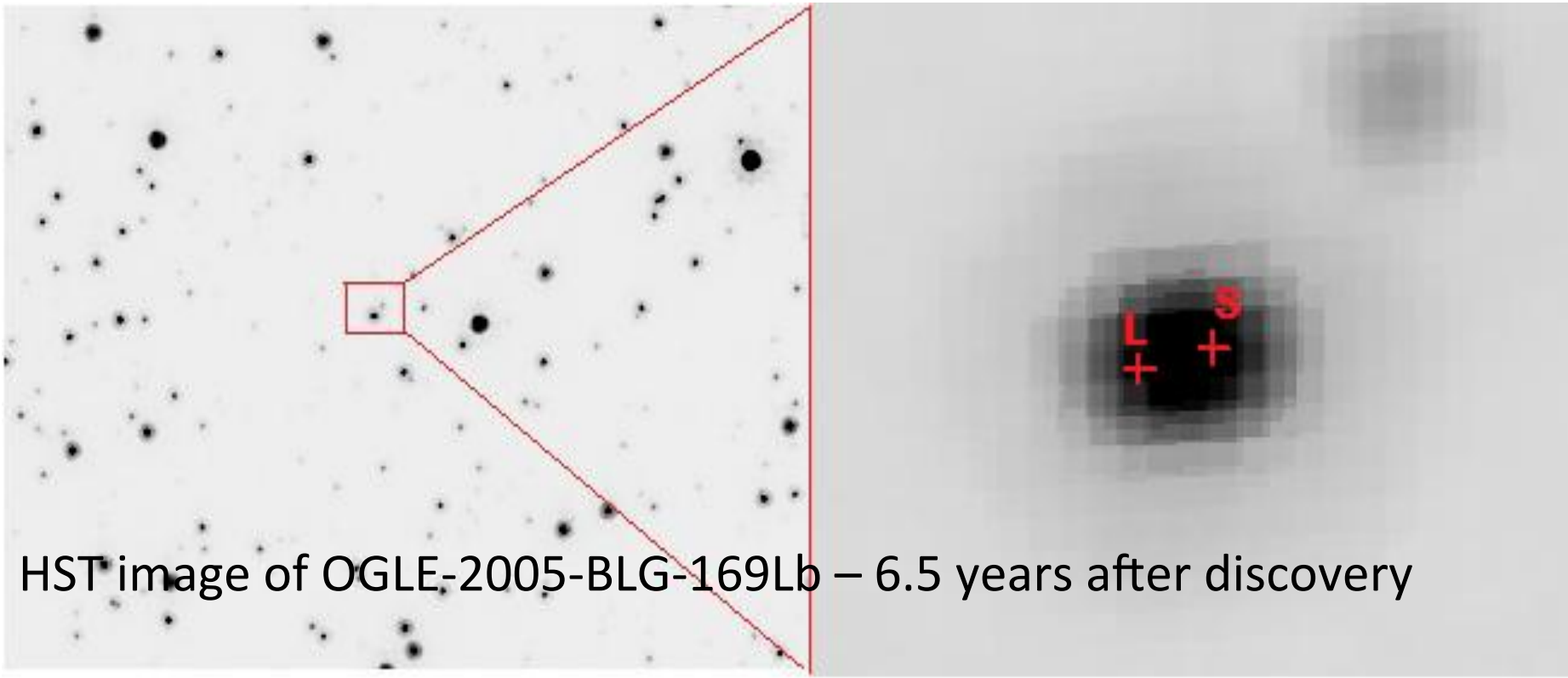
Proper motion of neighbors must be accounted for:

Precision photometry requires precision astrometry

Bhattacharya: Measured Lens-Source Relative Proper Motion to Measure Lens Mass+Distance

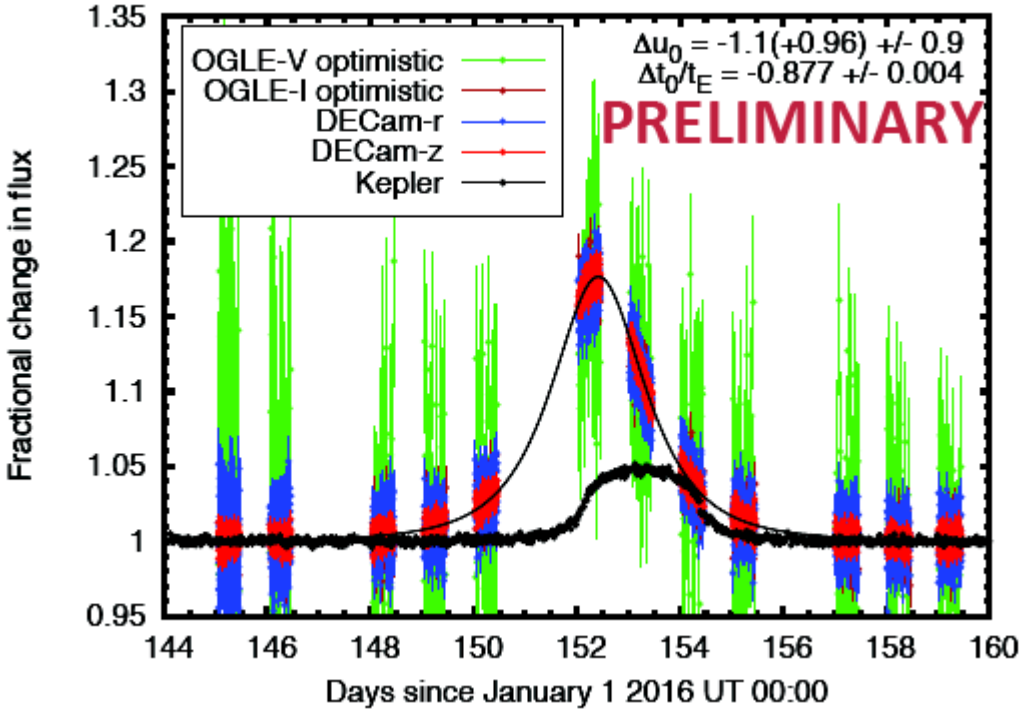
- M_{host}= 0.687 ± .021 M♦◆■
- M_{planet} = 14.1 ± 0.9 $M_{\oplus}$

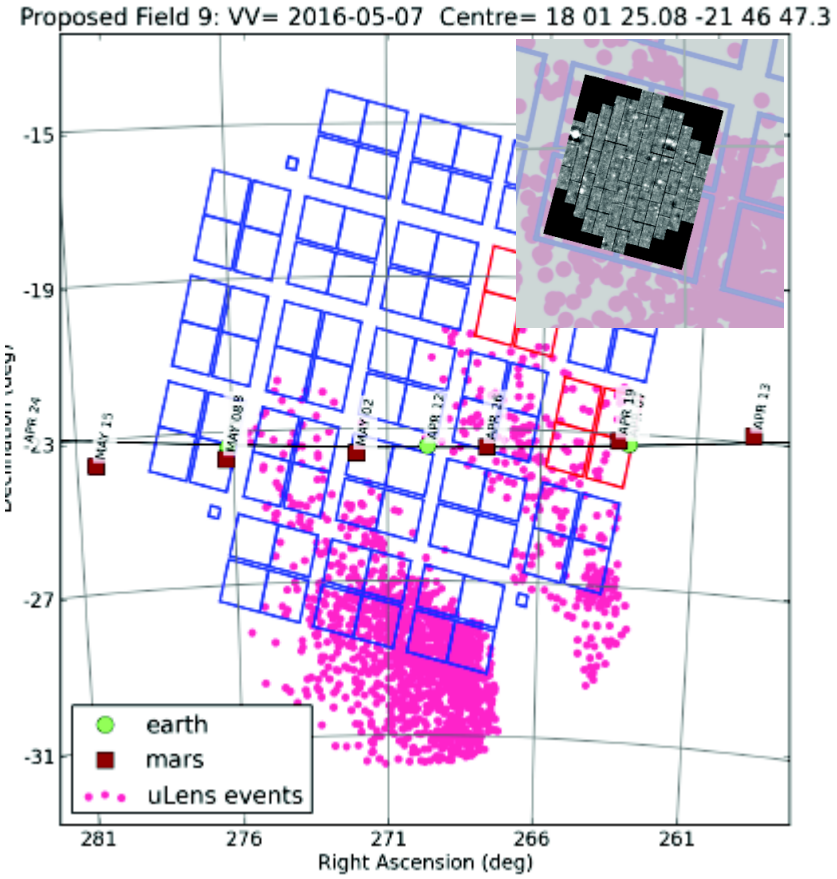
- D_L = 4.1 ± 0.4 kpc
- $a_{\perp}$= 3.5 ± 0.3 AU (projected separation)



HST image of OGLE-2005-BLG-169Lb – 6.5 years after discovery

Henderson: K2 + DECam microlensing parallax survey in 2016





- ~6 sq degree survey in 2016 (Campaign 9)
- Simulations estimate ~18 parallaxes for Jupiter-mass Free-Floating planets