Nancy Grace Roman Space Telescope:
Exoplanet-Planet Focused Investigations

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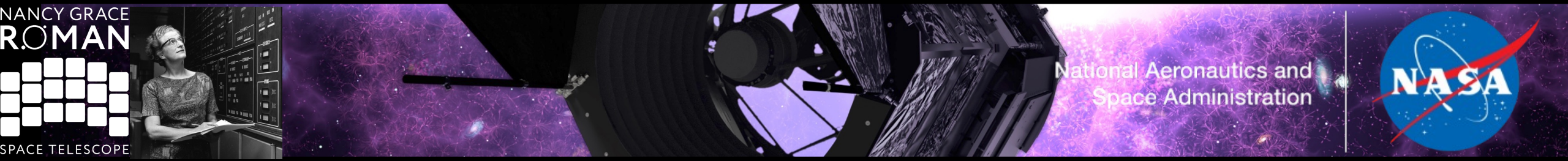
National Aeronautics and Space Administration

NASA

Nancy Grace Roman

- Served as NASA's first Chief of Astronomy throughout the 1960s and 1970s
- Known to many as the "Mother of Hubble" for her foundational role in planning the Hubble Space Telescope

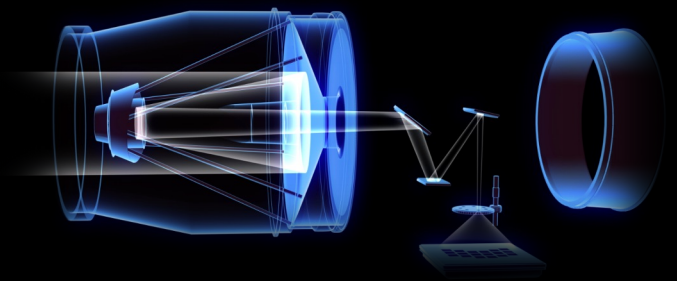


Summary of Roman Space Telescope Properties

Properties	Roman
Eff. Aperture	2.28m
FOV	0.281 deg^2
Wavelengths	~0.5-2 μm (WFI)
FWHM@1μm	0.10”
Pixel Size	0.11”
Launch/ Lifetime	202/5 years
Orbit	L2

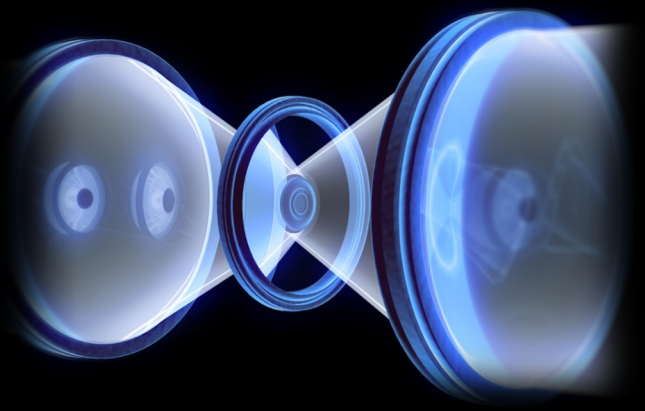
Wide-Field Instrument (WFI)

- ~0.5–2.0 micron bandpass
- 0.281 sq. deg. FoV (~100x HST ACS FoV)
- 18 H4RG detectors (288 Mpixels)
- 7 filter imaging, grism and prism spectroscopy



Coronagraph Instrument (CGI)

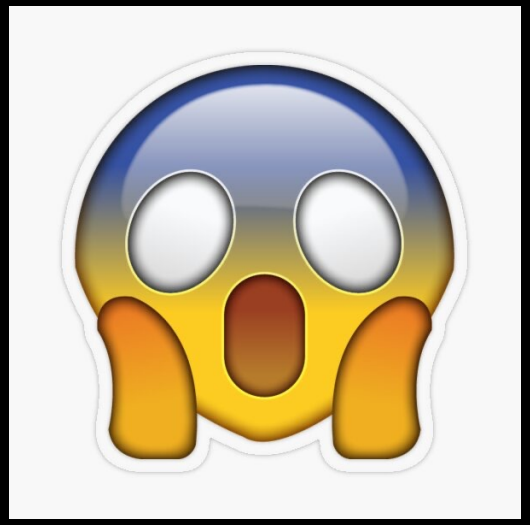
- Visible (545-865nm) high-contrast imager
- Polarimeter and spectrograph
- 3 types of coronagraph masks



Surveys and Observations

- HLS: Imaging & spectroscopy over 1000's sq deg
- SNe & μL: Repeated monitoring of smaller areas
- Coronagraph: tech demo observations

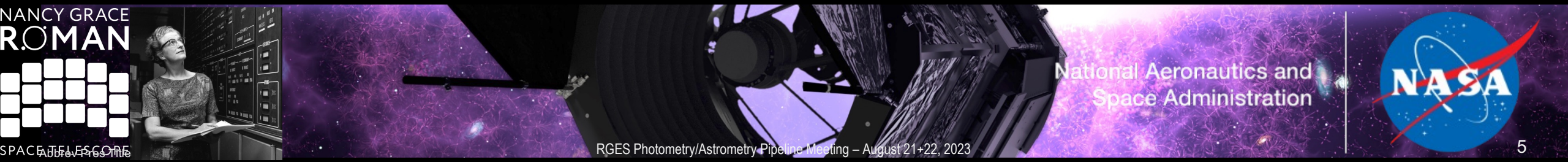
ON TRACK FOR AN OCTOBER 2026 LAUNCH DATE!



D.14 Nancy Grace Roman Space Telescope Research and Support Participation Opportunities

"This program element solicits proposals to work on preparation for the operational phase of the Nancy Grace Roman Space Telescope, using one of three categories depending on the type of work being proposed."

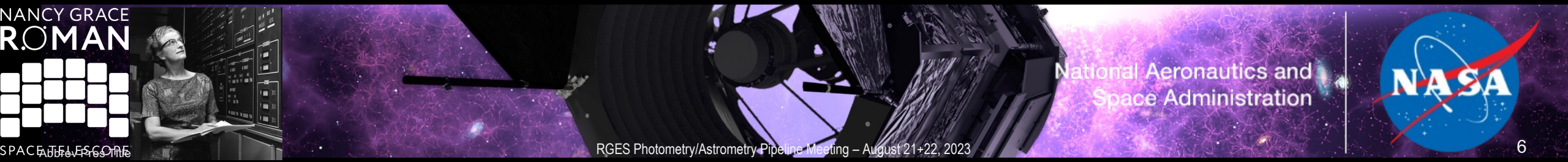
- Wide Field Science (WFS)
  - "Supports investigations that prepare for and/or enhance the science return of Roman that can be addressed with its WFI"
- WFI Project Infrastructure Teams (PIT)
  - "Sustained funding for teams to work in partnership with the Science Centers to develop scientific infrastructure needed to enable the community to pursue Roman's ambitious science goals."
- Coronagraph Community Participation Program (CPP)
  - "Solicits individuals or very small teams to work with the Coronagraph Instrument team to plan and execute its technology demonstration observations… will join to form the single team that plans and executes Coronagraph Instrument technology demonstration observations."



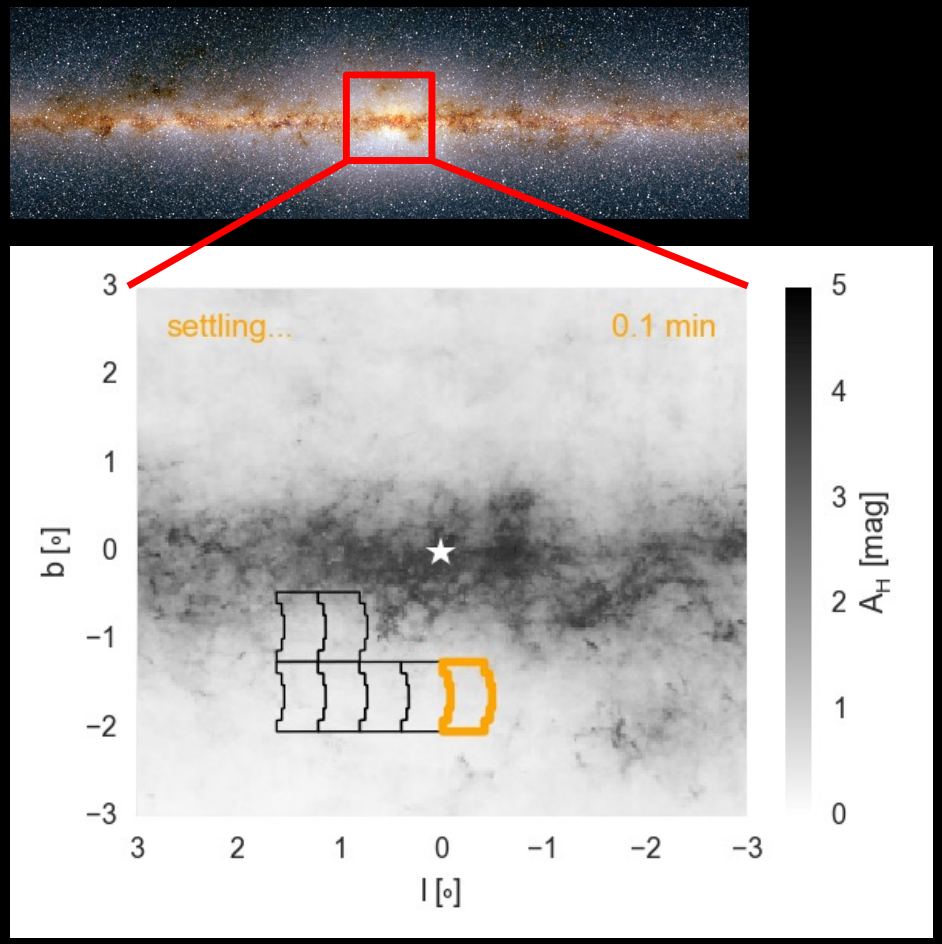
Selected proposals

30 proposals selected (5 PIT, 18 WFI, 7 CPP)

- Two exoplanet/related PIT proposals
  - Roman Galactic Exoplanet Survey (RGES) PIT – Scott Gaudi PI
  - RAPID: Roman Alerts Promptly from Image Differencing - Mansi Kasliwal PI
- Two exoplanet/related WFI proposals
  - Rubin Increases the Power of Roman - Rosanne Di Stefano PI
  - Laying the Foundation for a Comprehensive View of Transiting Exoplanets with GBTDS - Elisa Quintana PI
- 7 CPP proposals



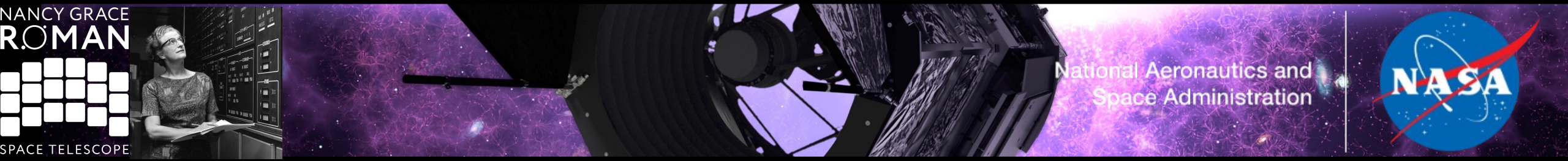
Notional* Parameters for the Roman Galactic Bulge Time Domain Survey

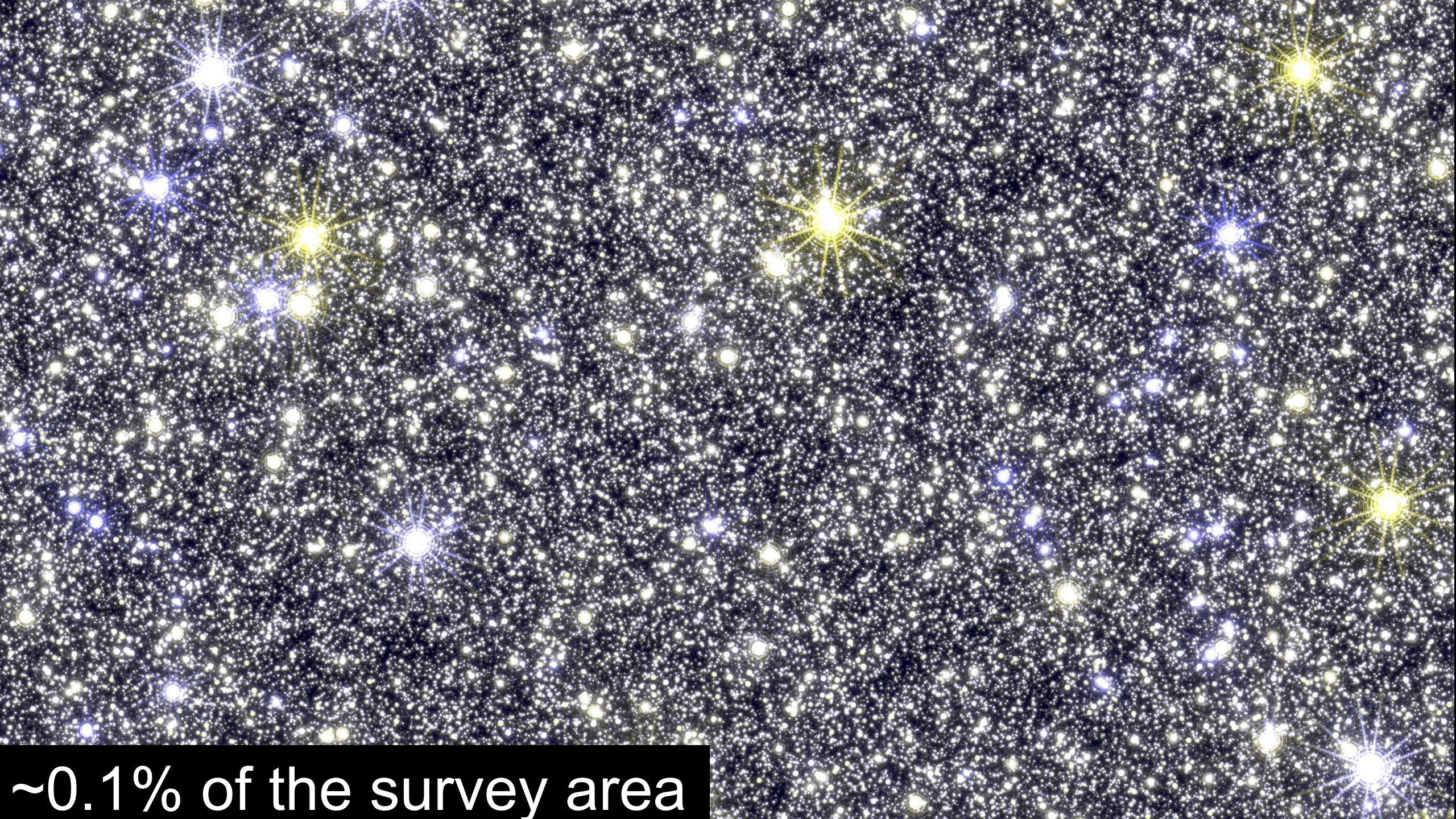


- 7 fields for a total of ~2 deg2
- Wide F146AB (0.93-2 μm) filter**.
- 15-minute cadence.
- ~50s exposures.
- Observations every at 6 hours in alternating filters (e.g., F087,F219), 2 x 450 total obs.
- 6 x 72-day seasons.
- ~41,000 exposures in W149AB.
- ~432 total days spread over 5-year mission.

*Notional survey strategy, actual strategy to be determined based on broad community input.

**One photon per second for F146AB ~27.6




~0.1% of the survey area

Statistical Power of the RGBTDS

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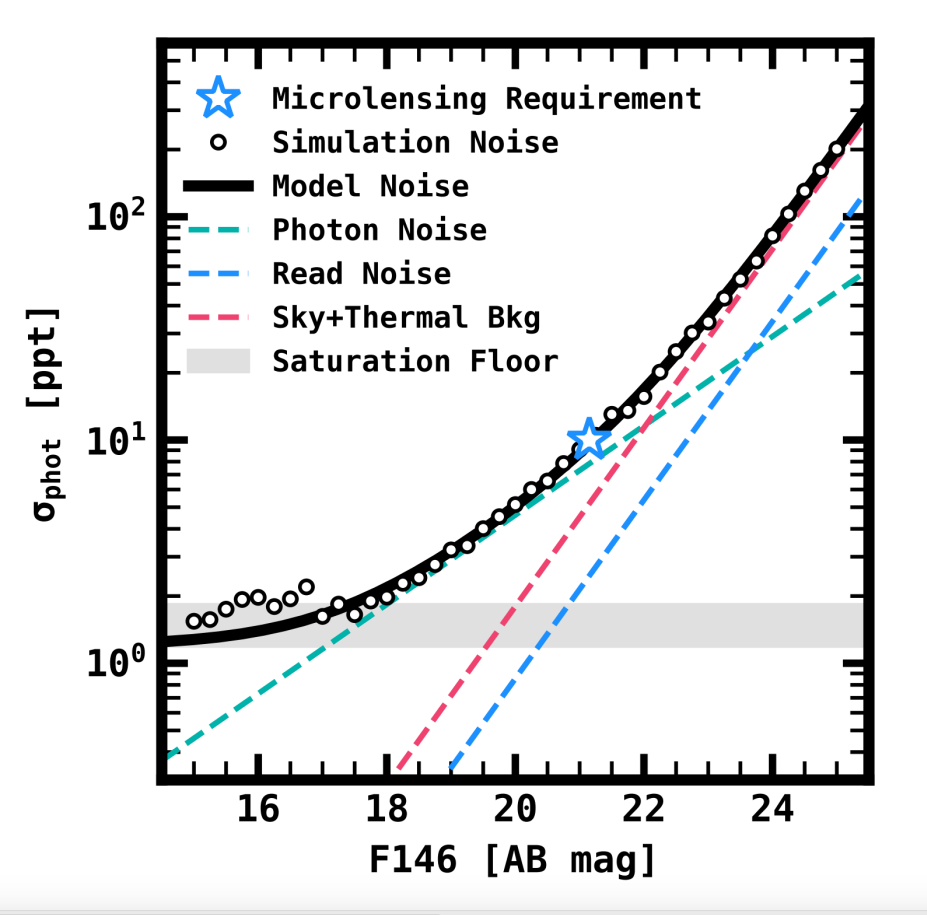
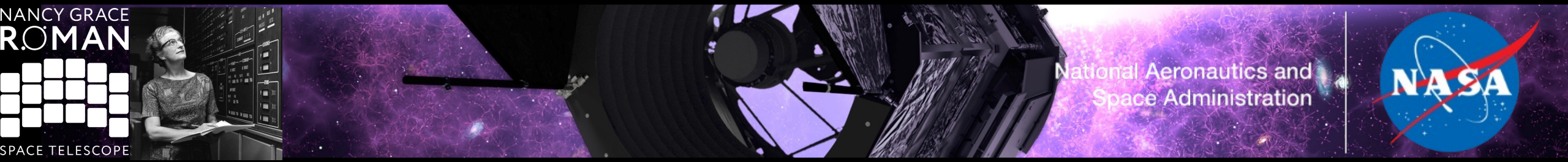
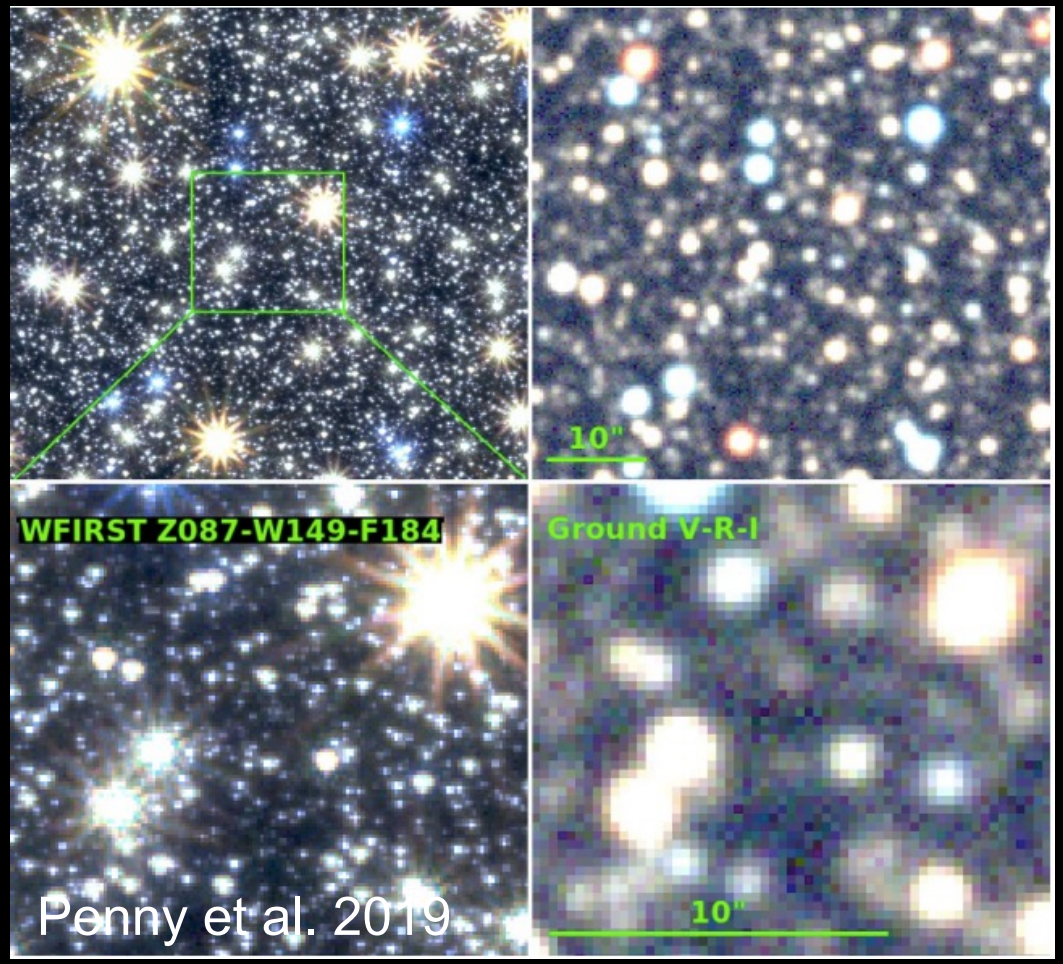


For a F146AB~21.15 star:

- Photometric precision of σ~0.01 mag per exposure.
- Astrometric precision of ~1mas mag per exposure
- Total of ~109 photons over the survey.
- Saturation @ F146AB ~14.8.
- Root N: $\sqrt[2]{41{,}000} \sim 200$.

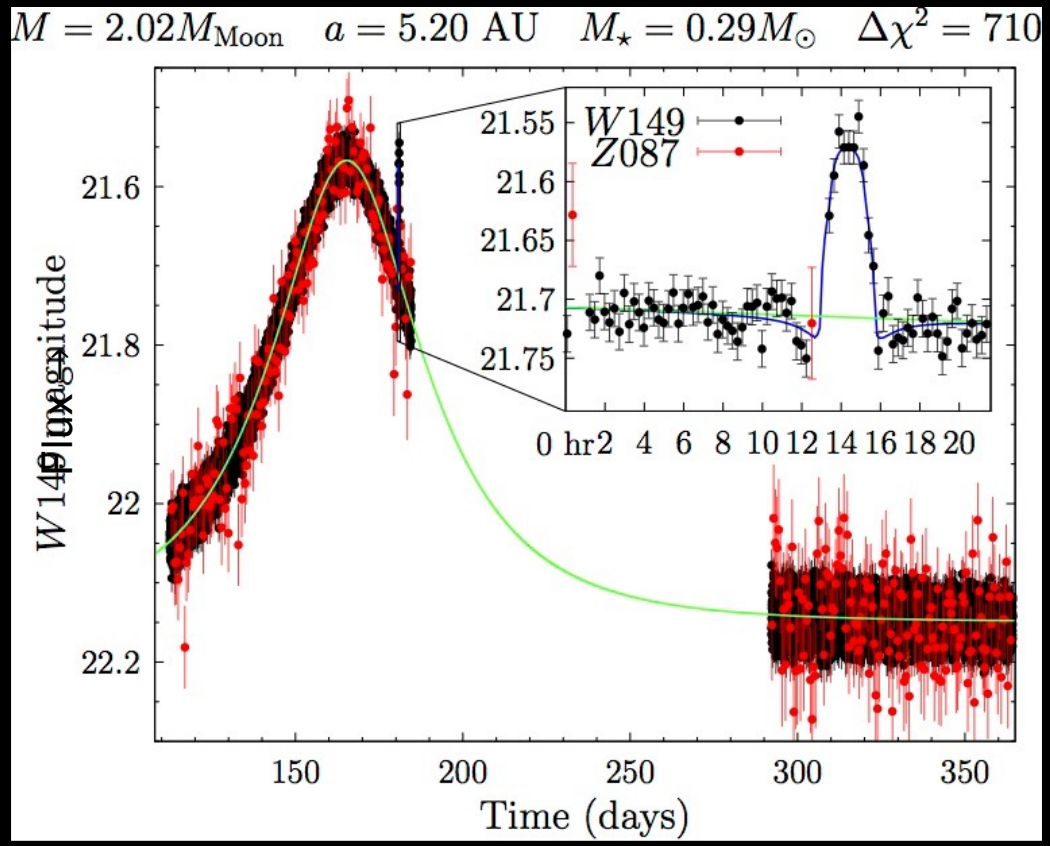


Number of Sources and Microlensing Events

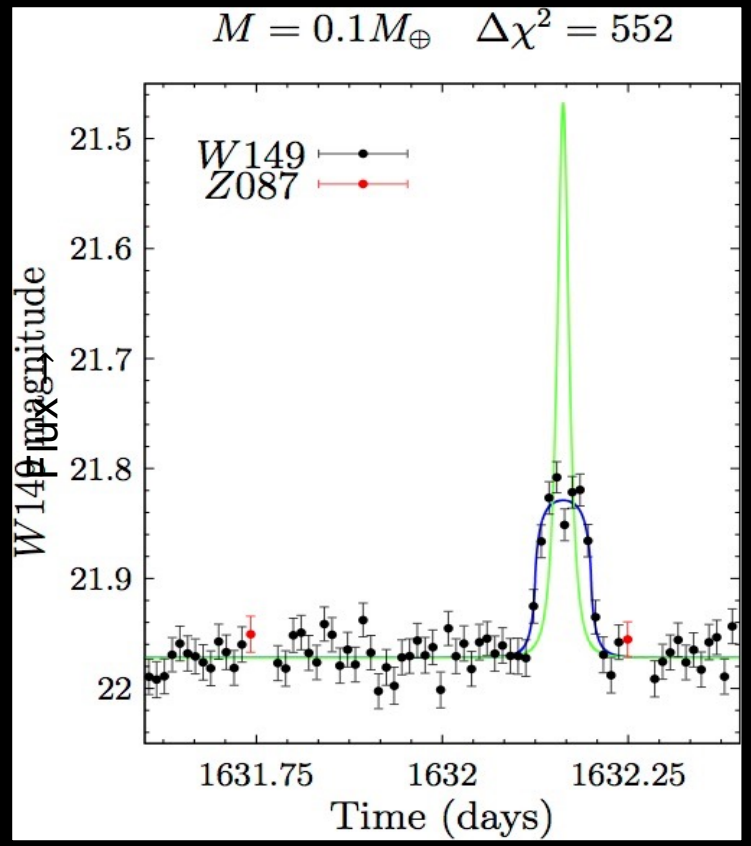


Stars ($W149 < 15$)	$\sim 0.3 \times 10^6$
Stars ($W149 < 17$)	$\sim 1.4 \times 10^6$
Stars ($W149 < 19$)	$\sim 5.8 \times 10^6$
Stars ($W149 < 21$)	$\sim 38 \times 10^6$
Stars ($W149 < 23$)	$\sim 110 \times 10^6$
Stars ($W149 < 25$)	$\sim 240 \times 10^6$
Microlensing events $\lvert u_0 \rvert < 1$	$\sim 27,000$
Microlensing events $\lvert u_0 \rvert < 3$	$\sim 54,000$

Simulated Microlensing Planet Detections

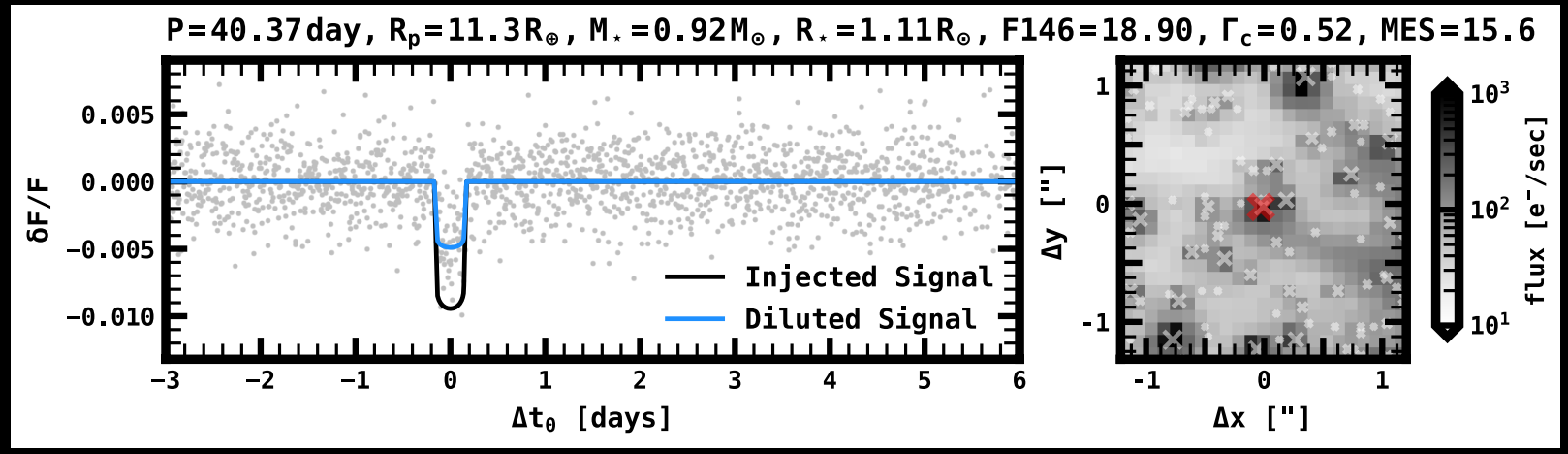


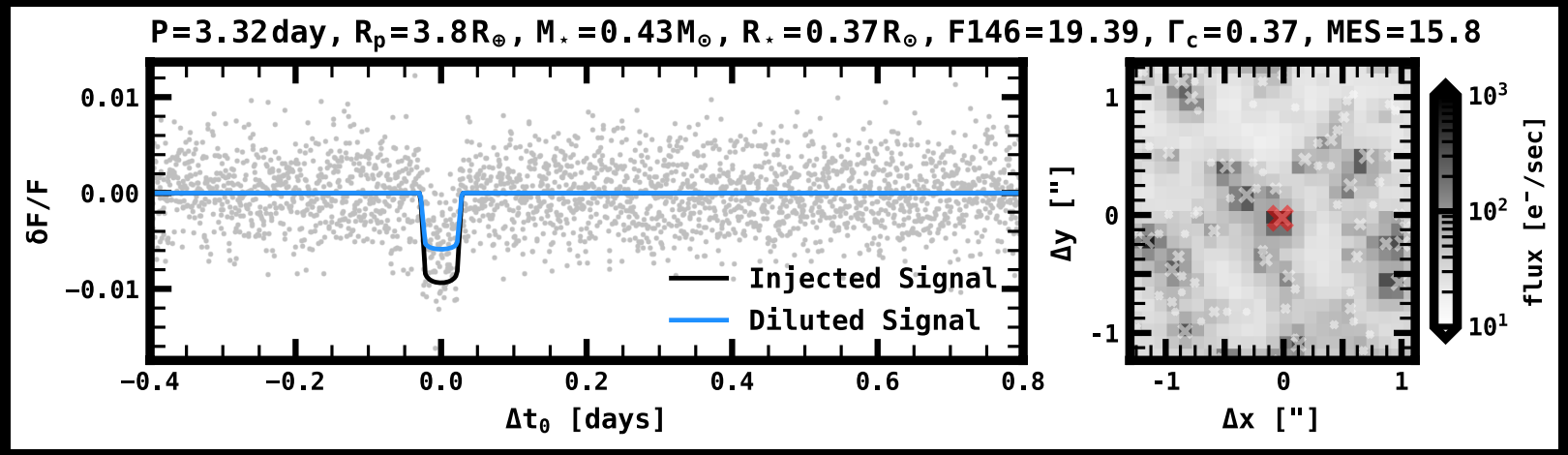
2 × Mass of the Moon @ 5.2 AU (~27 sigma)



Free floating Mars (~23 sigma)

Simulated Transit Planet Detections





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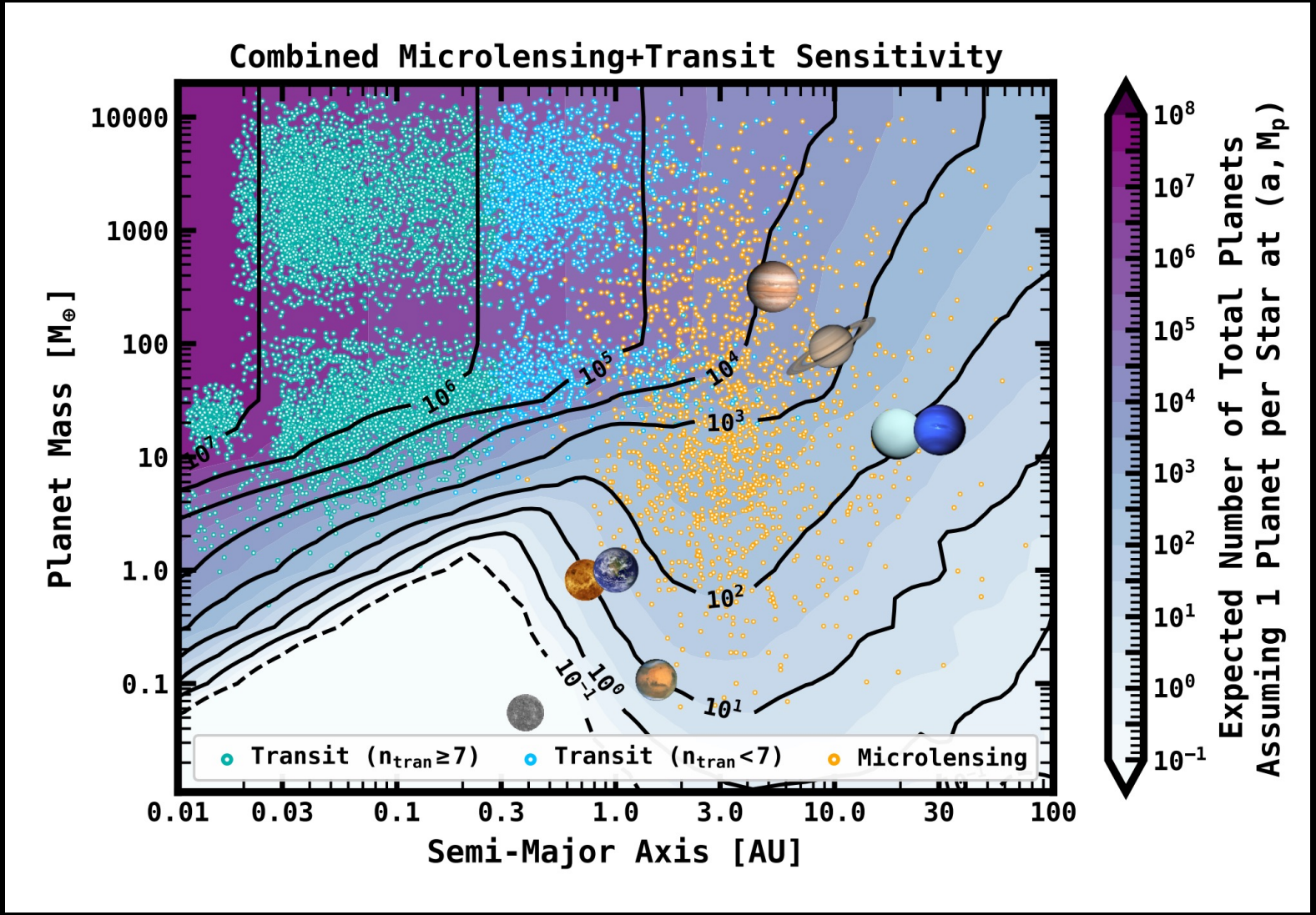
Estimated Exoplanet Yield

- 60k – 200k warm and hot planets
- ~1500 Bound Cold planets
- ~300 Free floating planets
- Sensitivity to planets in all major Galactic stellar populations



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Challenges and Opportunities for WFI Investigations

- Defining the survey strategy
  - Must consider the full range of science (not just exoplanets) enabled by the GBTDS
  - What metrics should be used to optimize the survey strategy?
- Developing sophisticated survey simulations
  - Used for estimating the science yield and optimizing the survey strategy
  - Used to make end-to-end tests of the data reduction and analysis pipelines
- Crowded field photometry and astrometry pipelines
  - Digging into the dirt to reach the photon noise limit
- Growing the microlensing community

We need your help!

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CPP Program Goals

- “Solicits individuals or very small teams to work with the Coronagraph Instrument team to plan and execute its technology demonstration observation”

- “…will join to form the single team that plans and executes Coronagraph Instrument technology demonstration observations.”

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Selected CPP Proposals

- Coronagraph Instrument testing andd performance evaluation in single and binary star modes - Rus Belikov
- Calibrating Roman's Coronagraphic Imaging and Polarimetry Modes - Max Millar-Blanchaer
- Data driven investigations of the Coronagraph Instrument as a starlight suppression yardstick - Laurent Pueyo
- Roman's Giants: Jovian Exoplanet Modeling and RCI Detectability -Tyler Robinson
- Target Selection and Observation Modeling Tools for Coronagraph Tech Demo and Beyond - Dmitry Savransky
- Imaging and Characterizing Exoplanets with the Roman Coronagraph and Open-Source Tools - Jason Wang
- Circumstellar Dust with the Roman Coronagraph - Schuyler Wolff

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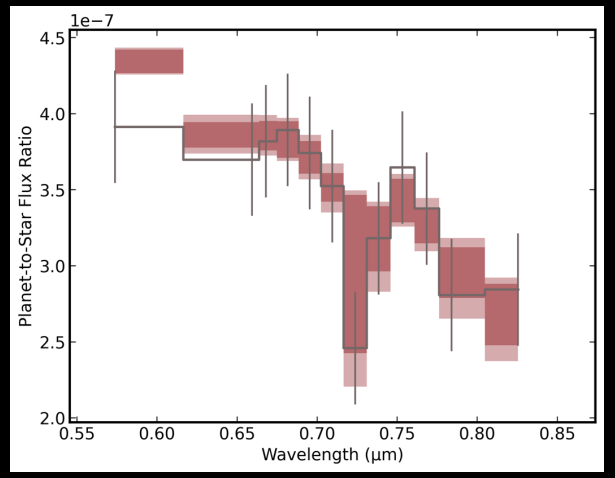
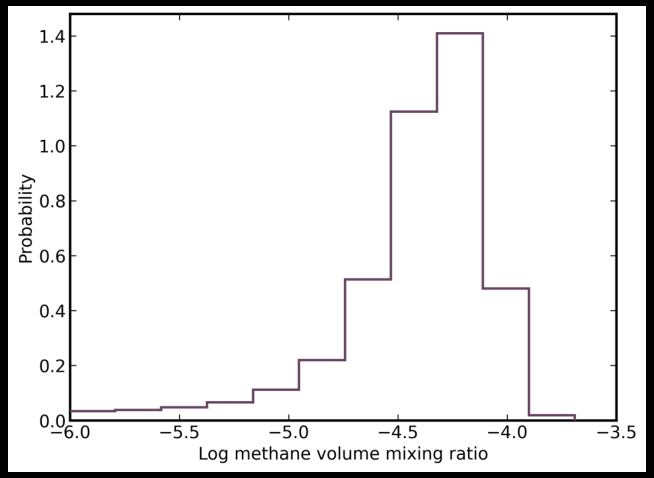
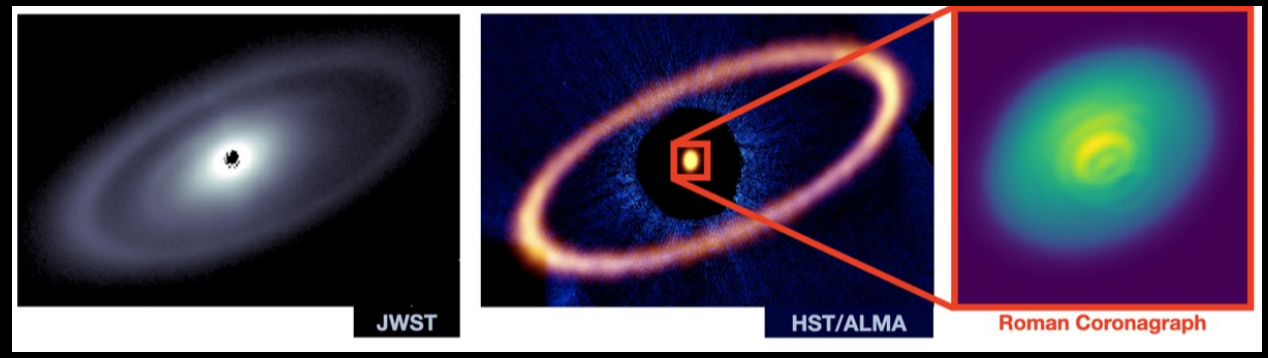
Wide Range of Topics for the CPP Proposals

- Lab testing
- Performance characterization and validation
- Testing of different coronagraph modes
- Calibration
- Polarimetry
- Atmosphere models, spectral simulations, and retrievals
- Target selection and survey strategy
- Data simulation and reduction
- Exozodi and debris disk imaging and polarimetry
- Software development







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Relevant Roman Sessions at AAS 243

- A Discussion of Science Drivers for Defining Roman's Core Community Survey

  Wednesday, January 10, 9:00 AM CT - 11:30 AM CT

- Maximizing the Science of Roman with Simulations

  Tuesday, January 9, 2:00 PM CT - 3:30 PM CT

- Nancy Grace Roman Space Telescope Town Hall

  Thursday, January 11, 12:45 PM CT - 1:45 PM CT

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Getting Involved with Roman

- Join Roman-news mailing list by sending email with Roman in subject line to roman-news-join@lists.nasa.gov
- Monthly Roman Forum https://asd.gsfc.nasa.gov/roman_forum/
- Monthly virtual lecture series https://roman.ipac.caltech.edu/Lectures.html
- Join technical working groups https://asd.gsfc.nasa.gov/roman_signup/
- Attend annual Roman science conference – next one hosted by IPAC (California) in Summer 2024.
- Three main surveys defined via a community process
  - Currently forming survey definition committees (https://roman.gsfc.nasa.gov/science/ccs_definition_committee.html)

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