2026 Sagan Summer Workshop

Tuesday, July 21

Poster Pops 2

SAGAN SUMMER WORKSHOP

nexsci.caltech.edu/workshop/2026

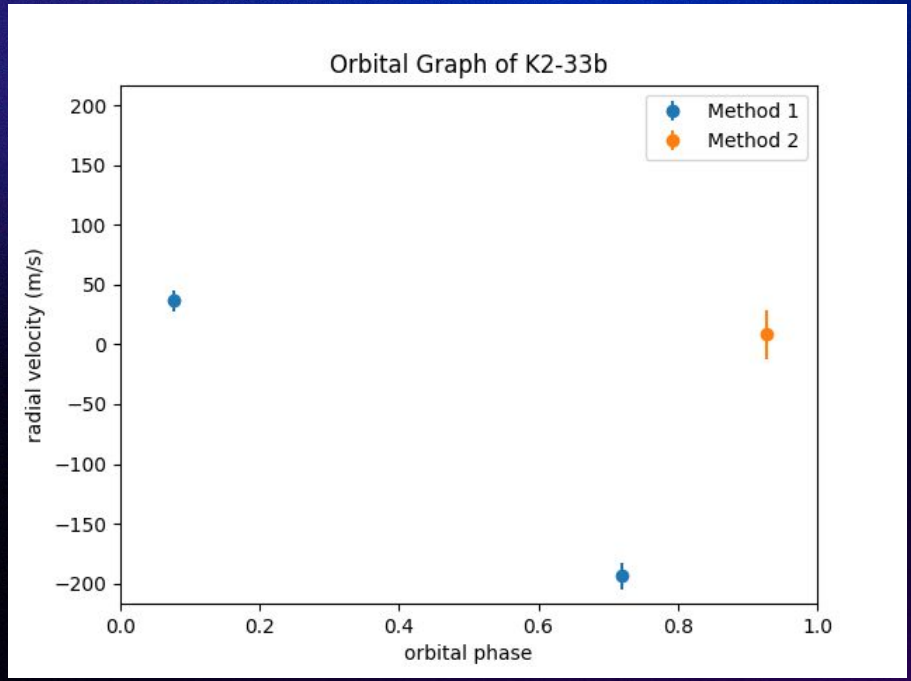
NExScI

Measuring the Mass of the Youngest Sub-Neptune, K2-33b, with 3 Years of VLT/CRIRES Spectral Data

Vincent Cheng
University of Hawaii at Hilo

The Project

- Getting Familiar with the Data
- Data Reduction
  - EsoRex
  - VIPER
- Data Analysis
  - Keplerian Models
  - RV Signal Models
  - MCMC Sampling



Drawing Atmosphere–Interior Connections
MANTLE RESISTIVITY AND ATMOSPHERE ESCAPE

Laura Chin[1] Chuanfei Dong[1,2] Yuxi Chen[3]

[1] Department of Astronomy, Boston University, Boston, MA
[2] School of Natural Sciences, Institute for Advanced Study, Princeton, NJ
[3] Center for Space Environment Modeling, University of Michigan, Ann Arbor, MI

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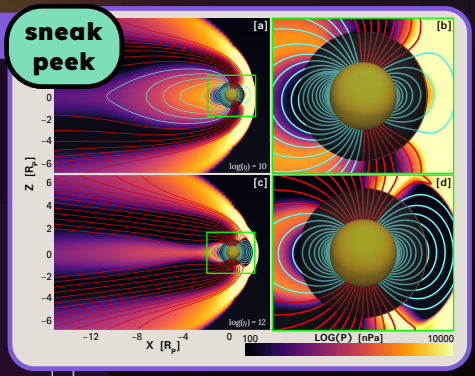
BATS-R-US 3D MS-MHD SIMULATION RESULTS

1 Planetary interiors contain layers with different resistivity

$$\rho = \frac{1}{\sigma} = \mu_o \eta$$

- ρ: electrical resistivity
- σ: electrical conductivity
- η: magnetic diffusivity

sneak peek



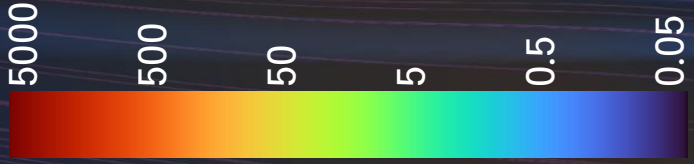
2 Solar system: mantle $\eta \sim 10^8 - 10^{13}$ m^2/s

Earth — Mercury

MANTLE

CORE

SURFACE



3 How can η alter magnetic field line transport in exoplanets?

Will η impact atmospheric ion escape?

→ Magnetic diffusion timescale t_D depends on η

→ Escape rate changes by ~180x

Citizen Science Project: Flares in Open Clusters

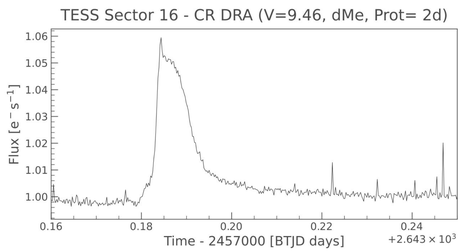
Aylin Garcia Soto[1] (e-mail?) and Brian Jackson[1]
1 - Department of Physics and Astronomy, Boise State University

BOISE STATE UNIVERSITY

OVERVIEW

Stellar flares are violent eruptions driven by magnetic reconnection that can severely impact exoplanet atmospheres and distort transit signals.

Typical Flare Profile:



Characterizing these events requires high-cadence observations; however, space-based assets like TESS are often suffer from blending challenges in crowded fields. To address these limitations, we present a citizen science project that leverages a **network of 4-inch Unistellar eQuinox 2**. These scopes also offer better spatial resolution over TESS, mitigating its blending issues. These scopes will be operated by educators across Idaho.

We will attempt to isolate the flares' chromatic behavior across the blue, green, and red channels. The combined green and red channels can approximate the TESS bandpass, while the blue mirrors the Kepler peak. Preliminary analysis demonstrates that continuous 4-hour observation windows are sufficient to capture multiple, distinct flaring events on active objects. With this project, we could determine the flare rates for different young stars in open clusters.

Will this Project Work?

PRECISION

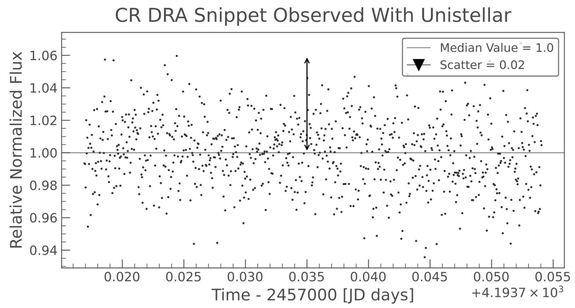
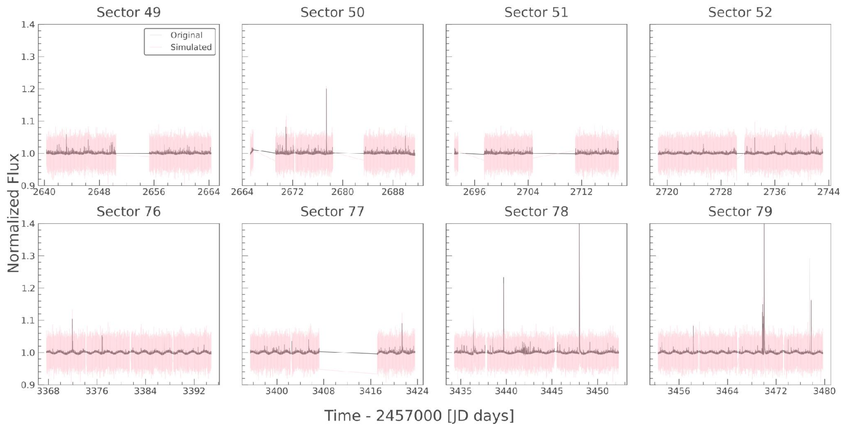


Figure 1: Light curve of the Unistellar observation for M dwarf CR DRA. In this figure, we calculate the scatter of the data points. We note that the exposure time for this object was 4 seconds, making the max counts at the center of the object less than 9000 (saturation limit ~60000 counts). Increasing the exposure time would most likely decrease the scatter and allow for more comparison stars.

Figure 2: All TESS sectors with 20s cadence. The black data is the original TESS data, while the pink data illustrate the photometric scatter by a Unistellar scope for comparison. Each line sticking up from the baseline flux is a flare. From this plot, we see that the Unistellar scopes could detect the larger flares exhibited by CR DRA. A longer exposure time could likely allow us to see smaller flares.



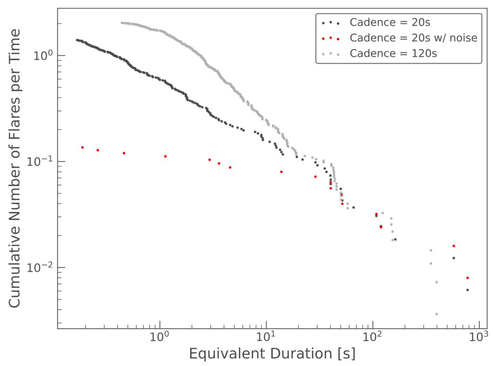


Figure 3: A flare frequency distribution (FFD) plot for TESS 20s cadence, TESS 120s cadence and TESS 20s cadence with the scatter calculated from the Unistellar scope. The 120s cadence data exhibit the most flares because it has the most sectors. The 20s cadence data more clearly exhibit lower energy flares(< equivalent duration). While 20s cadence with noise is worse at both. However, we plan to increase the exposure time and make sure each target has at least one other telescope. Even with the limited sensitivity of the Unistellar scopes, we expect to be able to recover population-level flare statistics.

FUTURE STEPS

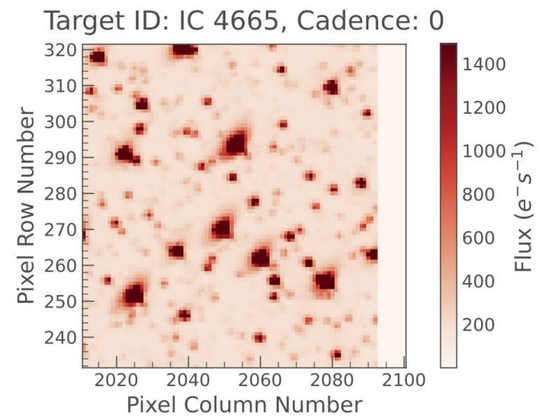


Figure 4: The goal is to use the Unistellar scopes this summer to observe an open cluster and allow for multiple telescopes for each object. Here we have a TESS FFI of the IC 4665 open cluster. Using the literature (e.g. *Prosser et al. 1993AJ....105.1441P*), we will be able to find targets to observe.

ACKNOWLEDGEMENTS

Funding for this project comes from the following grants: NASA Exoplanets Research Program, award #NSSC25K7170 and NASA Science Activation, award #NSSC22M0008

This poster includes data collected by the TESS mission, which are publicly available from the Mikulski Archive for Space Telescopes (MAST). Funding for the TESS mission is provided by NASA's Science Mission directorate.

Preparing for *Gaia* DR4: Detecting Long-Period Giant Planets with Astrometry

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Department of Astronomy, University of Illinois Urbana-Champaign

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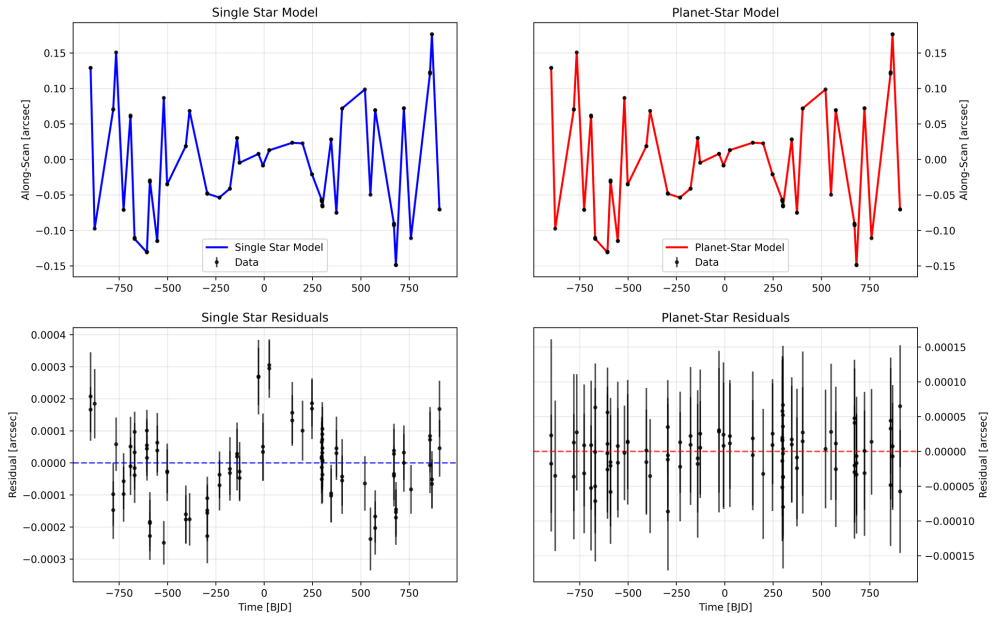
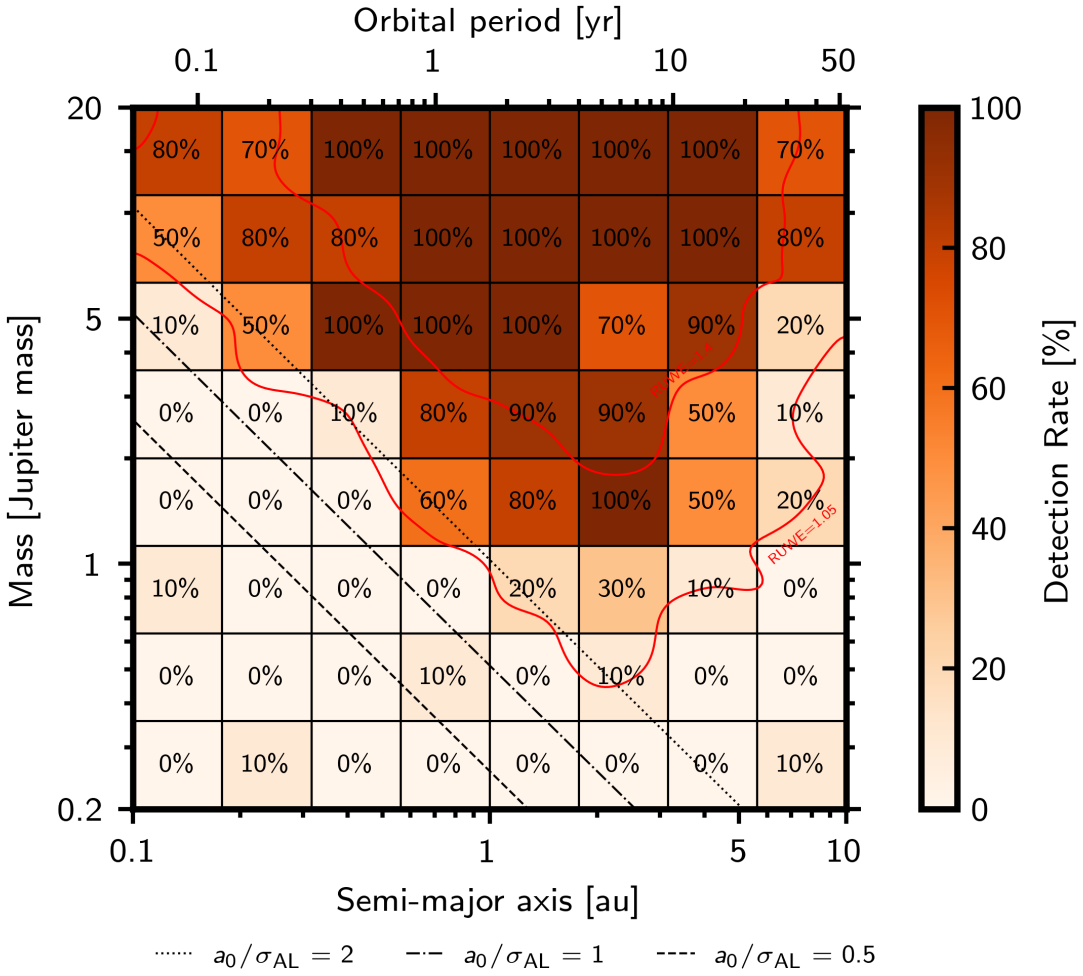
Project Objective

Build a Bayesian astrometric detection pipeline that can detect low S/N exoplanets in *Gaia* DR4 that standard *Gaia* DR4 pipeline may reject.

Gaia DR4 Prerelease: Modeling of Gaia-4b



Injection-Recovery Results for 0.35 $M_\odot$ star

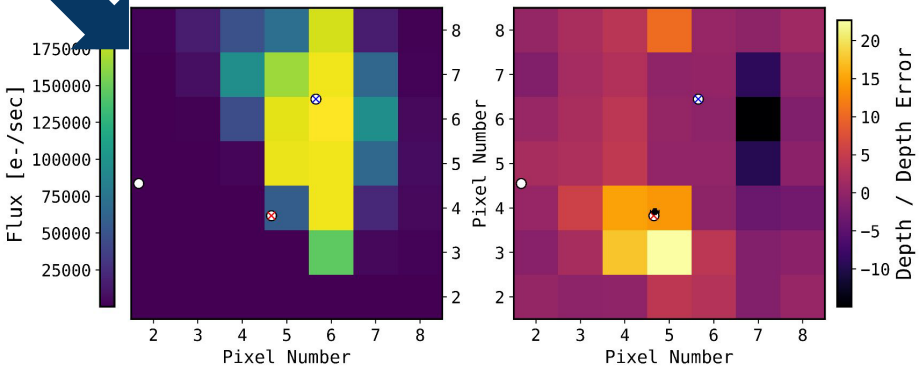


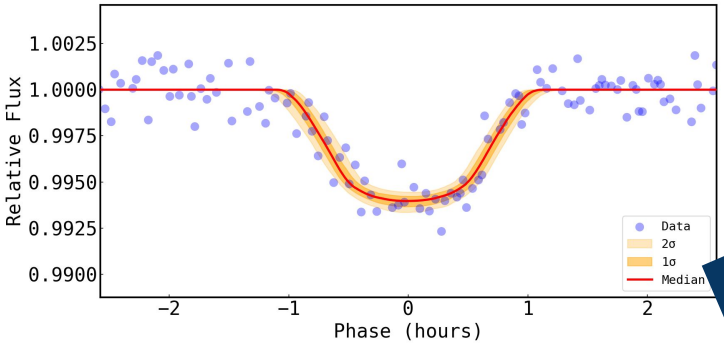
One Man's TraSHDUMP is Another Man's Treasure

Julie Moquin, Robert F. Wilson, Elisa Quintana, Christina Hedges, Jorge Martínez-Palomera, Zachary Claytor, Emily Gilbert, Jason Rowe, Kelsey Hoffman, Veselin Kostov, David Ciardi

DO YOU LIKE EXOPLANET TRANSITS?

Want to learn about a **new** pixel-level vetting technique????





Want to learn about a **sub-Neptune** planet candidate in the Kepler Bonus Light Curves????

COME SEE MY POSTER!

Fast screening before expensive 2L1S modelling

The problem

Roman-scale data: high-cadence light curves at survey volume.

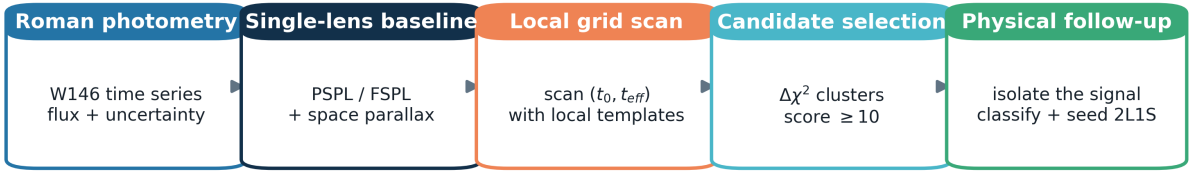
Planet signals: brief, diverse residual perturbations that manual inspection can miss.

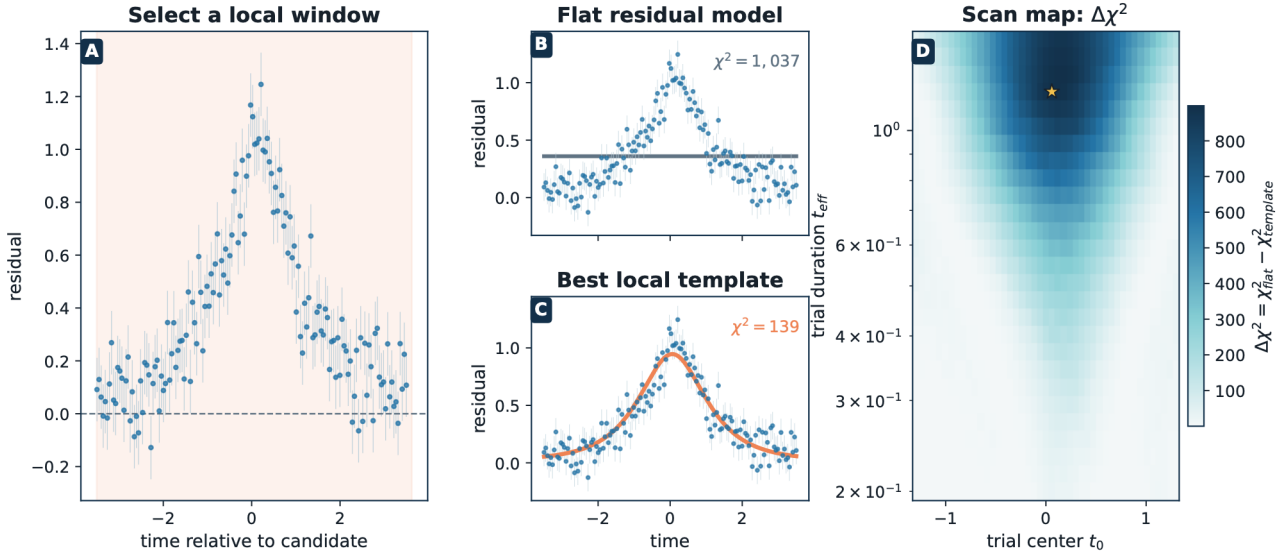
Goal: a fast front-end detector that prioritizes candidates for physical modelling.

Detector idea

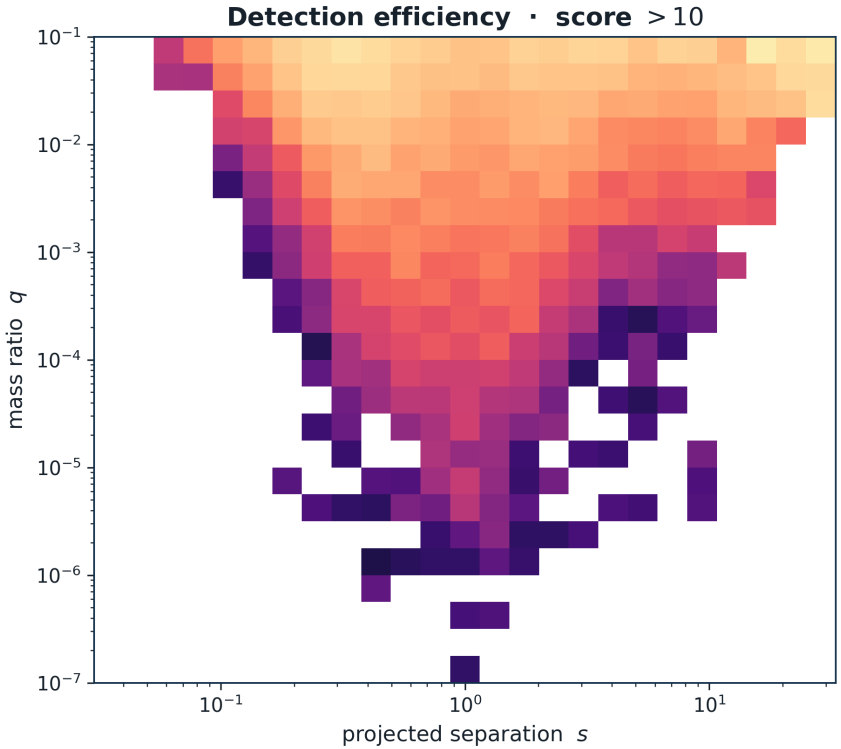
Fit a smooth single-lens baseline, scan the residuals over trial center and duration, and rank localized template improvements by $\Delta\chi^2$ and score.

Anomaly-search pipeline





A fast score becomes survey sensitivity and 2L1S seeds



What happens after detection?

Detected interval
candidate window from the local scan

→

Refit the baseline
mask or downweight the planetary signal

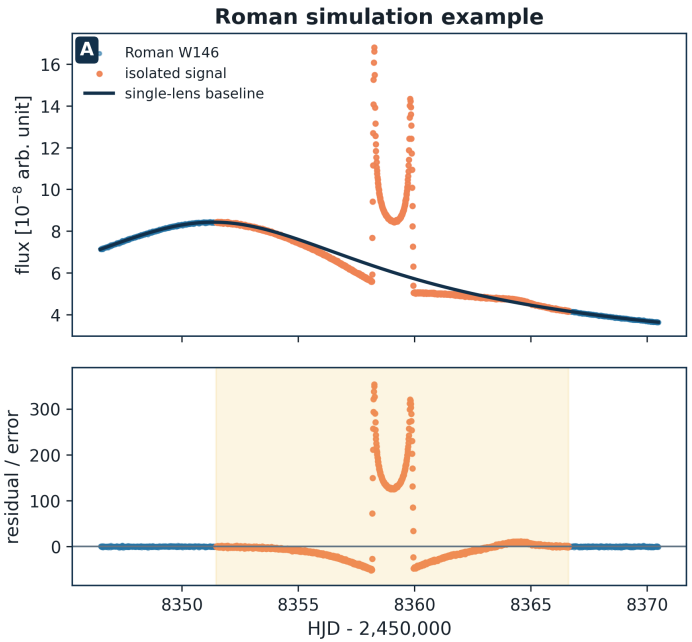
→

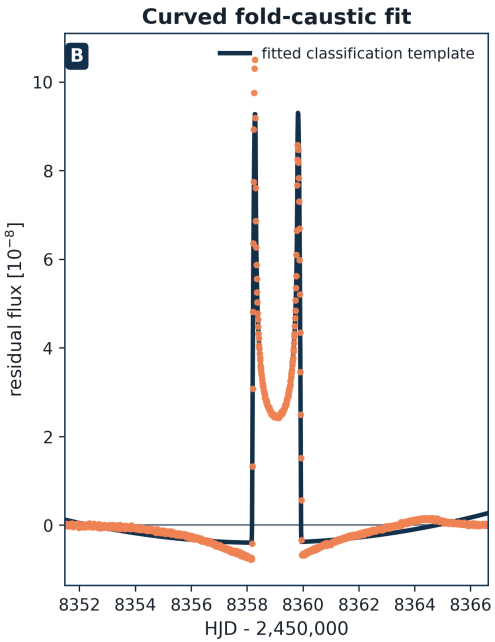
Morphology templates
fold · cusp · central major-image bump

→

2L1S seed bank
ranked (q, s, α) starting points

Example candidate





Searching for GEMS: Building the Largest Volume-Limited Sample of Giant Planets around M Dwarfs

Pranav Premnath, Paul Robertson, Shubham Kanodia, Caleb Cañas

GEMS (Giant Exoplanets around M dwarf Stars)

1,000,000 M dwarfs (< 200 pc)

$R_p > 8\ R_\oplus$

* - Estimated

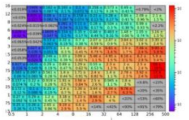
Brown Dwarfs

Eclipsing Binaries

~ 100* Astrophysical False Positives

~ 100* Transiting Planets
Occurrence Rate* (0.2%) x Transit Probability* (5%)

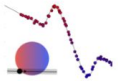
Occurrence Rates
- Dependence on St. Mass
- Dependence on Period



NEID · HPF · MAROON-X · PFS

> 40* Transiting Gas Giants w/ RV Masses

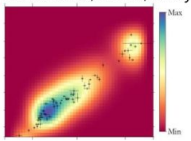
Obliquity Measurements

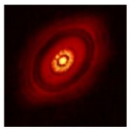


Atmospheric Characterization

WEBB SPACE TELESCOPE · Ariel

Cycle 2 GO 3171: 132 hours
PIs: Kanodia, Canas, Libby-Roberts



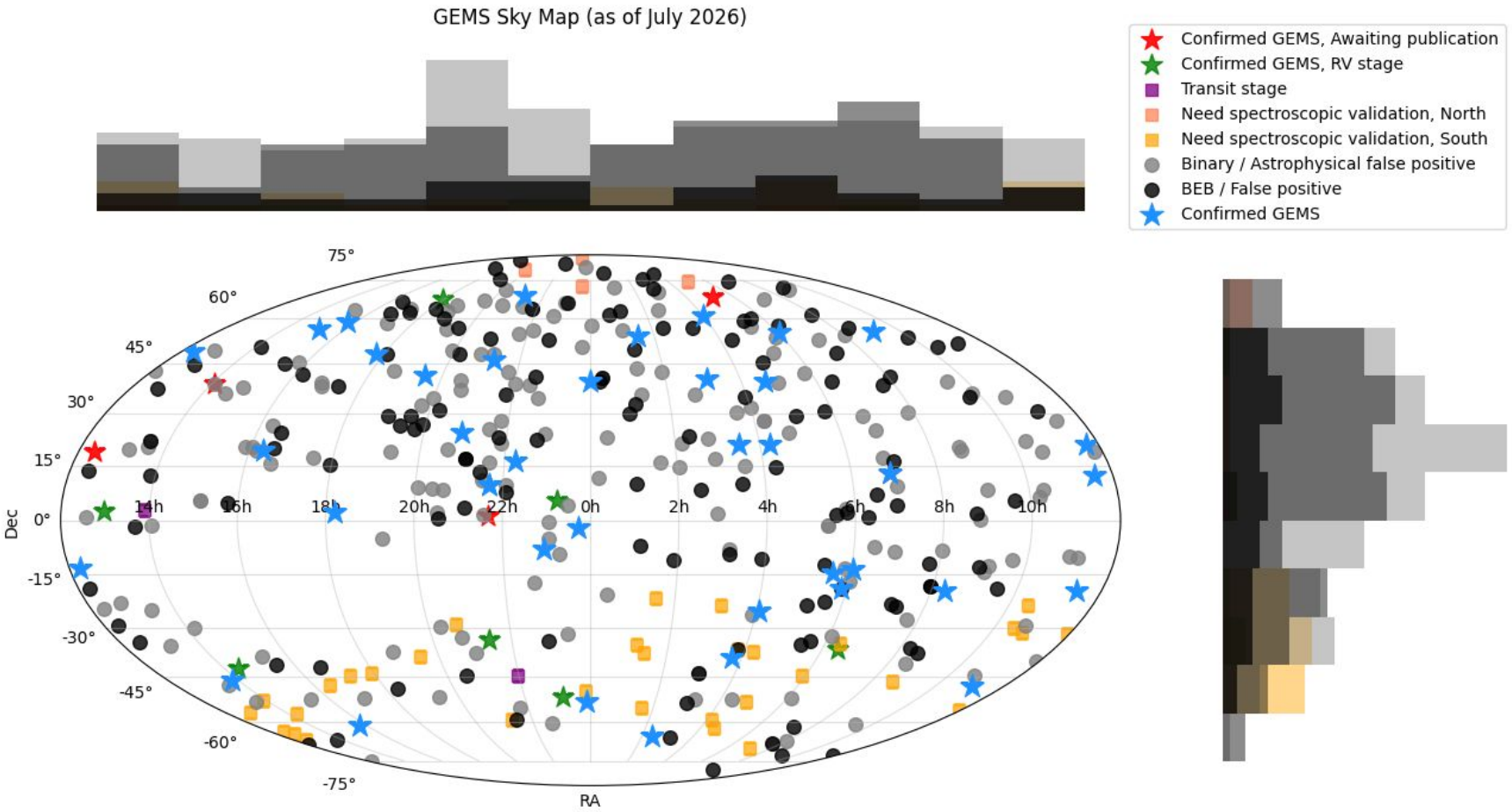


Connection to Protoplanetary Disk Mass/Age

n-Dimensional model
Pl. Mass + Pl. Radius + Insolation + Stellar Mass + Fe/H

Searching for GEMS: Building the Largest Volume-Limited Sample of Giant Planets around M Dwarfs

Pranav Premnath, Paul Robertson, Shubham Kanodia, Caleb Cañas

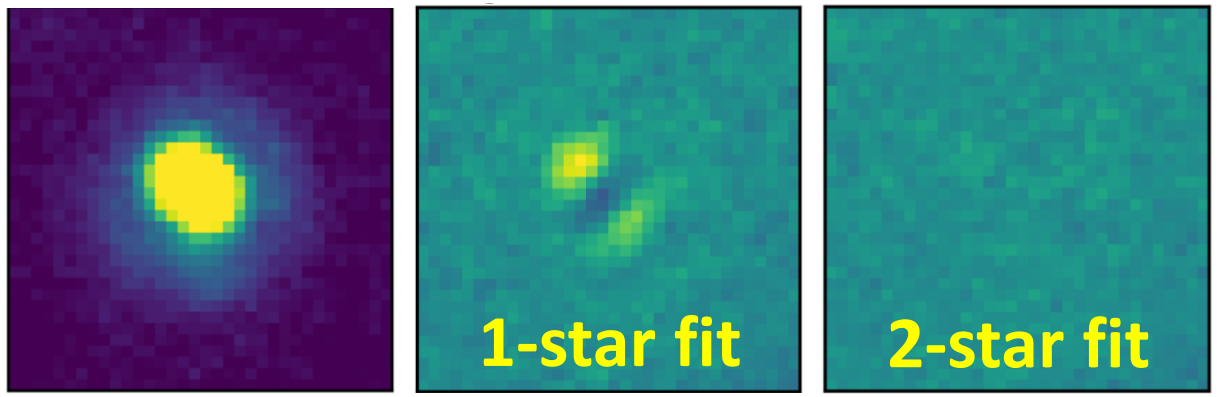


Fast Two-Star Modeling of High-Resolution Images toward Joint Light-Curve and Image Fitting of Microlensing Events

Takuto Tamaoki
Department of Earth and Space Science, The University of Osaka

Two-star Image Fitting

- **Model**
  DAOPHOT-based
  Two position-shifted, flux-scaled PSFs
- **MCMC** inference of positions and fluxes



Keck/OSIRIS

Vectorized PSF evaluation over all pixels with JAX
+ Just-In-Time (JIT) compilation

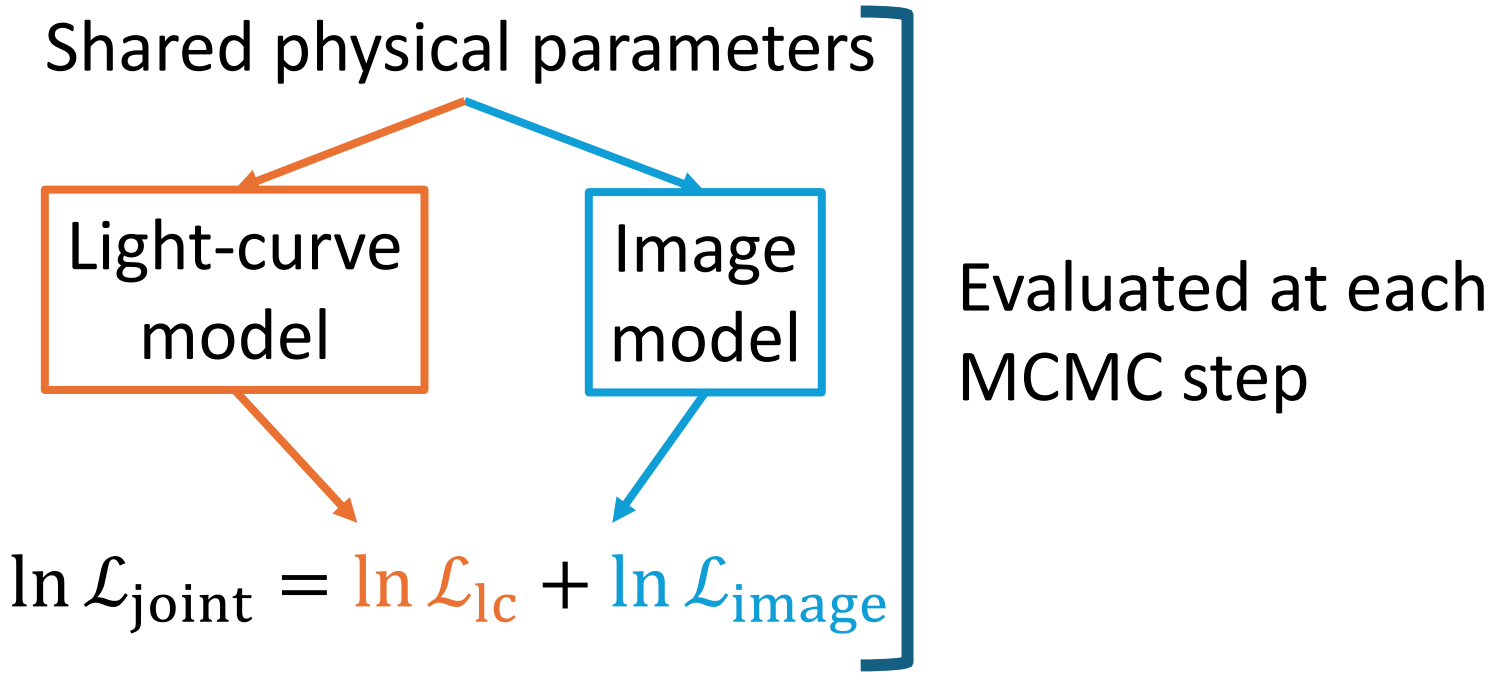
Implementation	Likelihood-evaluation time per 32-walker batch
Two nested Python for loops (pixel-by-pixel PSF evaluation)	4.91 s
Vectorized JAX + JIT	2.39 ms

≈2,000× faster

Automatic differentiation also enables **HMC** sampling.

Joint Light-Curve and High-Resolution Image Fitting

Especially useful when the lens is faint and unresolved from the source.



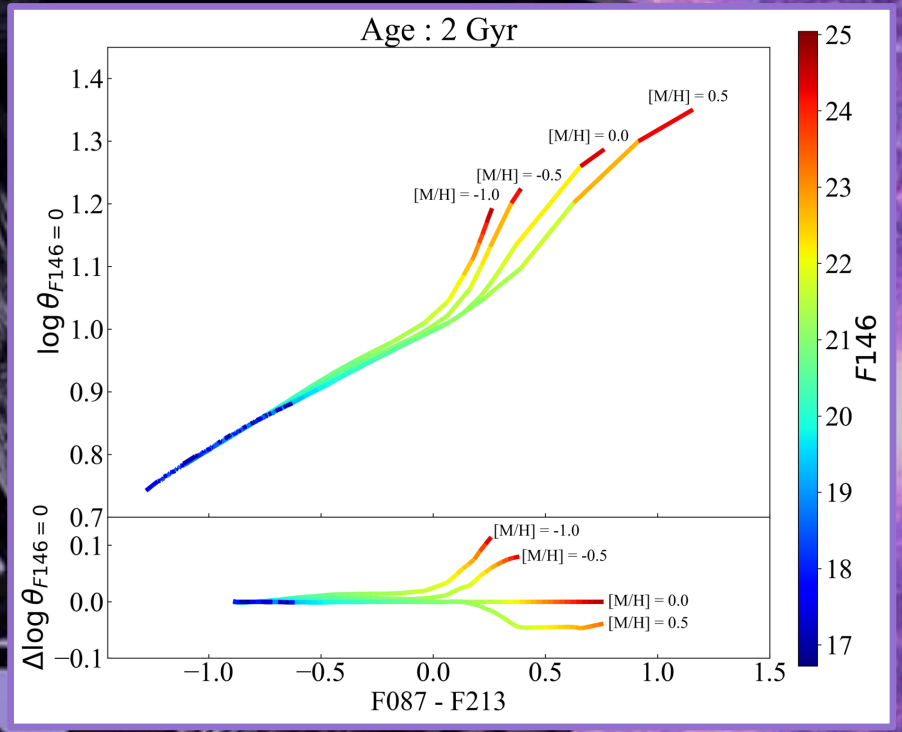
Fast image-likelihood evaluation enables efficient joint MCMC fitting.

Color-Surface Brightness Relations With The Nancy Roman Space Telescope

Emelly Tiburcio, Tabetha Boyajian, Matthew Penny, Ashley Elliott

LSU
Department of Physics & Astronomy

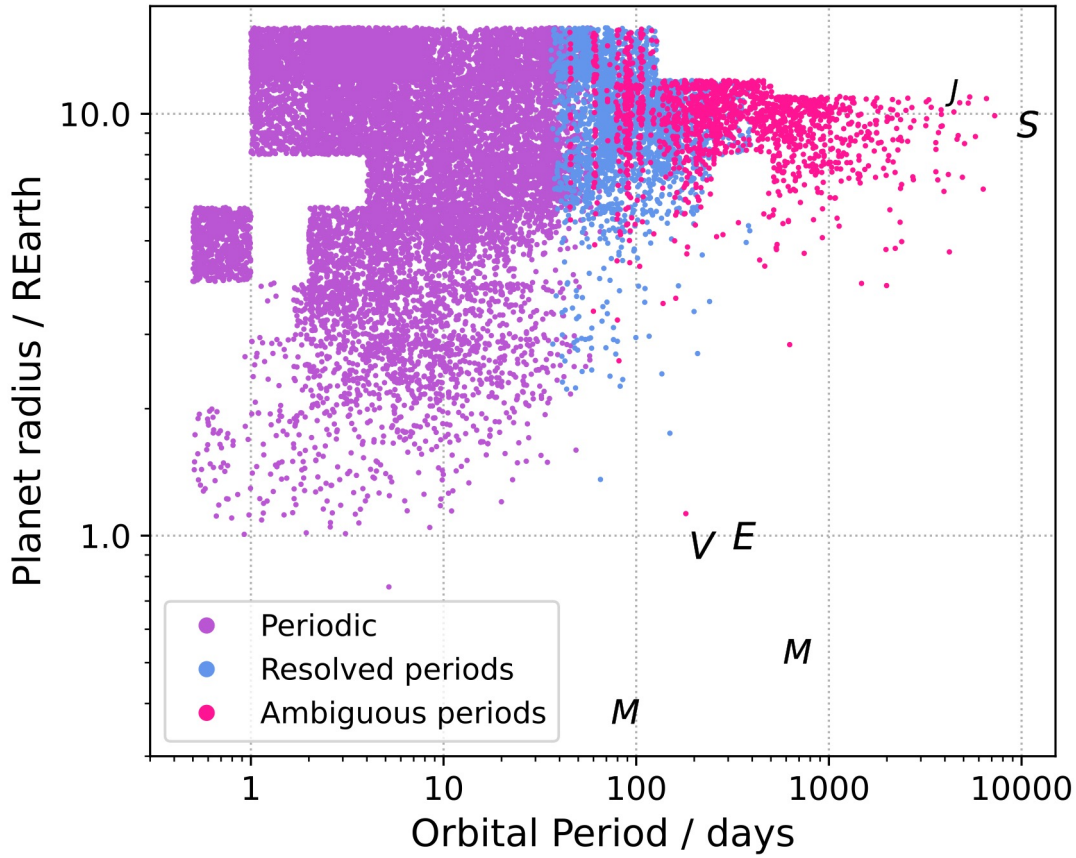
- Color-surface brightness relations (CSBRs) are critical tools for estimating lens masses in microlensing studies.
- CSBRs connect a star's color and magnitude to its angular diameter.
- This is key for microlensing events with finite source effects, enabling planet mass measurements.
- Ground-based microlensing typically targets FGK stars, where CSBRs are tight and reliable.
- Roman Space Telescope will push to fainter, redder M dwarfs, where:
  - CSBRs show more scatter
  - Metallicity effects become significant
- This shift challenges existing CSBR assumptions and motivates the need for better calibrations in the M-dwarf regime.



Want to find out how we deal with that?

See my poster!

Long-Period Transiting Exoplanets in the Roman GBTDS



Roman is predicted to discover ~100,000 transiting exoplanets [Wilson et al. 2023].

About 9% will have an ambiguous orbital period, with ≤ 1 observed transit per season.

Approved Roman Cycle 1 Proposal (PI: Tuson) to search for single transits in the Roman GBTDS.

We need to include these discoveries in demographic studies to gain a complete understanding of the exoplanet population.

Amy Tuson

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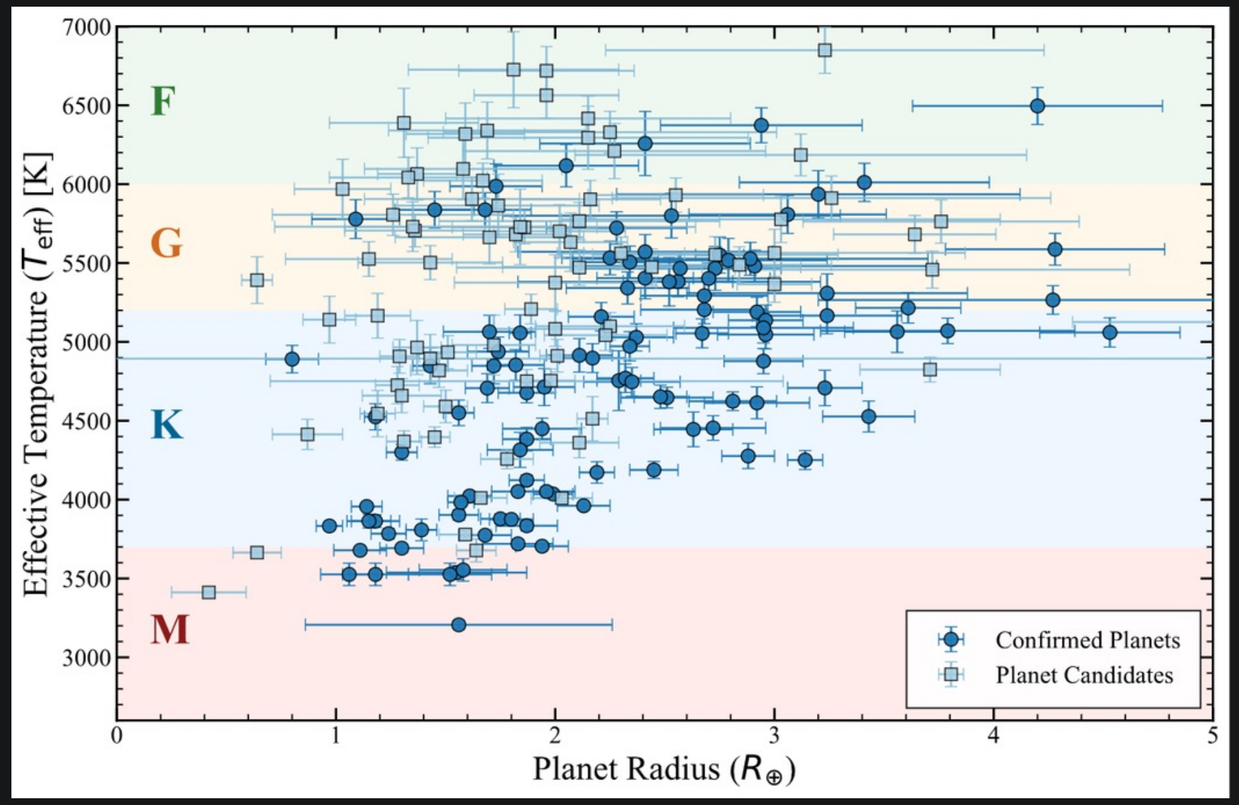
Website: amytuson.wordpress.com

WE HOMOGENOUSLY REANALYZED PLANETARY PARAMETERS WITH GAIA DR3 STELLAR PARAMETERS AND STATISTICAL VALIDATION FOR 187 KEPLER CONFIRMED AND CANDIDATE PLANETS

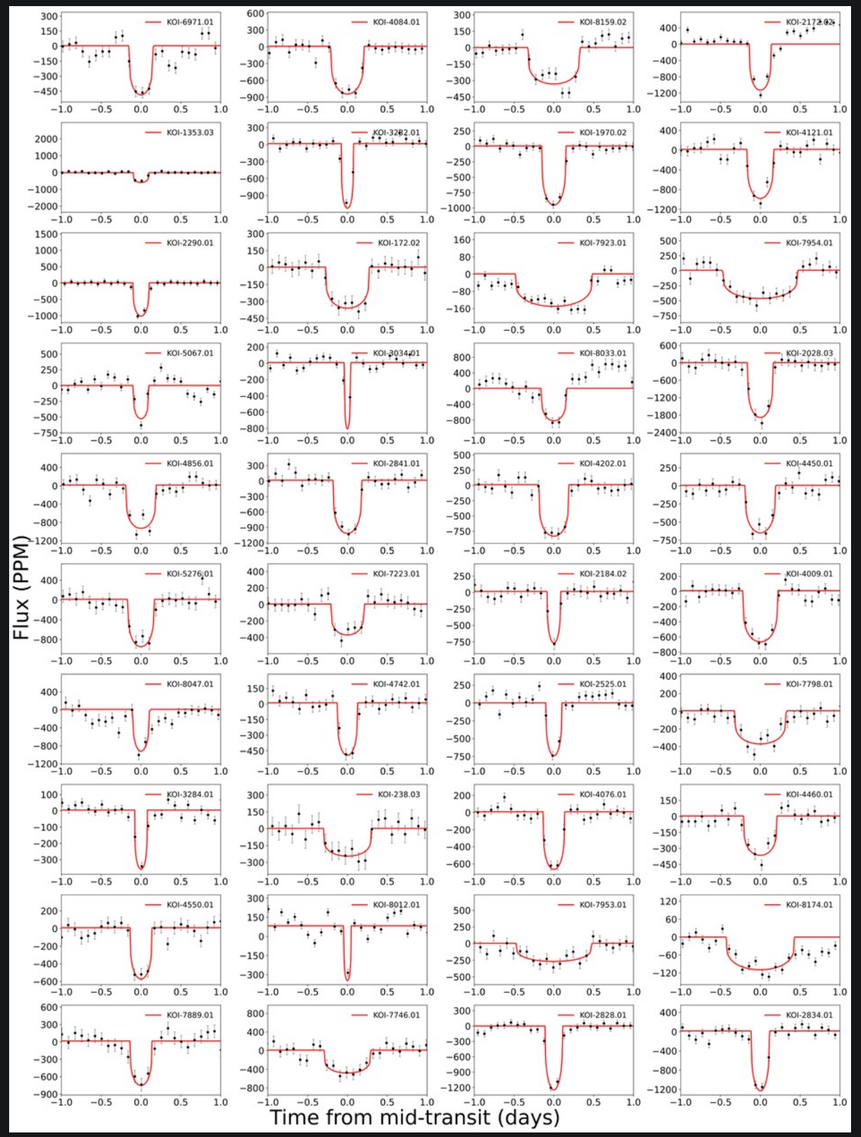


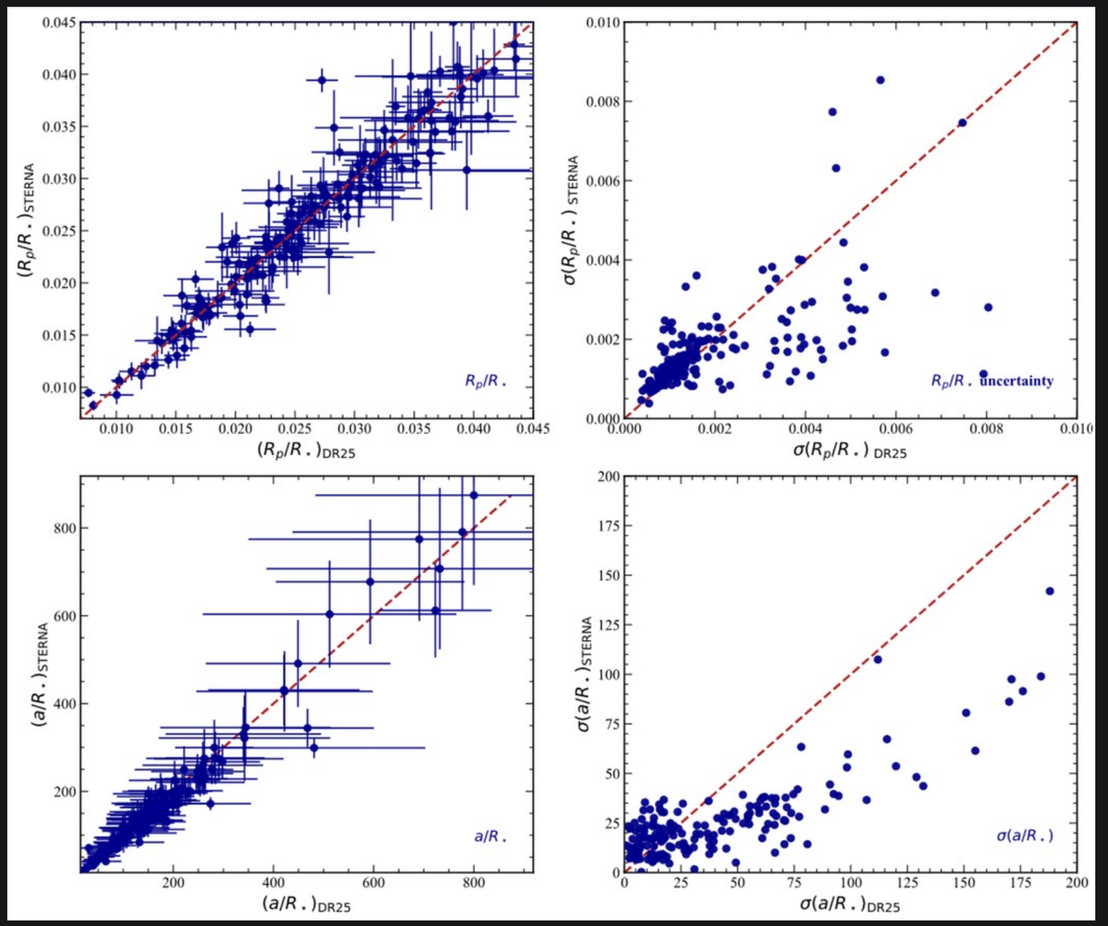
STERNA
SYNTHETIC TRANSIT LIGHTCURVE HARVESTER FOR EXOPLANET SCIENCE CASES

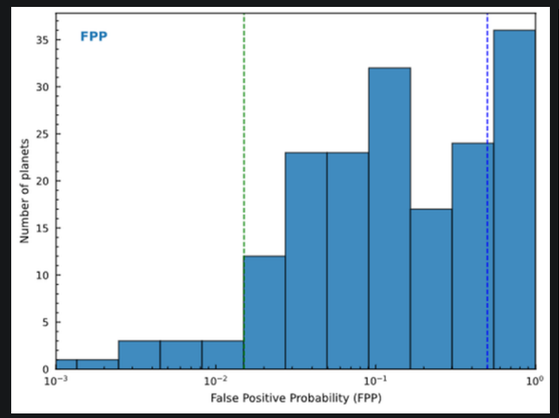
TRICERATOPS

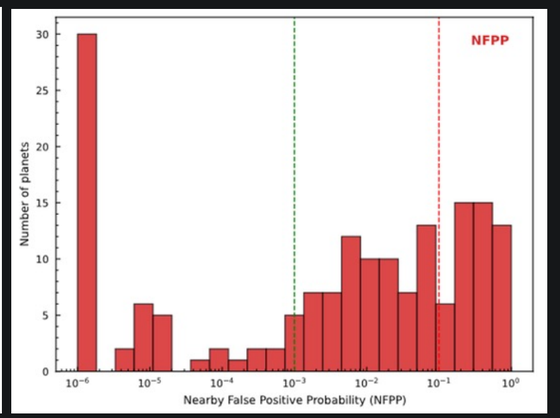
Zaman, MD A. Al, **Crossfield**, Ian

RESULTS



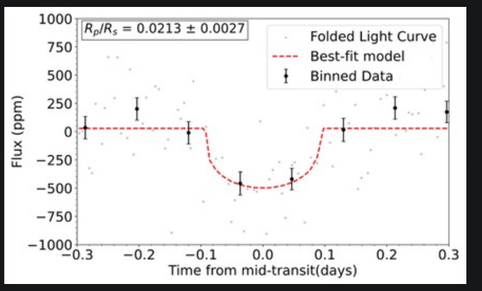




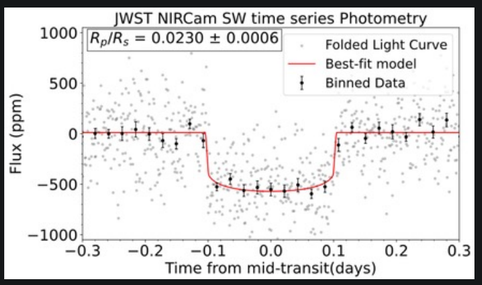


EVEN A SINGLE TRANSIT FROM JAMES WEBB OR LAZULI CAN IMPROVE THE RELIABILITY

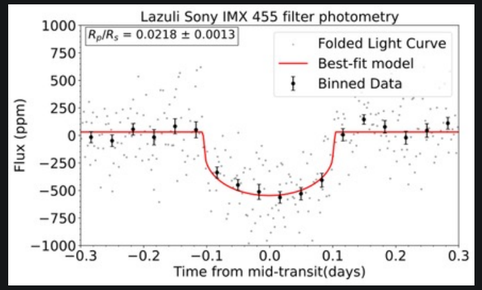
KEPLER — 3 TRANSITS



JWST — 1 TRANSIT



LAZULI — 1 TRANSIT



Zaman, MD A. Al, **Crossfield**, Ian J. M.