

Roman and Microlensing: Precursor Studies

Sean K. Terry
(UMD/NASA GSFC)

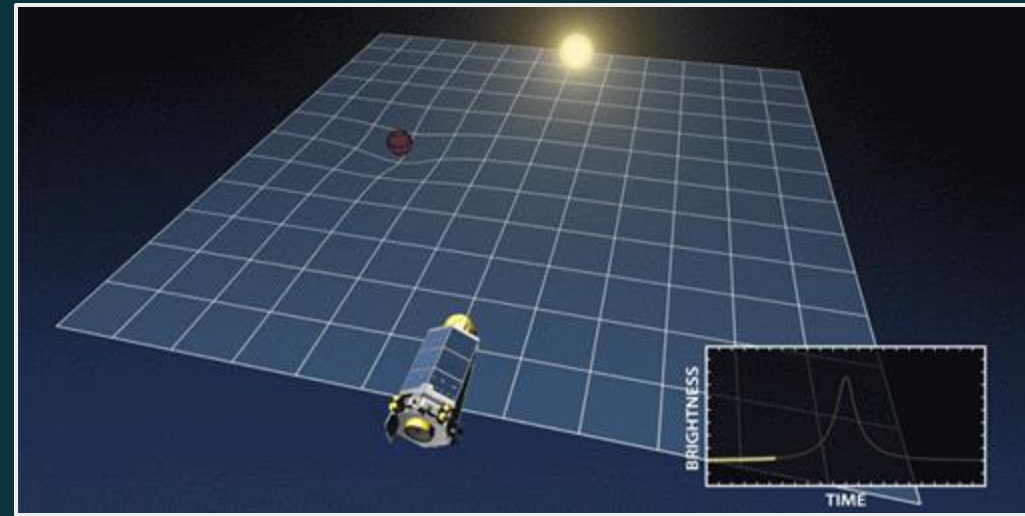
rges-pit.org



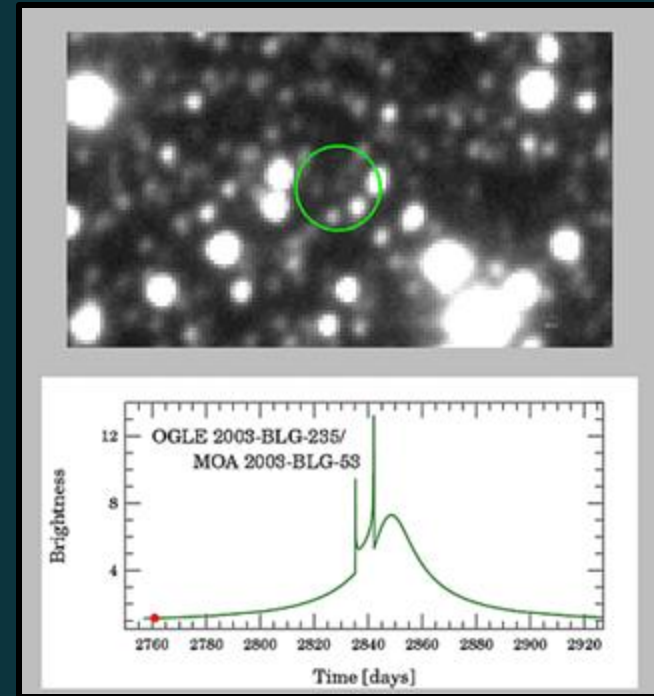
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Microlensing Background



Caltech/IPAC



Bond et al., 2004

Please visit rges-pit.org/resources to learn much more about microlensing!

Precursor Surveys with *Hubble Space Telescope* & *Euclid*

The Idea: We know where the *Roman* GBTDS fields will be, so let's obtain a very early-epoch of high-resolution imaging of those fields with *HST* & *Euclid*.

Enhances many *Roman* science cases (microlensing+transiting exoplanets, other transient things, extinction/reddening, etc).

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HST Cycle 32-33 program (PI: S. Terry) + *Euclid* Galactic Bulge Survey
(Exoplanets Working Group)

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A Precursor Survey of the Roman Galactic Bulge Time Domain Fields HST Proposal 17776


Sean Terry ([publications @ ADS](#))
University of Maryland

Cycle: 32
Category: Exoplanets and Exoplanet Formation
Proposal type: GO
Status: implementation

[HST Proposal Information:](#)
[about this proposal](#)
[about other proposals by this PI](#)

Proposal Abstract

We propose a coordinated parallel HST imaging survey of the upcoming Roman Galactic Bulge Time Domain Survey (RGBTDS) field. Precursor imaging of this area with HST several years before the start of the Roman Galactic Exoplanet Survey (RGES) will greatly strengthen Roman's ability to characterize a majority of detected exoplanet systems, as well as provide a rich and wide-field archive for use as a Legacy dataset toward the Galactic bulge for the broader community. The campaign proposed here will secure HST's lasting impact on the high-precision study of stellar populations, dynamics, exoplanet systems, interstellar extinction, metallicities, cluster associations, and many more toward the center of the Galaxy. This HST survey will complement what will effectively be one of the deepest exposures ever taken of the sky: the RGBTDS.



euclid

EUCLID GALACTIC BULGE SURVEY

On March 23rd 2025 the ESA Euclid telescope was pointed towards a location close to the Galactic Centre (Figure 1), in order to obtain an unpre-bulge region of our Milky Way galaxy.

Nine adjoining fields (Table 1), spanning a total area of 4.8 deg², were imaged by Euclid, using its optical VIS camera, over a period of about 24 each, giving a total exposure of 1.8 hours per field. Euclid's optical sensitivity and resolution (0.16 arcsec) is comparable to the Wide Field Camera 3 (WFC3) field. However, each Euclid field covers an area that is 270 times larger than a WFC3 field, underlining the true nature of Euclid as a sky surveyor.

As well as offering an unprecedented crisp view of stars over a wide area of the inner Galaxy, the principal science driver of the Euclid Galactic Bulge Survey (EGBS) is to detect and characterize over 200 distant exoplanets that have been discovered towards the Galactic bulge using the gravitational microlensing method. Microlensing involves close (milli-arcsecond) temporary alignment on the sky of a passing foreground star or planetary system. The foreground host star can induce perturbations on timescales of hours to a few days.

The Euclid Galactic Bulge Survey covers an area that contains many historical planetary microlensing signals observed from ground-based surveys. The foreground host star light, and its separation over time from the background magnified star, allows confirmation of the planetary nature of the microlensing event.

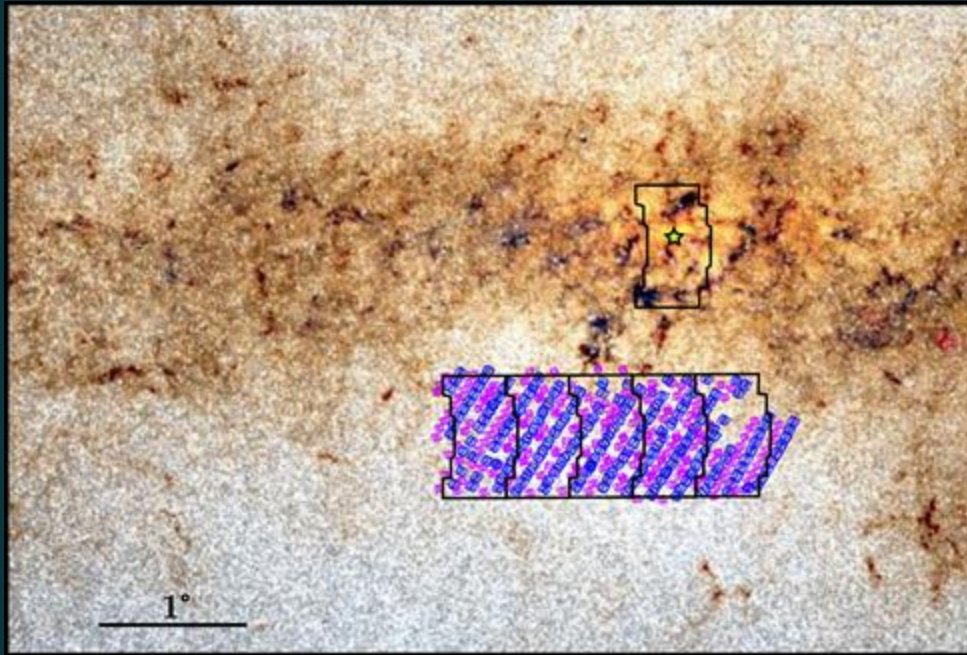
The survey also covers the region that the NASA Nancy Grace Roman Space Telescope (Roman) will monitor over a 5-year period from 2027 for its exoplanet science. Roman will use Euclid images to identify the foreground planetary host lenses that are seen by Roman several years later to microlens background stars. Roman will observe the host system and its motion over time, allowing more accurate measurements of the planetary masses than would otherwise be possible with Roman alone.

The Euclid Exoplanet Science Working Group is responsible for the design and science analysis of the Euclid Galactic Bulge Survey. As the data

Observational Fields

Observational Fields

Terry+ in prep

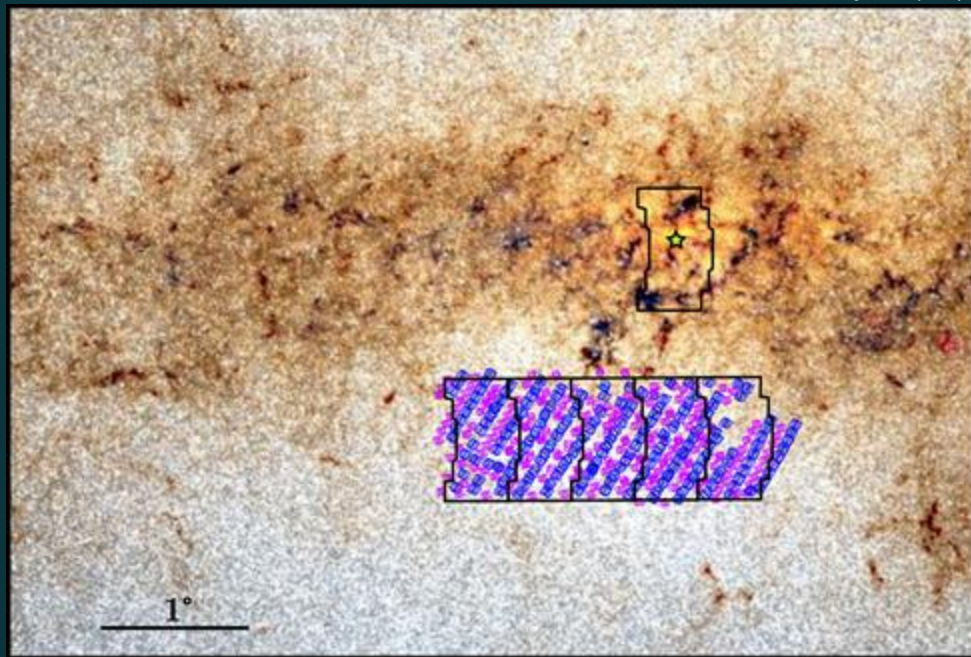


HST (354 fields)
~70% complete

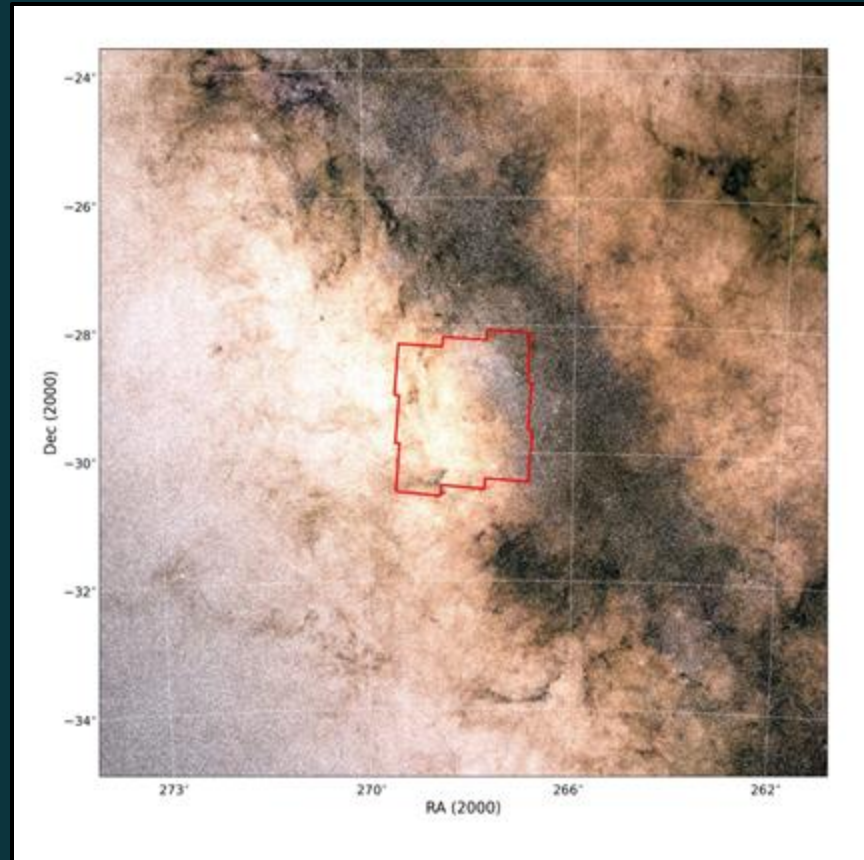
Observational Fields

Bozza+ in submitted

Terry+ in prep

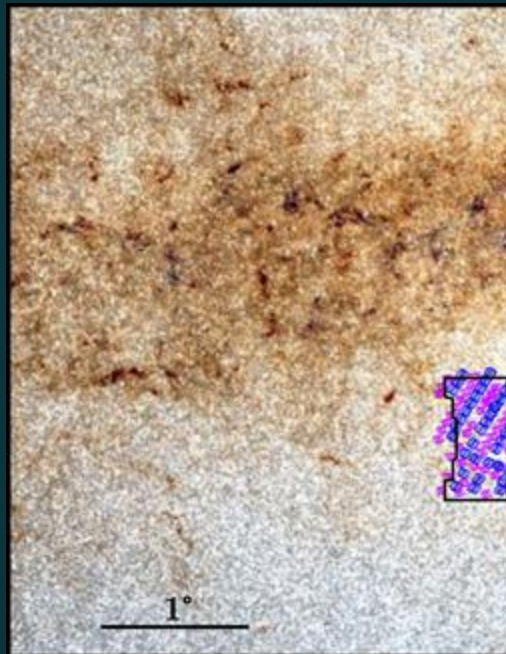


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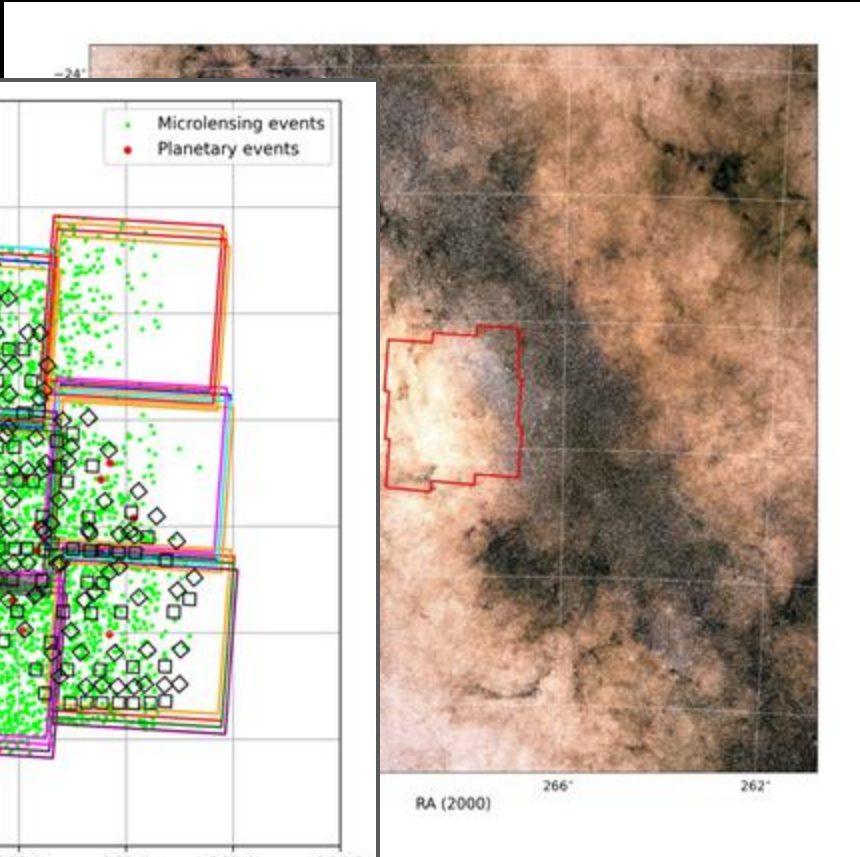
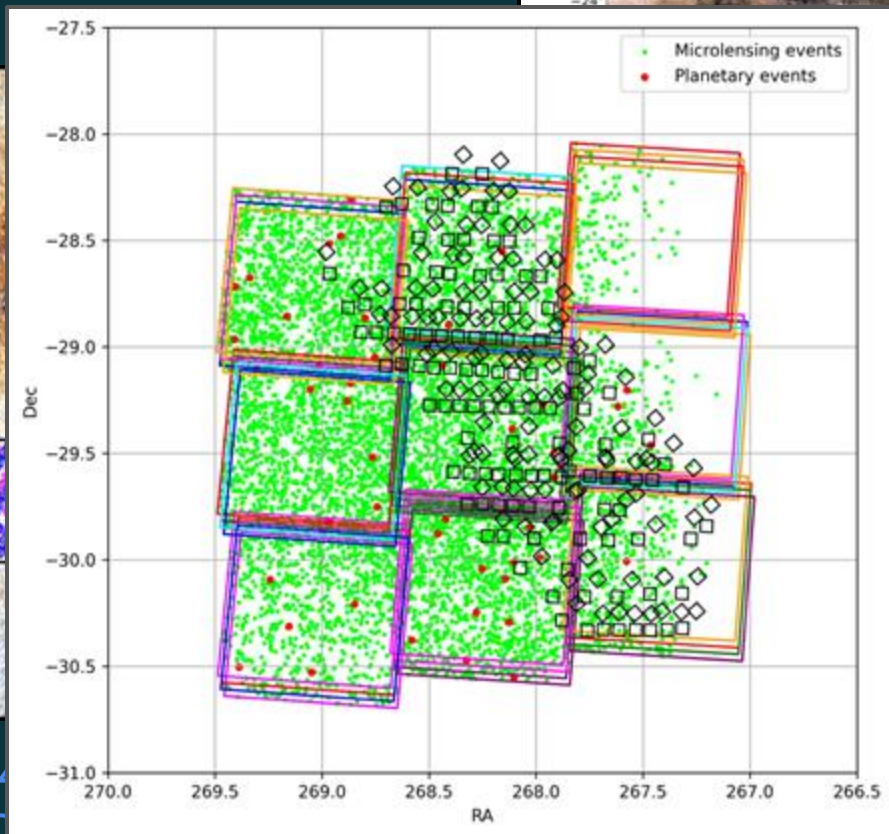


Euclid (9 fields)
Completed March 2025

Observational Fields



HST (35%
~70% co

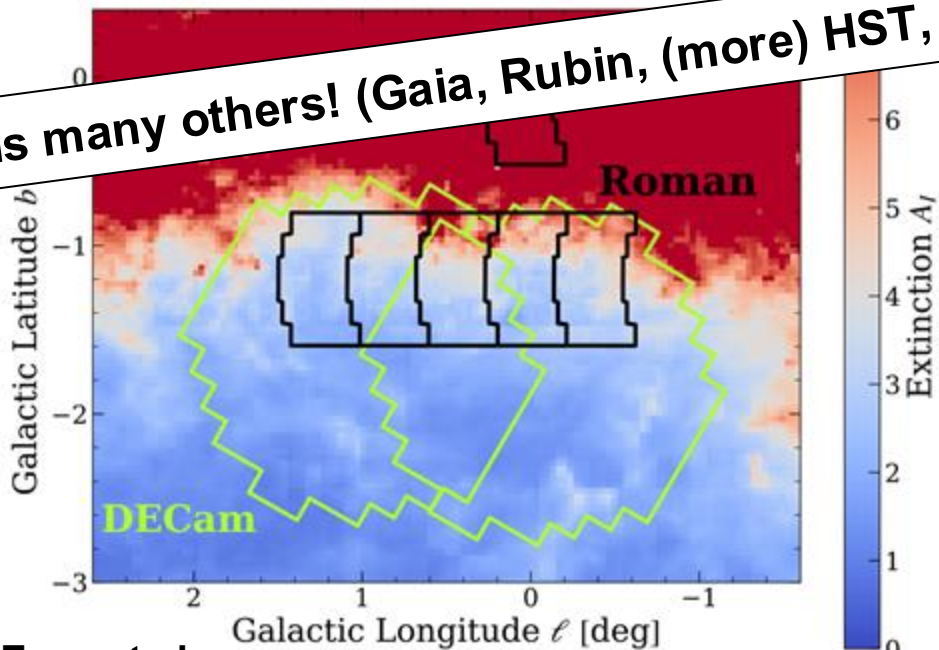


Legend (9 fields)
Completed March 2025

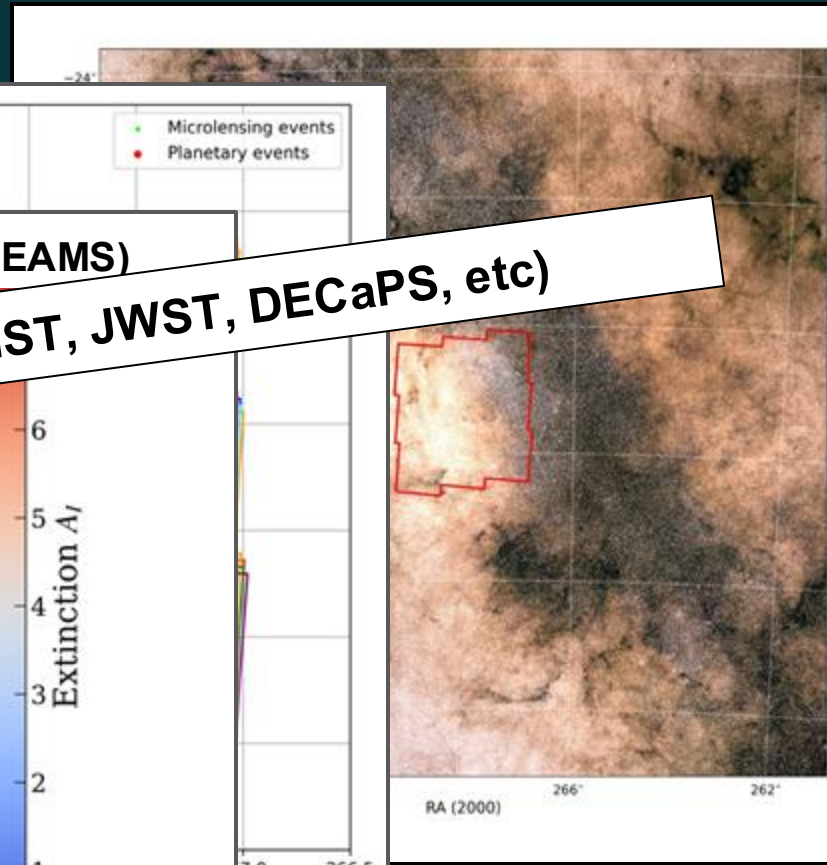
Observational Fields

DECam Rogue Earths and Mars Survey (DREAMS)

Plus many others! (Gaia, Rubin, (more) HST, JWST, DECaPS, etc)



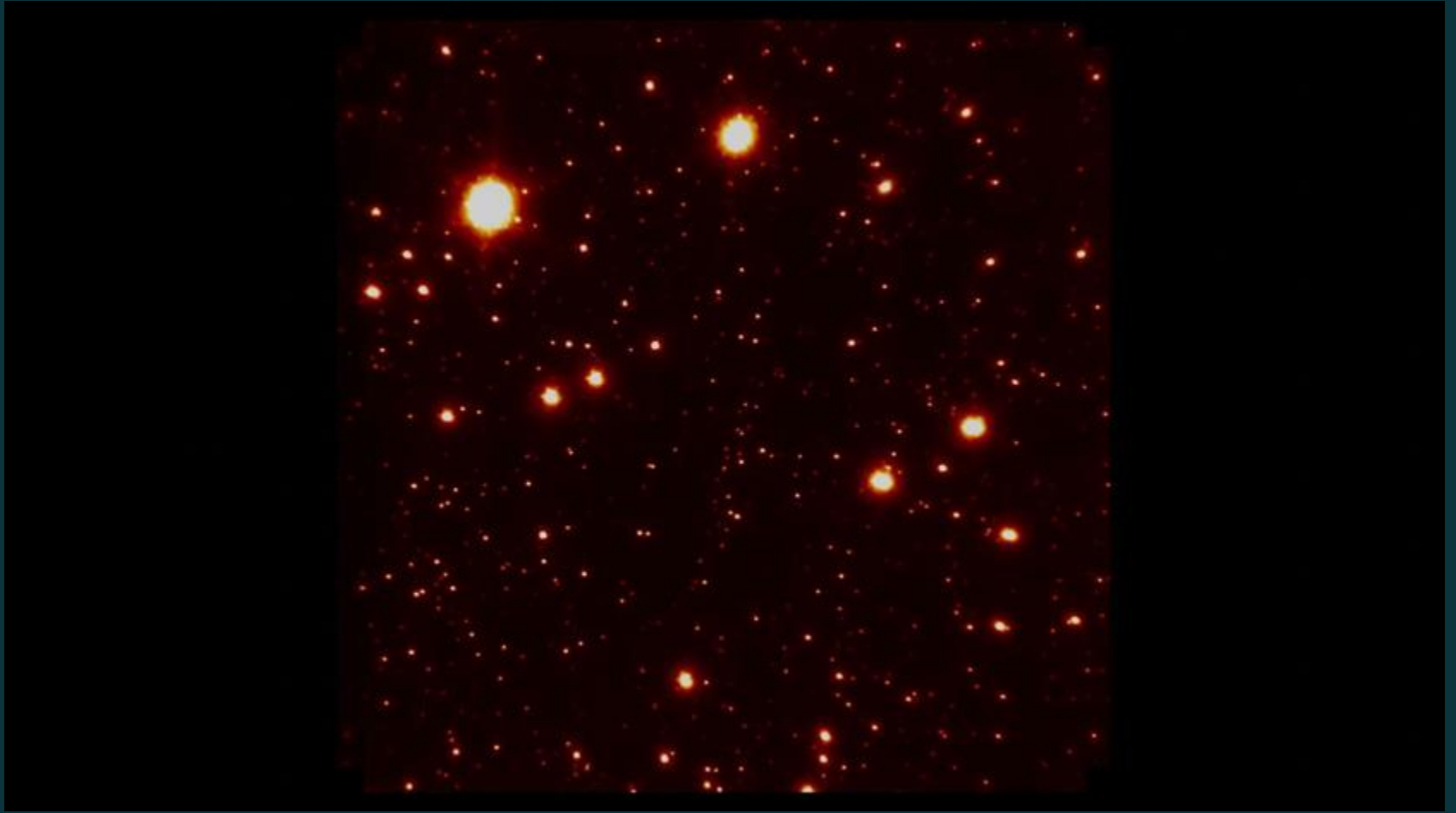
Zang et al.



Legend (9 fields)
Completed March 2025

One Science Case (Detecting Microlens Objects)

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Let's try to catch the lenses [in HST/Euclid] **BEFORE(!)** they align with the source stars [in Roman].

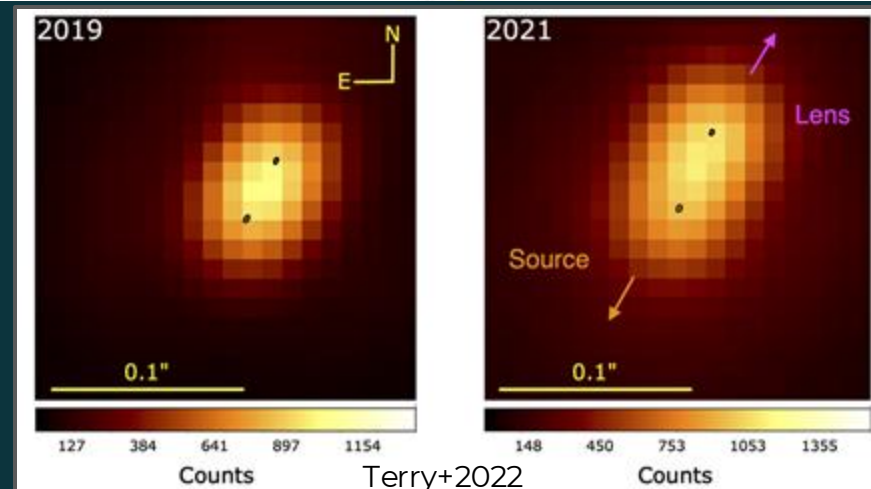
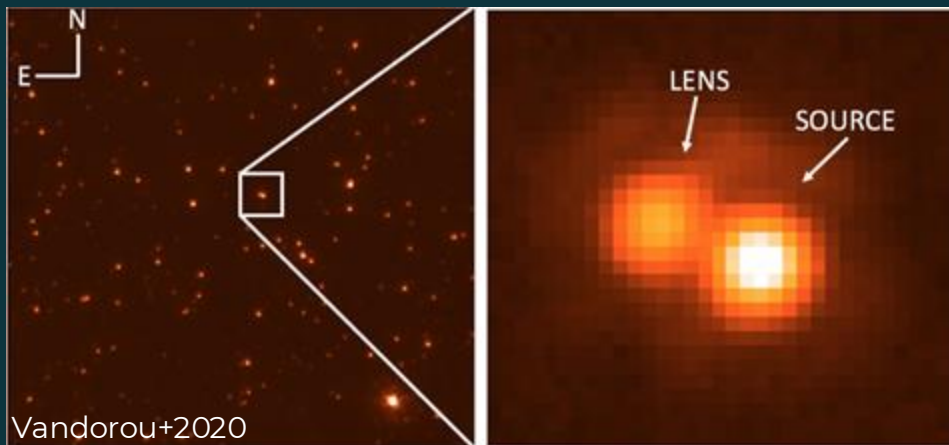
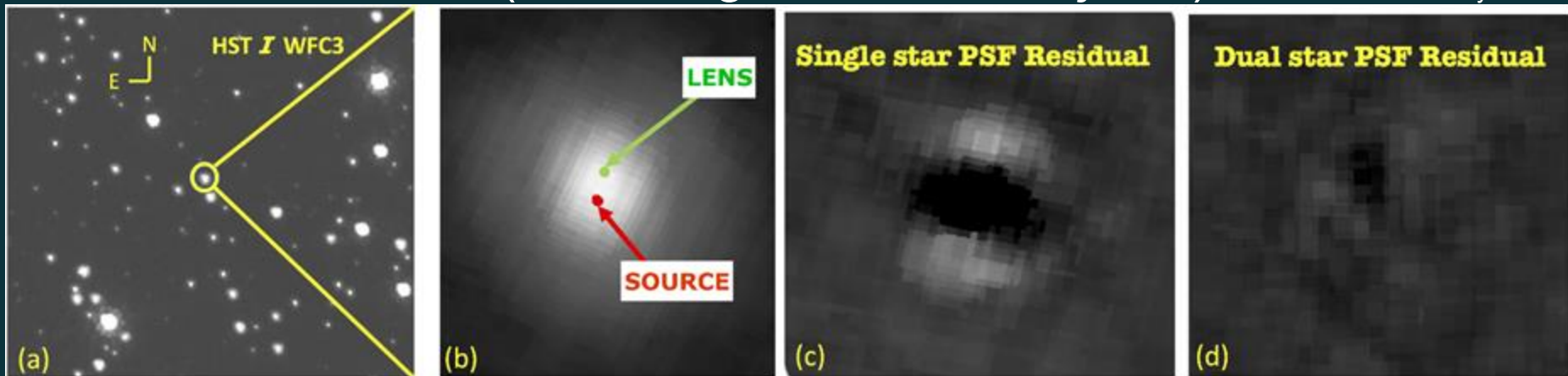
One Science Case (Detecting Microlens Objects)

Let's try to catch the lenses [in HST/Euclid] **BEFORE(!)** they align with the source stars [in Roman].

We have demonstrated lens detections for previous ground-based events many years **AFTER** peak magnification.

One Science Case (Detecting Microlens Objects)

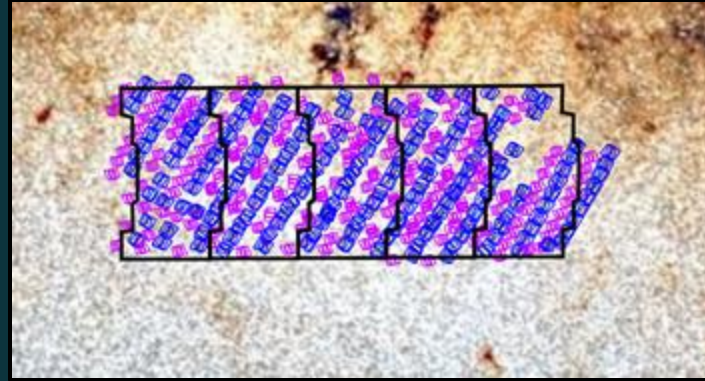
Bhattacharya+2018



Early Results: *HST* Precursor Survey

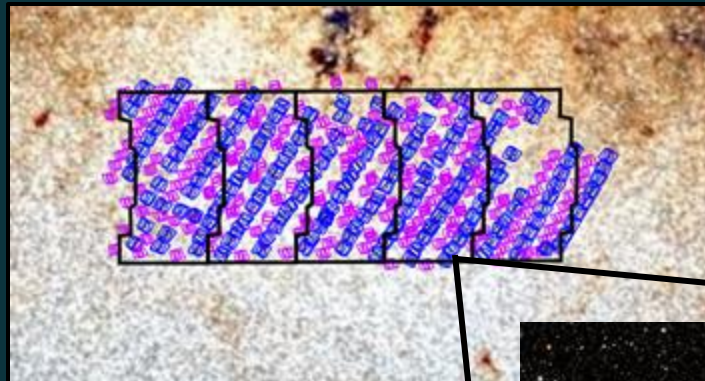
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Terry+ in prep



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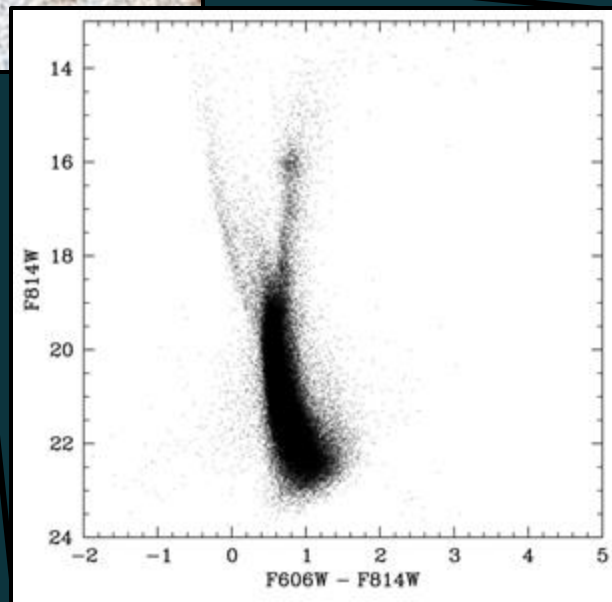
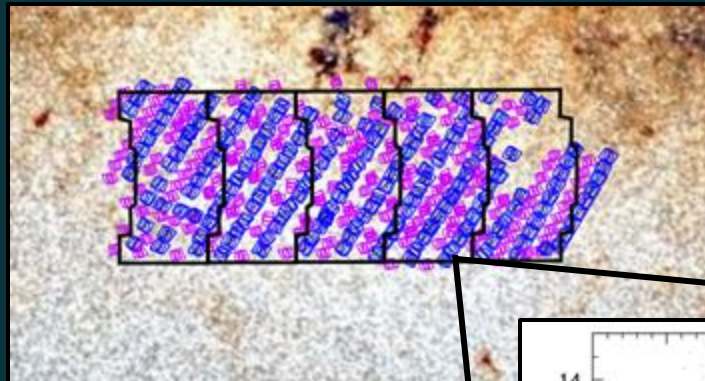


Terry+ in prep

~0.1% of HST footprint

Early Results: *HST* Precursor Survey

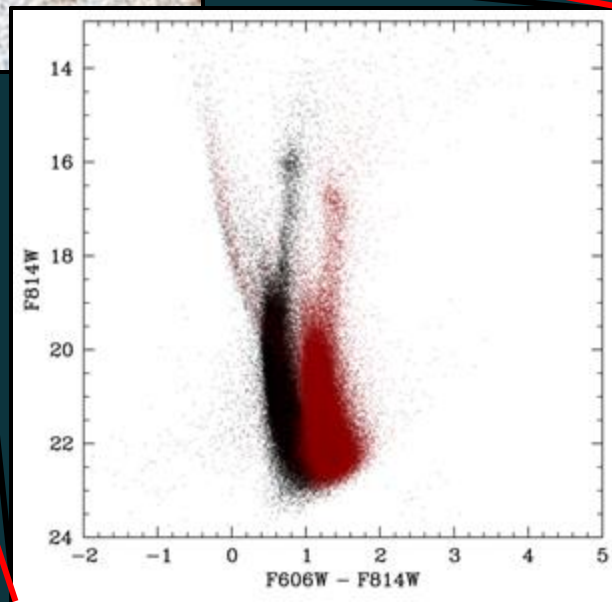
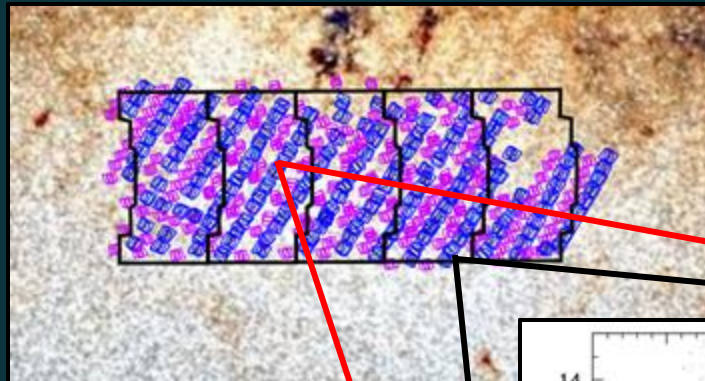
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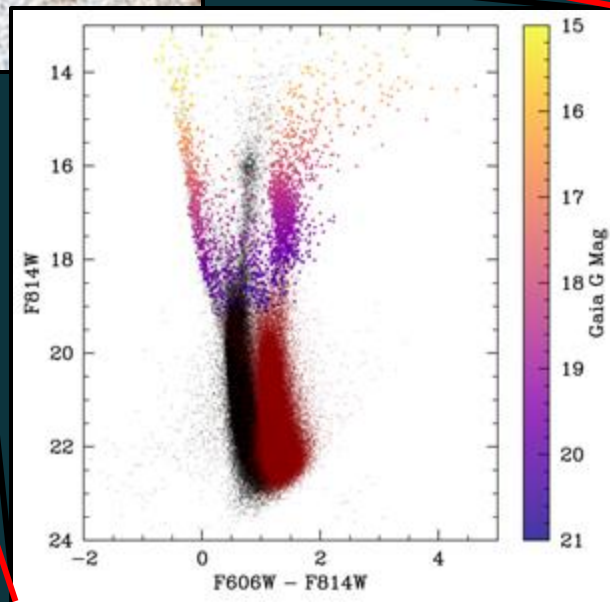
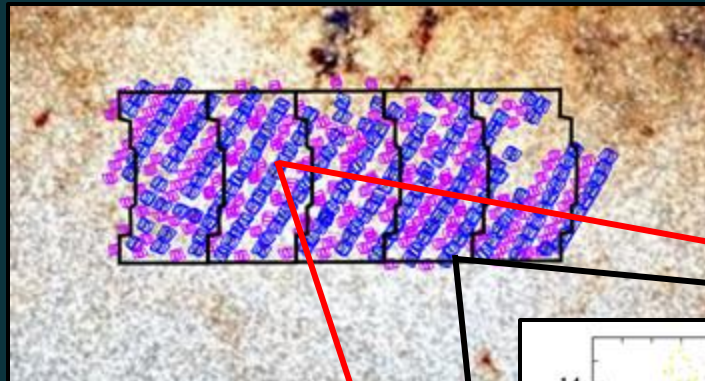
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Terry+ in prep



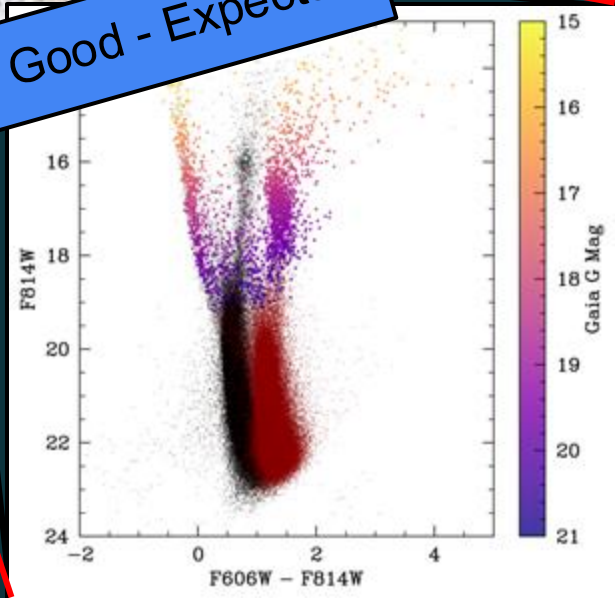
Terry+ in prep

Early Results: *HST* Precursor Survey

Terry+ in prep



All Good - Expected



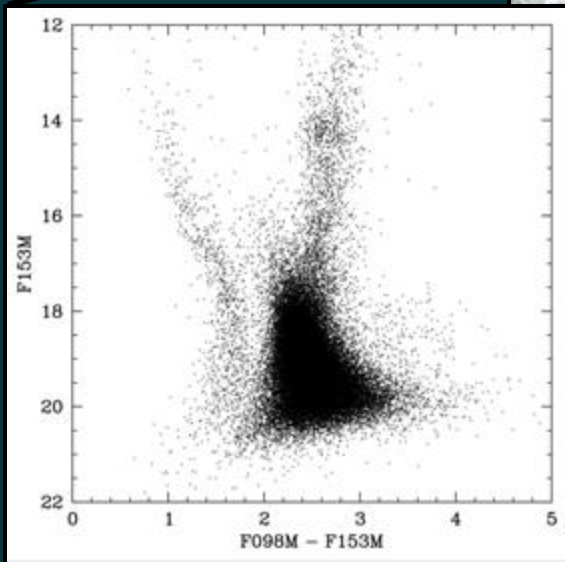
Terry+ in prep

Early Results: *HST* Precursor Survey

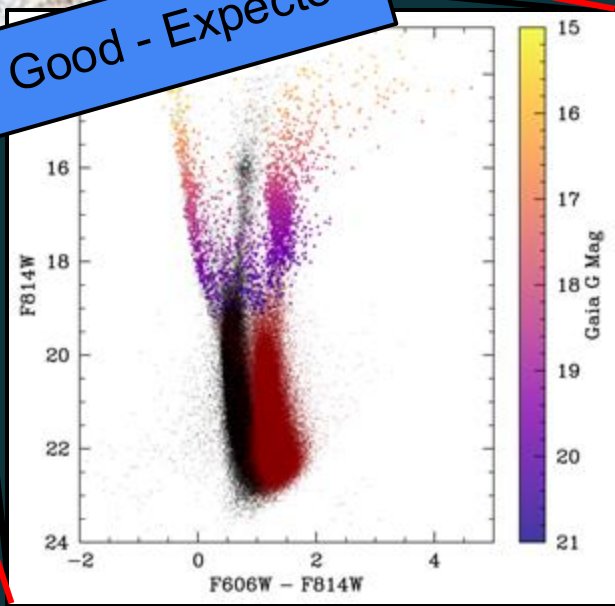
Terry+ in prep



Nataf+ in prep



All Good - Expected



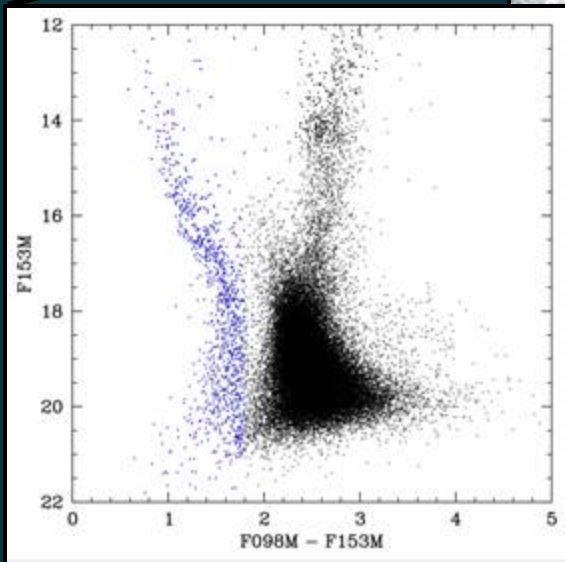
Terry+ in prep

Early Results: *HST* Precursor Survey

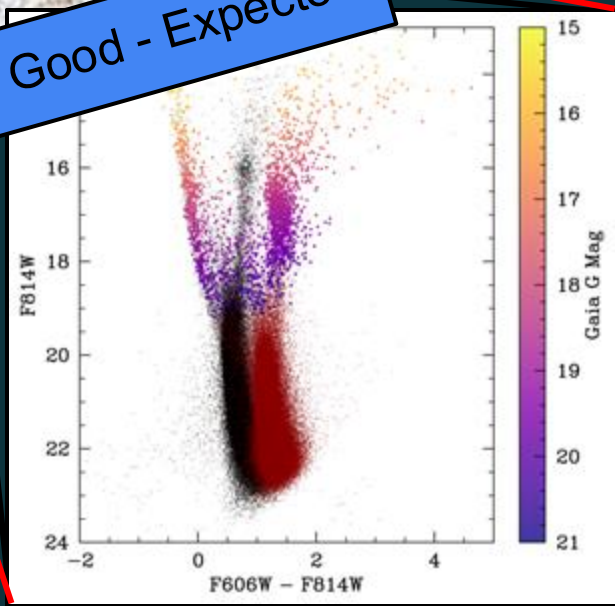
Terry+ in prep



Nataf+ in prep



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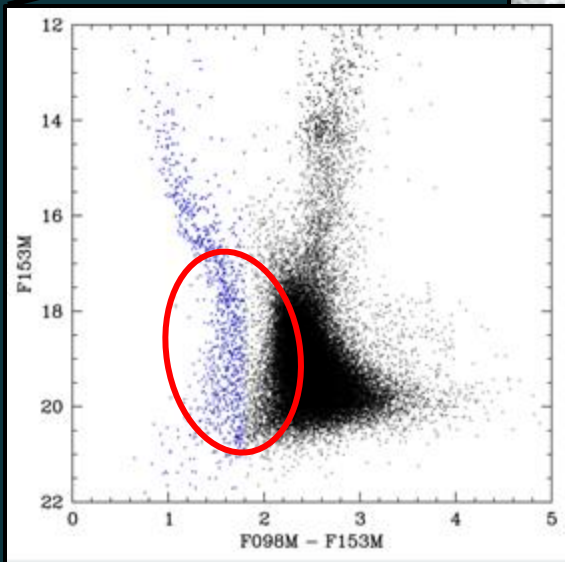
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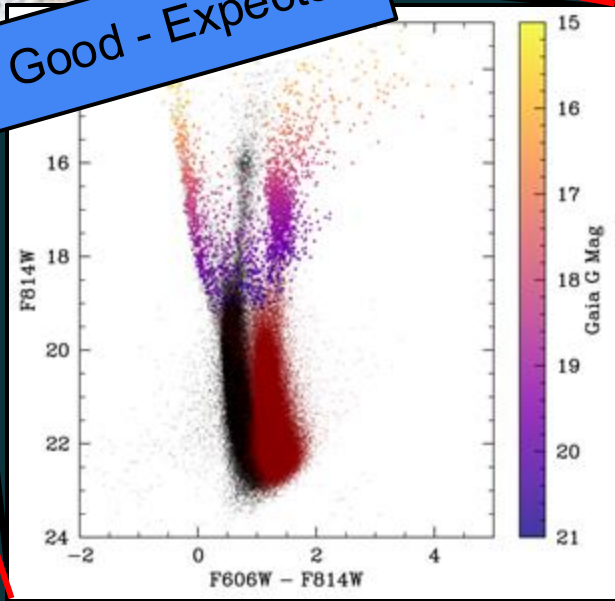
Terry+ in prep



Nataf+ in prep



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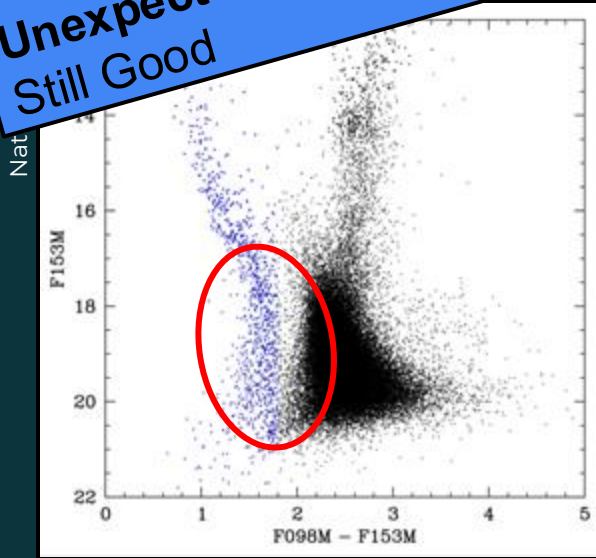
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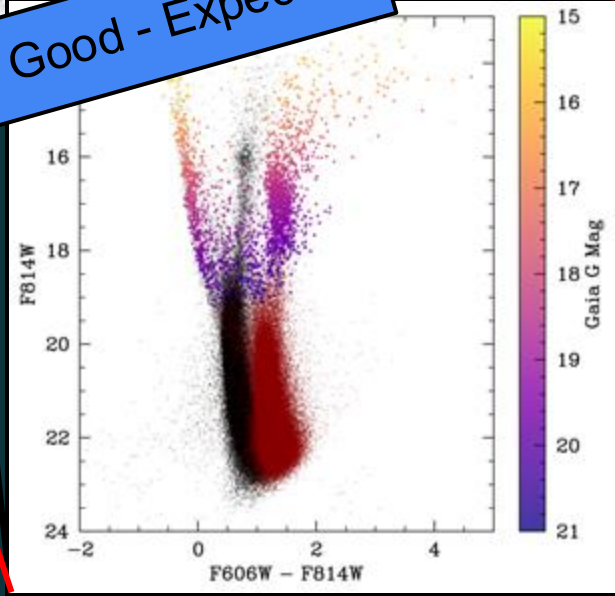
Terry+ in prep



**Unexpected!
Still Good**



All Good - Expected



Conclusions

- HST + Euclid + Other precursor surveys will ENHANCE Roman GBTDS science overall.
- *HST* survey delivers highest resolution dataset, extinction map, etc.
- HST data is immediately public. If you have a cool idea or know interesting objects that might've been captured, have a look yourself or contact me!
- Euclid data public June 2026.