



THE ROMAN GBTDS ALL-STAR CATALOG

Ashley Elliott¹, Alison Duck², Tabetha Boyajian¹, Sergio Fajardo-Acosta³, Emily Gilbert³, Samuel Grunblatt⁴, Kevin Hardegree-Ullman³, Xavier Lesley⁵, Eric Mamajek², Susan Mullaly⁶, David Nataf⁷, Jennifer Sobeck³, Kendall Sullivan⁸, Robert Wilson⁹

¹Louisiana State University, ²Jet Propulsion Laboratory, California Institute of Technology, ³Caltech/IPAC, ⁴University of Alabama, ⁵The Ohio State University, ⁶STScI, ⁷University of Iowa, ⁸University College London, ⁹University of Maryland/ NASA GSFC

THE GBTDS

- ★ The **G**alactic **B**ulge **T**ime **D**omain **S**urvey will use the Wide Field Instrument to perform high-cadence, continuous broad-band imaging of 6 fields towards the Galactic Bulge
- ★ Will operate over 6 observing seasons (72 days) over the 5 year Roman baseline mission
- ★ Additional lower cadence images and snapshots will be taken by Roman's other medium-band filters

SCIENCE GOALS

- ★ We will provide the first comprehensive catalog of stellar properties for the ~100 million GBTDS stars.
- ★ For stars with $F146_{\text{mag}} < 22$, catalog will provide:

- | | |
|--|---------------------------|
| ★ MSOS Object Identifier | ★ Metallicity |
| ★ Photometry (Roman, Rubin, Euclid, Gaia, and Hubble - Fig. 1) | ★ Age |
| ★ Radius | ★ Surface Gravity |
| ★ Mass | ★ Proper Motion |
| ★ Effective Temperature | ★ Distance |
| ★ Luminosity | ★ Extinction Prior |
| | ★ Binarity Indicator Flag |

AVAILABLE DATA SOURCES

- ★ To reduce source confusion, we will prioritize high-spatial resolution survey data and reject sources with insufficient spatial resolution in crowded regions.
- ★ MSOS sources will be cross-matched with existing and on-going surveys:

- ★ Gaia DR3 parallaxes for ~30,000 sources, photometry for ~1.5 million sources in the Roman GBTDS field
- ★ Rubin and Euclid observations of the GBTDS fields
- ★ Hubble photometric campaign will facilitate the line-of-sight extinction for 14 different representative fields of the GBTDS.

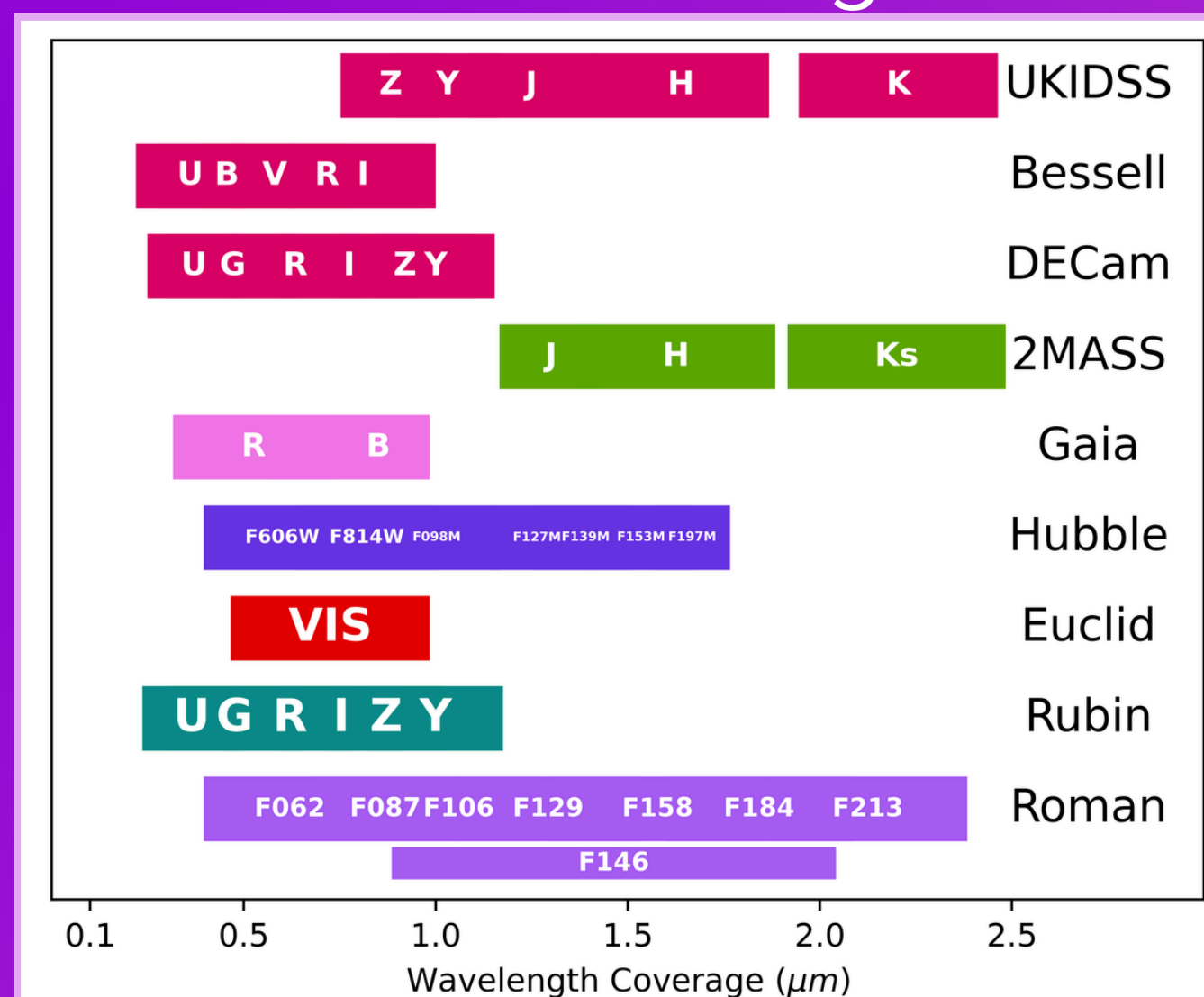


Figure 1: Comparison of the wavelength bandpass overlap between the Roman filters and other well known filters

MOTIVATION

- ★ Our ability to characterize exoplanets is fundamentally limited by our ability to characterize the host stars.
- ★ Roman is set to discover ~100,000 transiting exoplanets and ~1000 microlensing exoplanets by searching ~100 million stars in the Galactic Bulge.
- ★ A reliable stellar parameters catalog for the Roman stars will increase our understanding of the Roman exoplanets, which in turn will enable greater insight of exoplanet demographics.

Know thy star. Know thy planet.

METHODS

★ Empirical color- T_{eff} relations

- ★ Will be created using a catalog (Fig. 2) of stars directly measured with long-baseline optical/IR interferometry

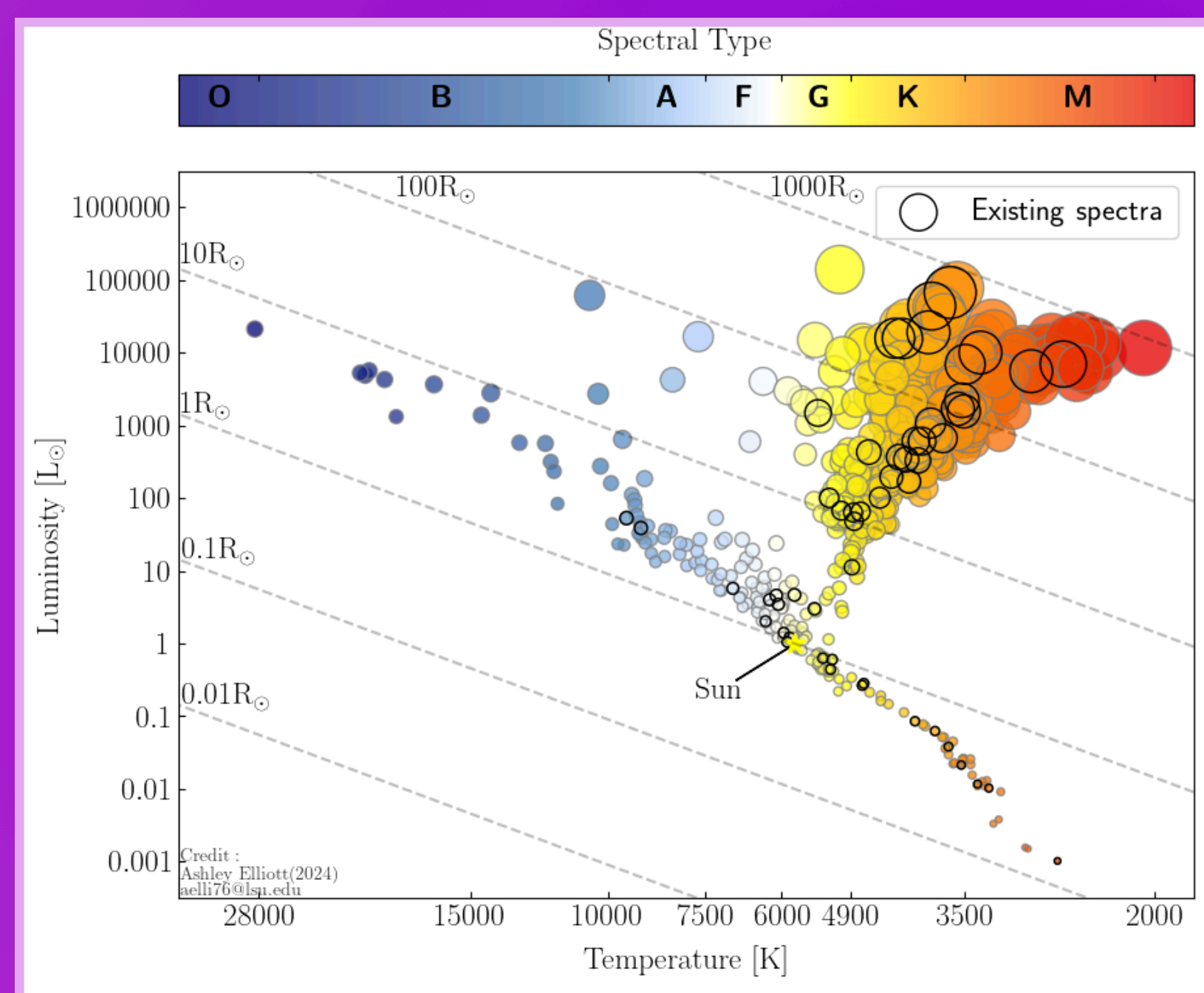


Figure 2: Empirical HR diagram consisting of 693 unique sources all with directly measured stellar properties

- ★ Photometry of stars will be converted into synthetic photometry in the Roman filters.

- ★ Will span between 2,000-28,300 K for full coverage across stellar parameter space.
- ★ Provide minimally model-dependent estimates of T_{eff} .

★ SEDs with Brutus (Speagel et al. 2025)

- ★ Simulated SED
- ★ Open-source Bayesian Python package capable of deriving stellar radius, mass, T_{eff} , luminosity, $[\text{Fe}/\text{H}]$, age, surface gravity, distance, and reddening from photometry and stellar model grids.

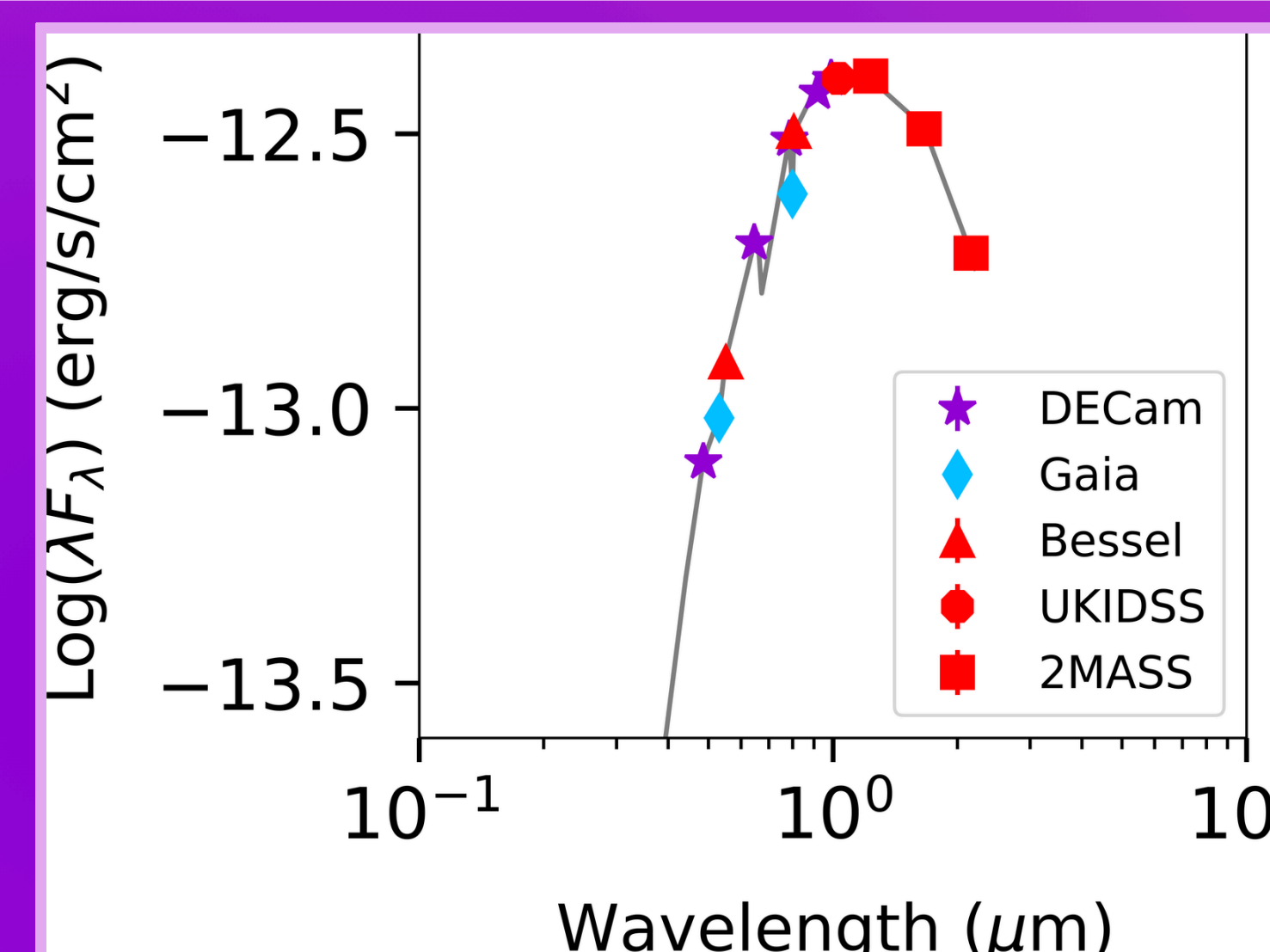


Figure 3: Simulated SED with Brutus of a model sun-like star at 4 kpc and an $A_v = 2.5$. We show the simulated Roman (red), Rubin (pink), and Hubble (blue) photometry using substitute bandpasses.

METHODS (CONT.)

Extinction towards the Galactic Bulge

- ★ Extinction will be estimated in each bandpass using high-res 2D E(J-Ks) measurements (see Fig. 4) from the VVV Survey photometry of the Galactic Bulge (Surot et al. 2020)
- ★ After Year 2, updated extinction maps will be created using LSST, Gaia DR4, and Roman photometry of red clump stars.

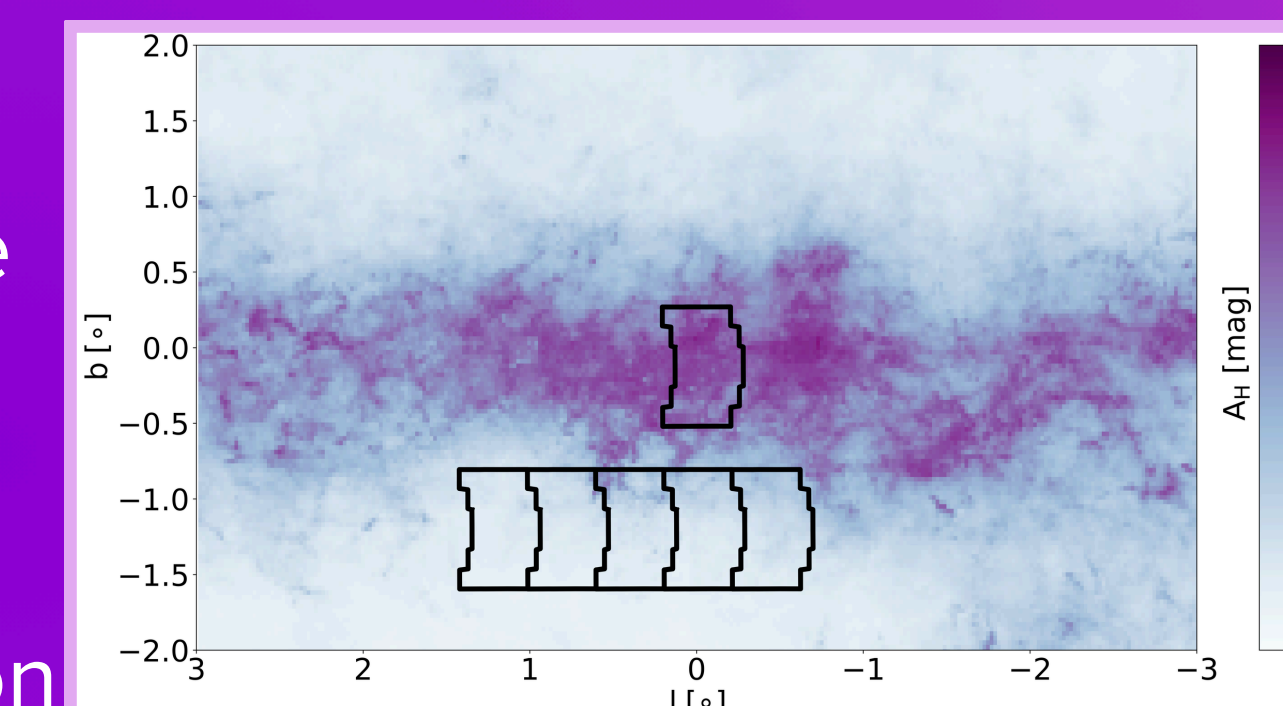


Figure 4: Reddening map of the VVV Bulge area from Surot et al. 2020 with the GBTDS fields overplotted

Parallax and Proper Motions

- ★ At the end of each season, MSOS will provide proper motions and parallaxes that will be incorporated into the pipeline.

Binarity and Blended Sources

- ★ Use proper motions and astrometry to identify any unresolved binaries, once available.
- ★ Apply multi-component PSF tools such as `blobblob` to estimate the fraction of stars with marginally resolved companions.

TIMELINE

- | End of Year 1 | End of Year 2 | End of Year 3 |
|---|--|--|
| First major catalog for all stars with $F146_{\text{mag}} < 22$ | Minor updates incorporating new sources, parallax info, etc. | Second major data release with updated information |