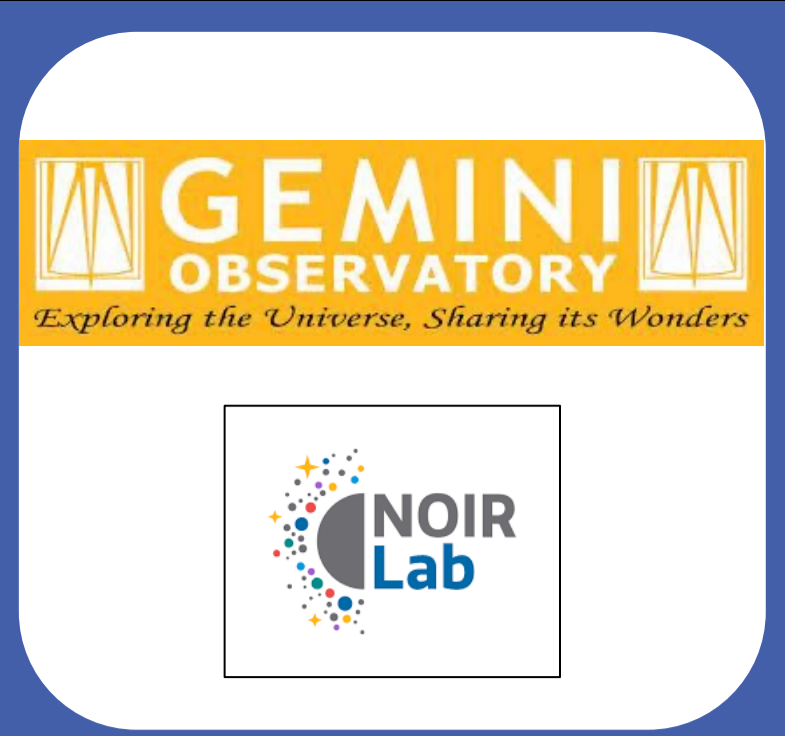


Examining the Multiplicity of Halo Stars within 100 Parsecs with Gemini

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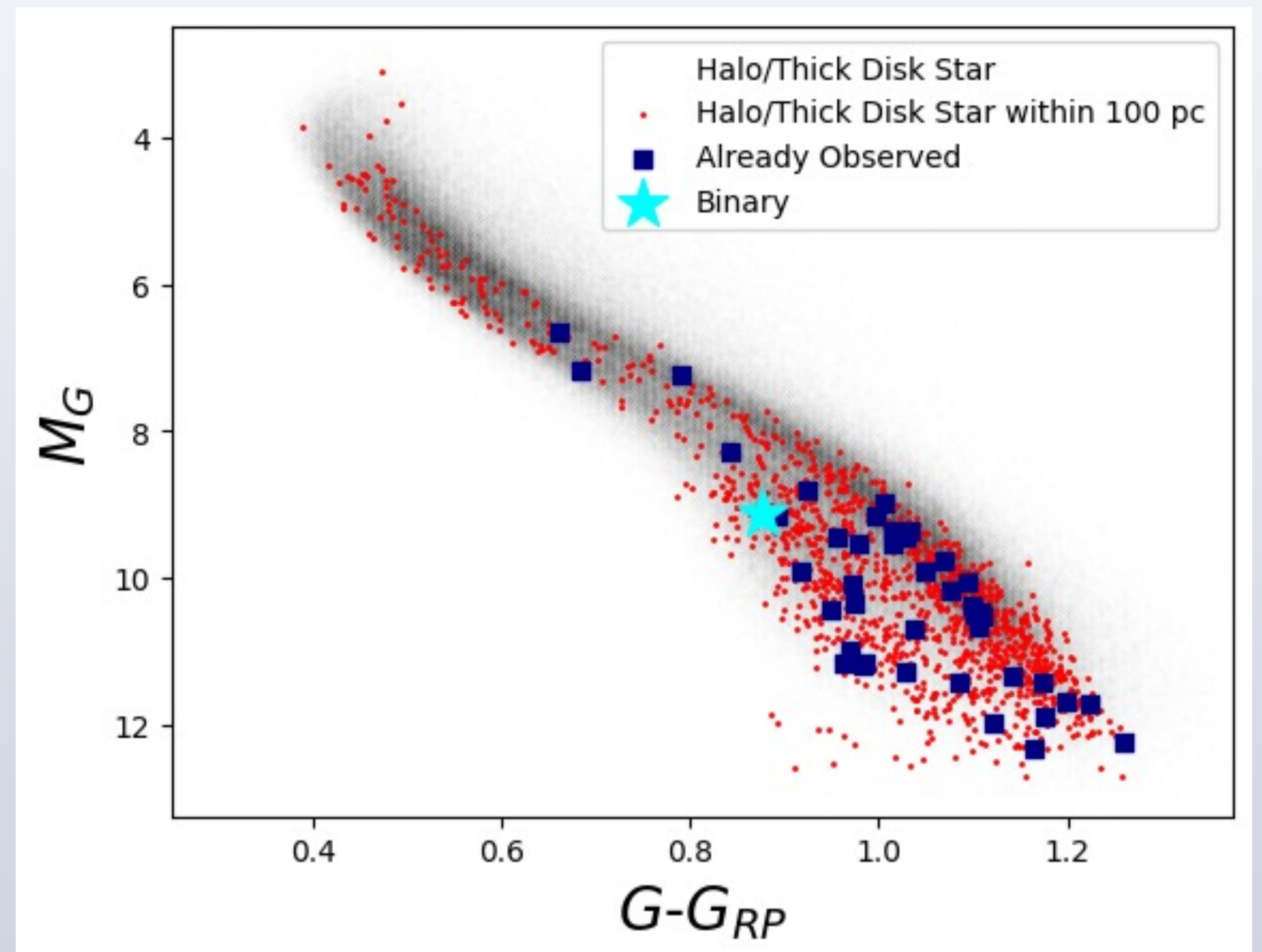
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Abstract

Over the past decade, our knowledge about the stellar multiplicity fraction as a function of various stellar parameters has been steadily filled in. It is now commonly accepted that as the stellar mass of the primary star decreases, the multiplicity fraction also decreases. However, the multiplicity fraction as a function of age continues to be elusive. In particular, the multiplicity fraction for old halo stars is not well known, with estimates varying between 12%-40%. To begin to address this, we present the first results of a speckle imaging campaign using `Alopeke and Zorro of old/metal-poor halo stars within 100 pc. Our targets are drawn from a sample of 1259 nearby halo stars that were identified in a cleaned-up sample of *Gaia* EDR3 stars selected based on their location in the reduced proper motion diagram and their large transverse velocities. Out of the 43 stars examined, 1 shows signs of binarity. We present some of the reconstructed images for our observed sample and comment on the lack of binaries in our examined stars. Additionally, we identify wide binaries by crossmatching our sample with that of published wide binary catalogs.

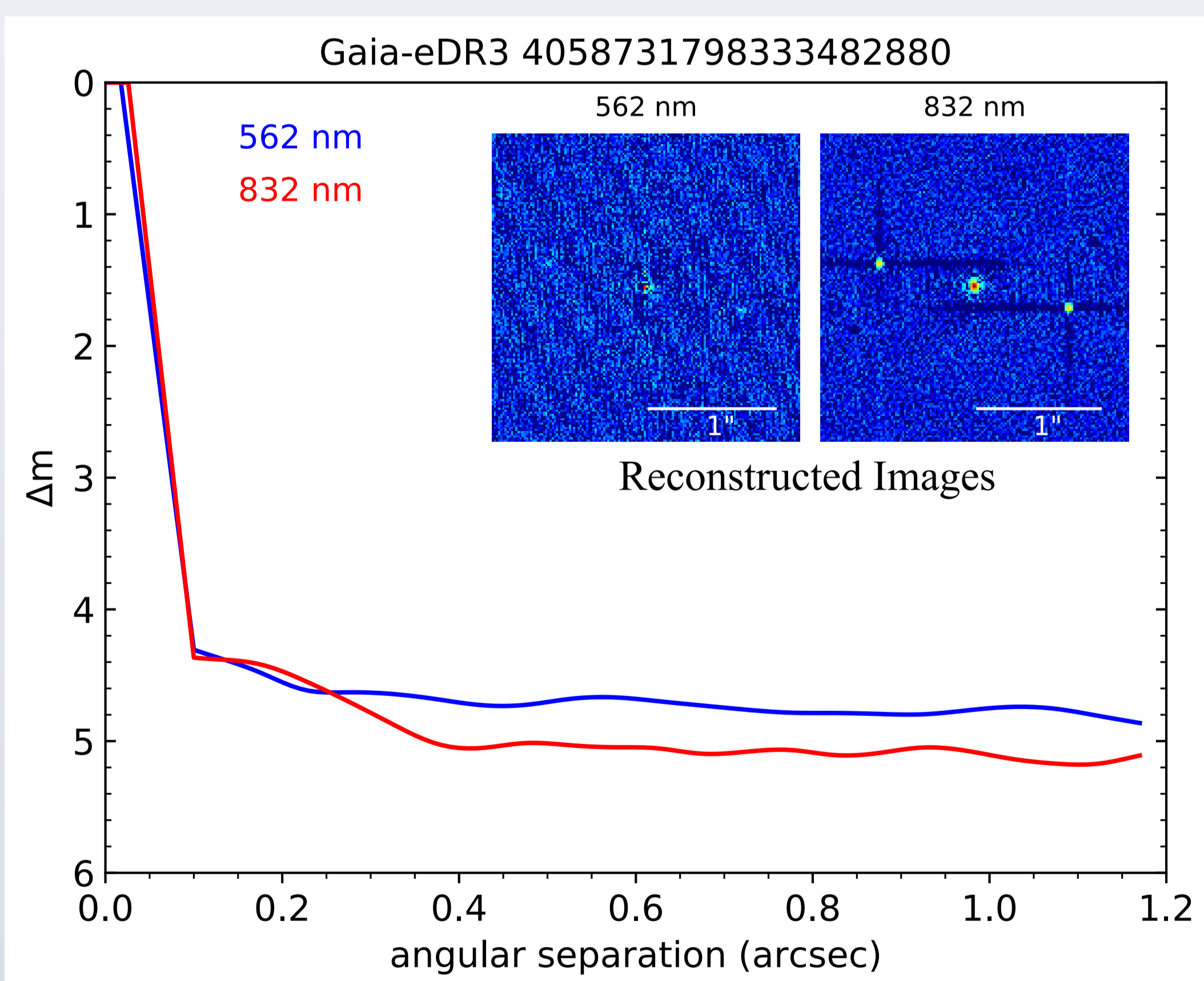
Selecting Local Galactic Halo/Thick Disk Stars within 100 Parsecs

- We start with the catalog of Kim & Lépine 2022.
 - Catalog is constructed from a "cleaned" sample of stars from *Gaia* EDR3 with $\mu > 40$ mas/yr
 - RUWE < 1.4
 - Error cuts on the parallax error and BP/RP flux errors
 - Final selection using Reduced Proper Motion Analysis
 - 551,214 halo/thick disk candidates within 2 Kpc
- We select a subset of 1259 stars from this catalog.
 - Distances < 100 pc
 - Estimated V magnitudes from *Gaia* Photometry < 18
 - Removed white dwarfs from the sample.



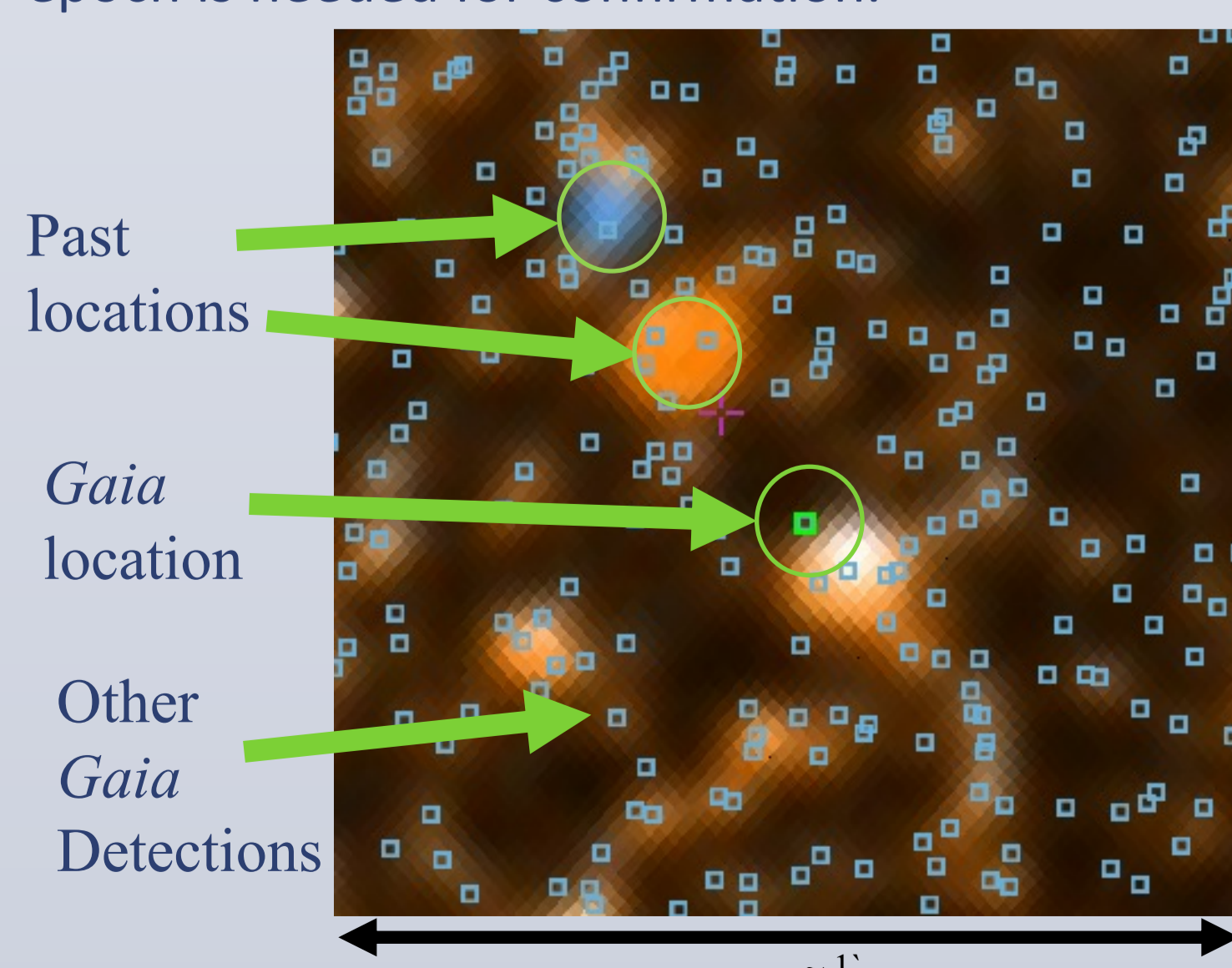
`Alopeke/Zorro Observations

- Over the course of the 2022B Semester, 43 halo stars have been observed with `Alopeke and Zorro.
 - Out of those 43, only **ONE** speckle binary candidate has been found.

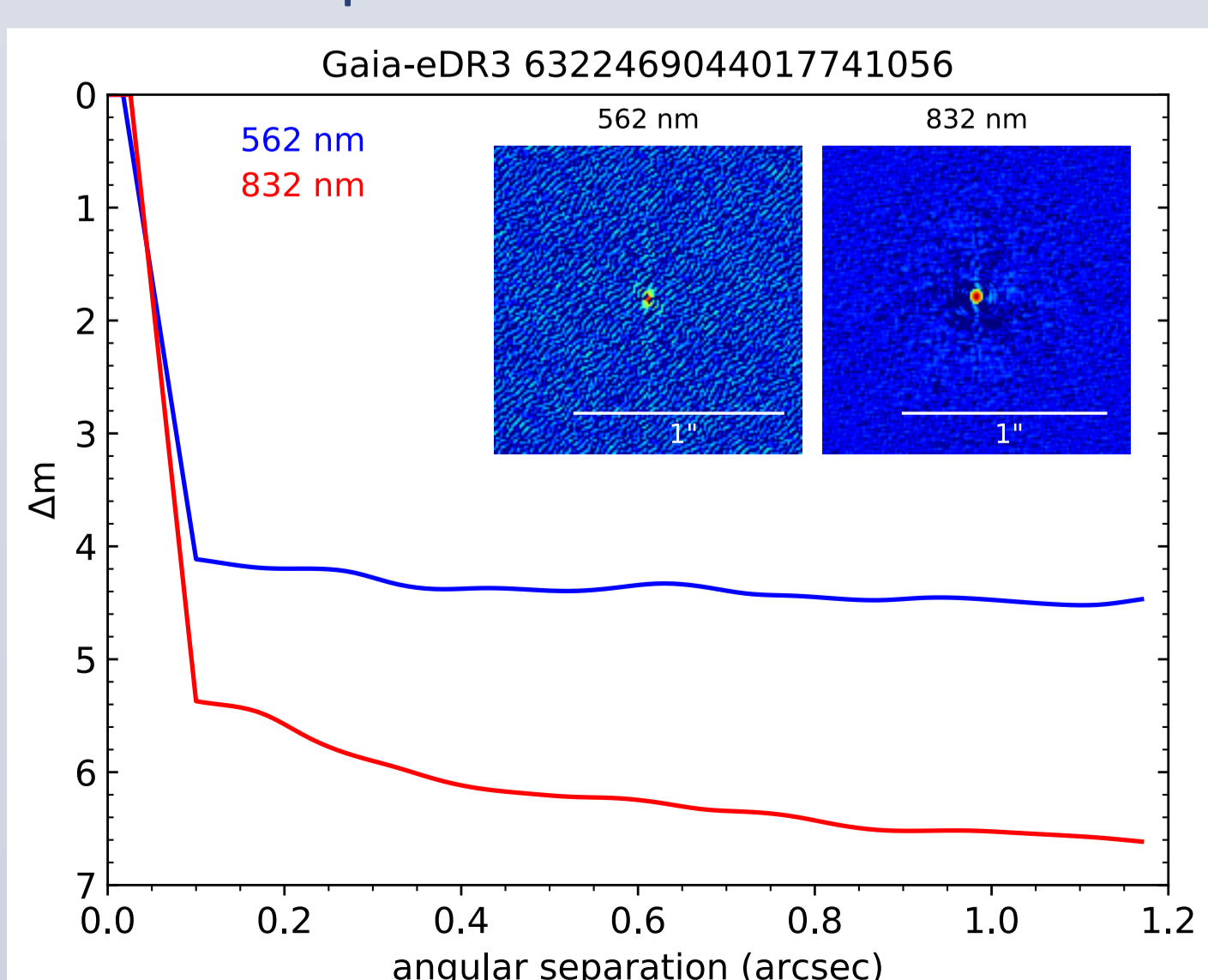


$\theta = 0.78''$
 $\Delta m_{562} = 3.28$
 $\Delta m_{832} = 1.21$
 RUWE = 0.862
 $G = 14.04$
 $G - G_{RP} = 0.875$

Aladin picture of field around detected binary candidate. Given the crowded field, another epoch is needed for confirmation.

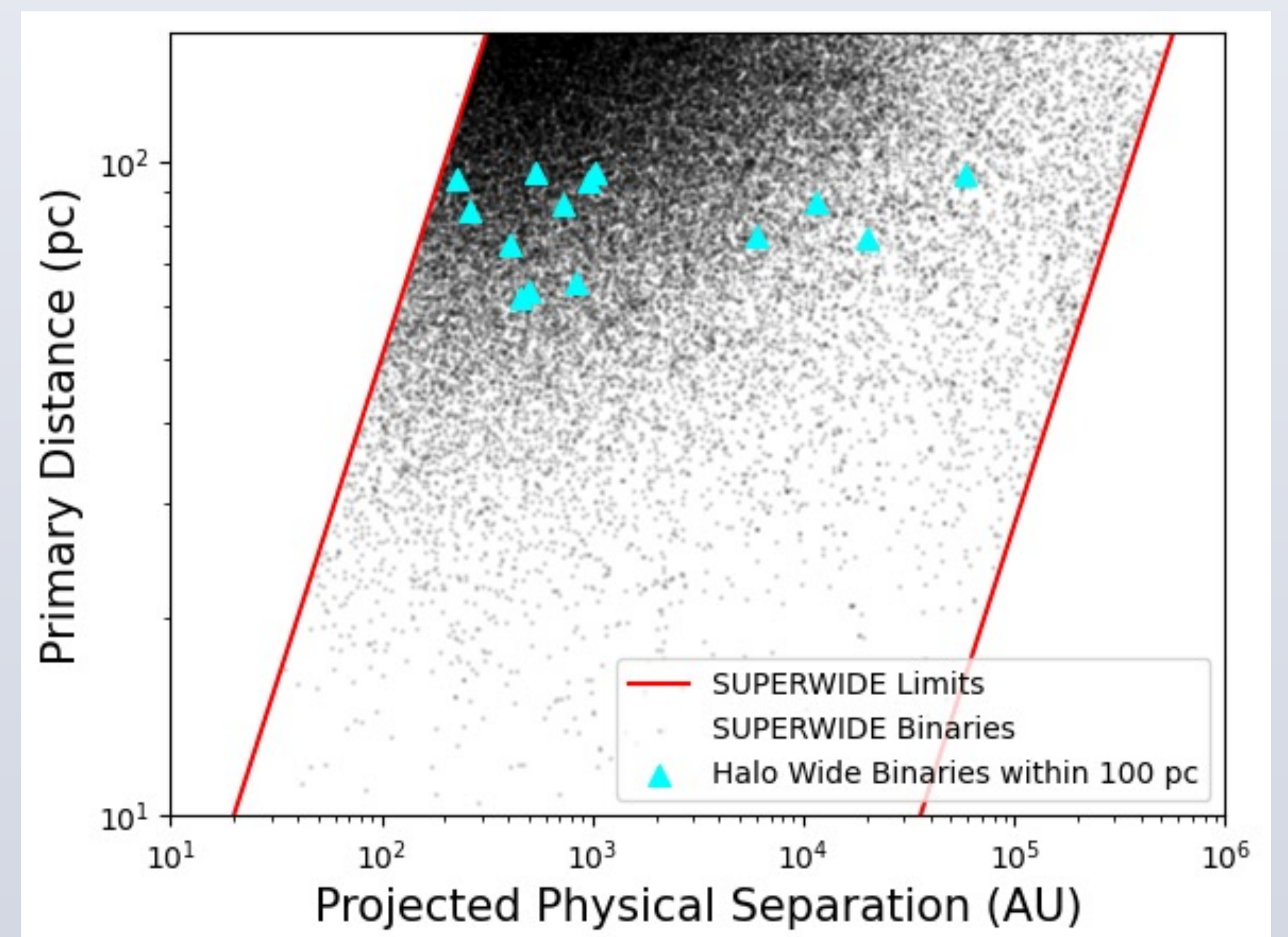


Example of Non-detection



Wide Binary Cross-match with SUPERWIDE

- We compare our sample of stars with the SUPERWIDE catalog of wide binaries (Hartman & Lépine 2020).
 - Bayesian Analysis of *Gaia* DR2 (now updated to DR3) using angular separations, proper motion difference and distance differences
 - Searched for common proper motion pairs with separations between $2''$ and $3600''$.
- We find 14 matches between the two catalogs.



- Future work involves expanding the sample to include Halo/thick disk stars within 100 pc that may have high errors in *Gaia* indicating the presences of an unresolved companion and continuing the speckle campaign.