

# SEARCHING FOR BINARY Y DWARFS WITH THE GEMINI MULTI-CONJUGATE ADAPTIVE OPTICS SYSTEM (GeMS)

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## ABSTRACT

The NASA Wide-field Infrared Survey Explorer (WISE) has delivered an exceptional harvest of new ultra-cool Y-type brown dwarfs. We present results from a diffraction-limited study of the binary status of a sample of Y dwarfs observed with the Gemini GeMS Multi-Conjugate Adaptive Optics system. We report no evidence of equal mass/luminosity binaries at separations larger than ~ 0.5 -2.0 AU for six Y dwarfs.

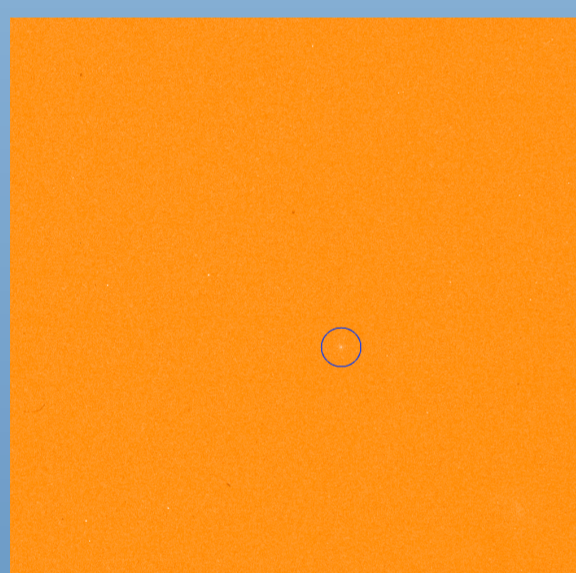
### OBSERVATIONS GEMS + GSAOI

Our images were recorded with the Gemini South Adaptive Optics Imager (GSAOI) and corrected for atmospheric aberrations by the Gemini Multi-conjugate Adaptive Optics System (GeMS).

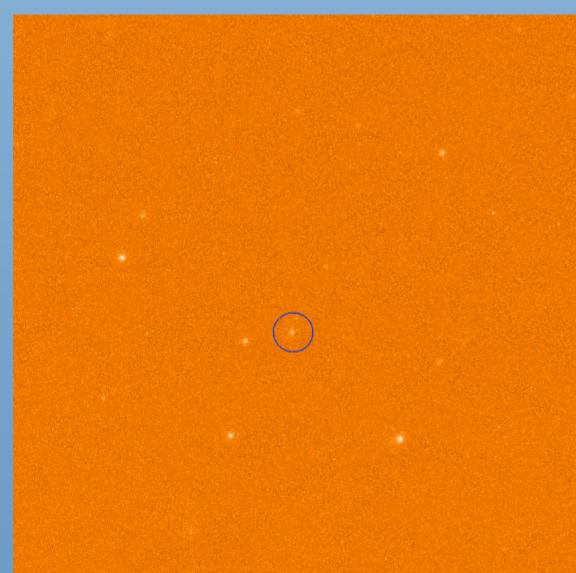
GSAOI has an image scale of 0.02"/pix and offers access to a field of view of 85"x 85".



The observations were obtained between March 2013 to January 2014 and delivered a typical FWHM of 85 mas in the CH<sub>4</sub>S passband (1.486-1.628 μm)



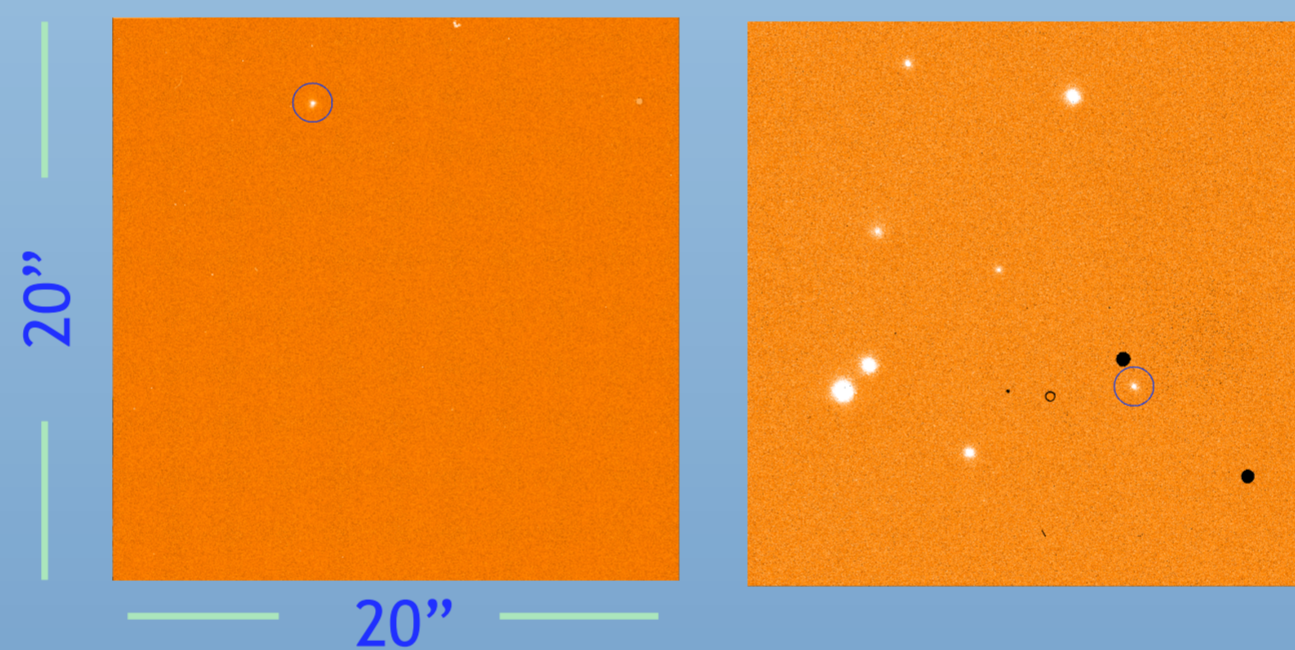
W0359



W0535

### TARGETS

Target	Magnitude (J)	Spectral Type
W0359	20.0	Y0
W0535	22.0	Y1
W0647	22.4	Y1
W0713	20.0	Y0
W1541	21.0	Y0.5
W1639	20.6	Y0

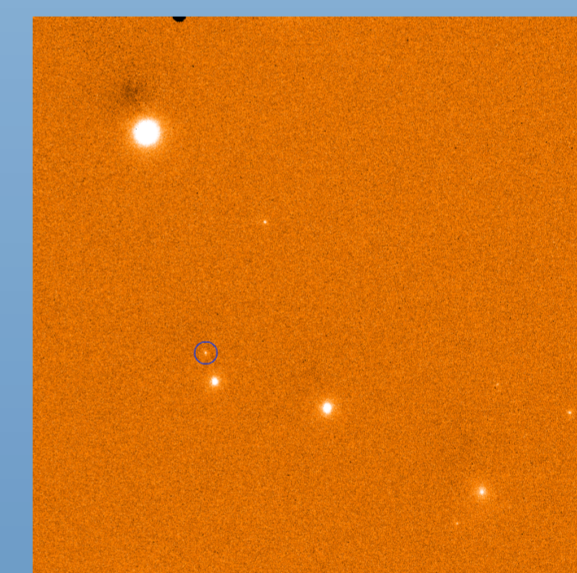


W0647

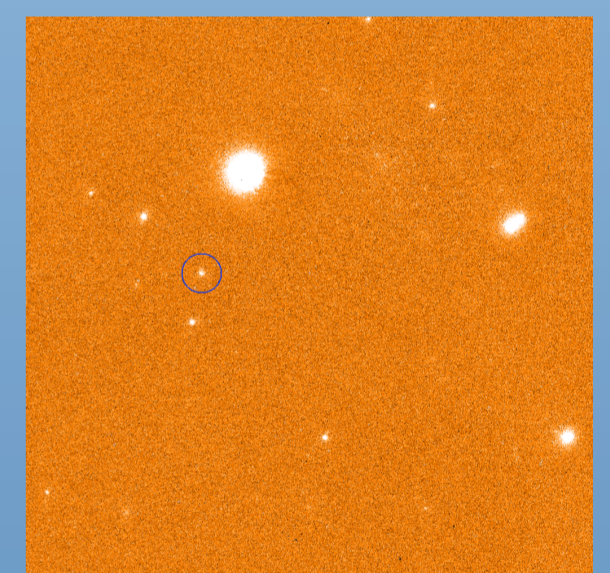
W0713

### UPPER LIMITS ON BINARITY

- Photometry was performed using the DAOPHOT II package implemented within the Starlink environment.
- Unsaturated stars were selected and used to determine the Point Spread Function (PSF).
- This PSF was used to fit and subtract all identified stars within the image.
- This did not reveal any companions within the halos of the Y dwarf targets.



W1541



W1639

### RESULTS

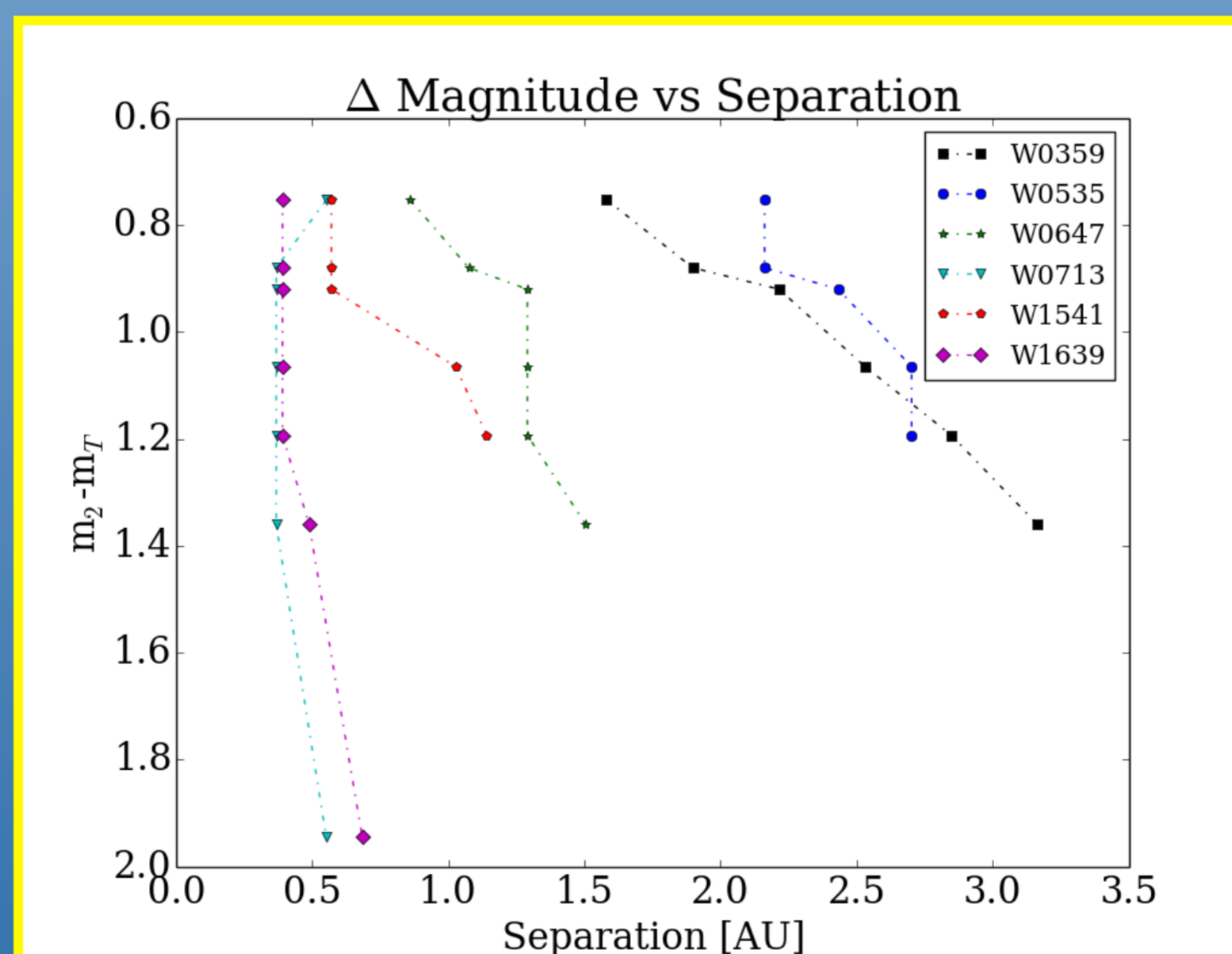
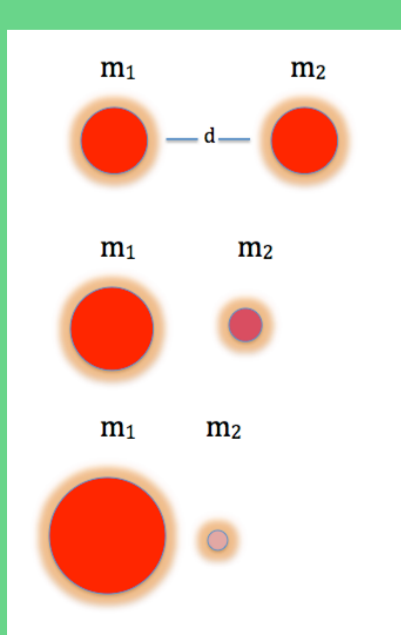


Fig. 1 Magnitude limit versus separation for our 6 objects.

### SIMULATIONS

Simulations were performed to determine the magnitude and separation limits for the non-detection of companions.

We injected synthetic binaries with a variety of separations and component magnitudes spanning 0.02-0.2" and a flux ratio of 0.2-1.0 into the observations to reproduce each object, where  $m_1$  is the



magnitude of the primary,  $m_2$  is the magnitude of the secondary and  $m_T$  refers to the magnitude of the system in total.

The magnitude and separation limits established by visual confirmation are displayed in Fig. 1.

### CONCLUSION

- None of these Y dwarfs are equal mass/luminosity binaries at separations larger than ~ 0.5-2.0 AU.
- Our best data is for W1639 and W0713 and shows no evidence for binarity to limits ~  $\Delta m = 2.0$  mag in CH<sub>4</sub>S at separations beyond 0.5 AU.

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### REFERENCES

- Beichman et al. 2014, ApJ, 783, 68
- Cushing et al. 2011, ApJ, 743, 50
- Kirkpatrick et al. 2012 ApJ, 753, 156
- Kirkpatrick et al. 2013 ApJ, 776, 128
- Tinney et al. 2012 ApJ, 759, 60