Binary Candidates in the Jovian Trojan and Hilda Populations from NEOWISE Lightcurves

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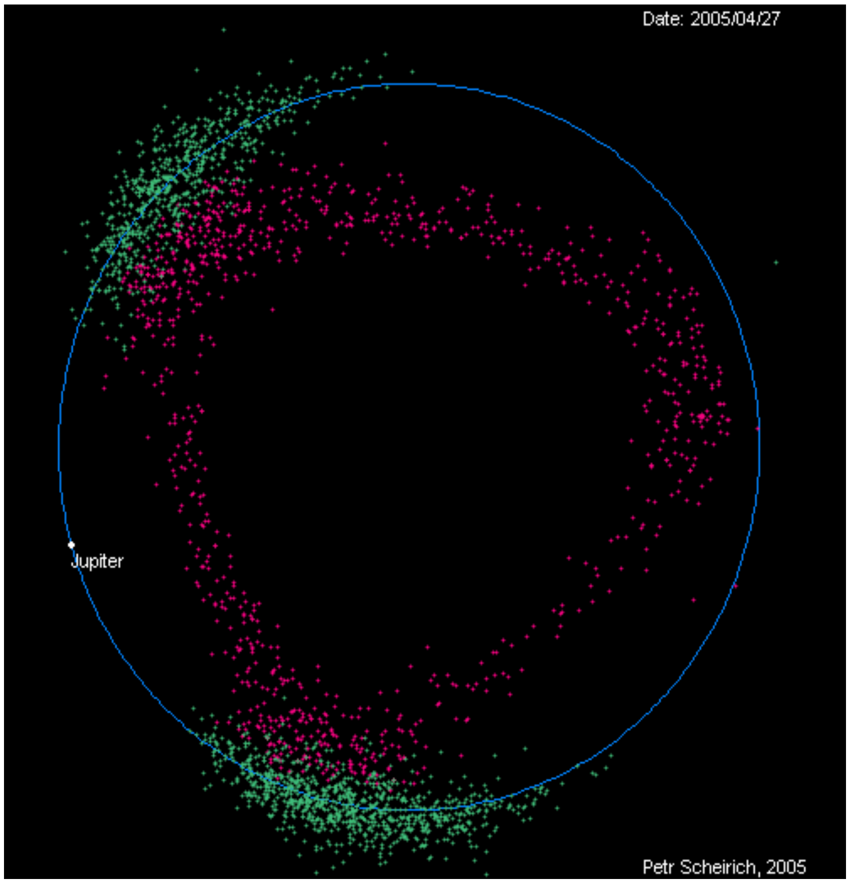
Sonnett et al. (2015)

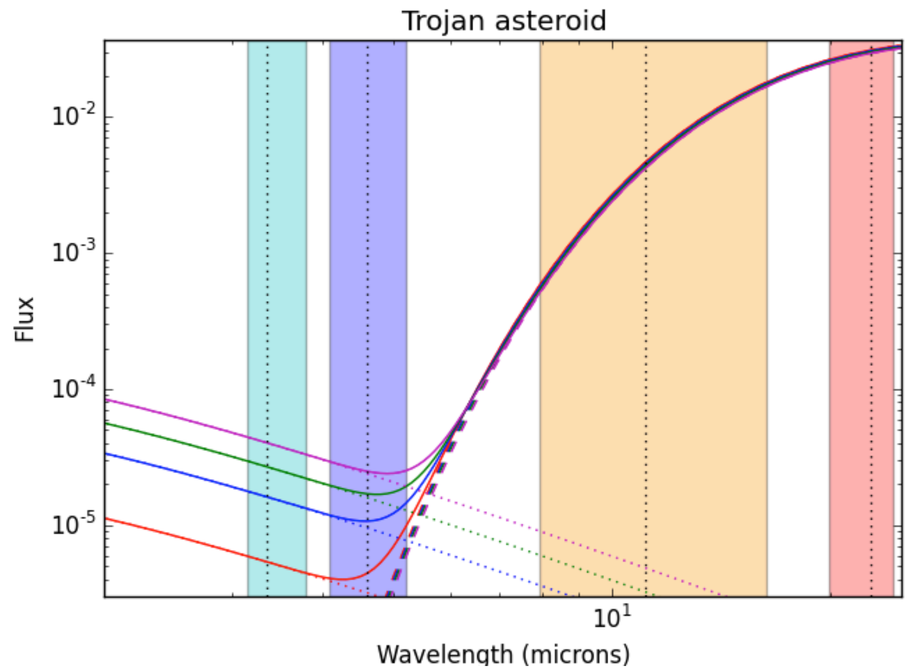
Jovian Trojans: Diagnostics of Solar System Formation

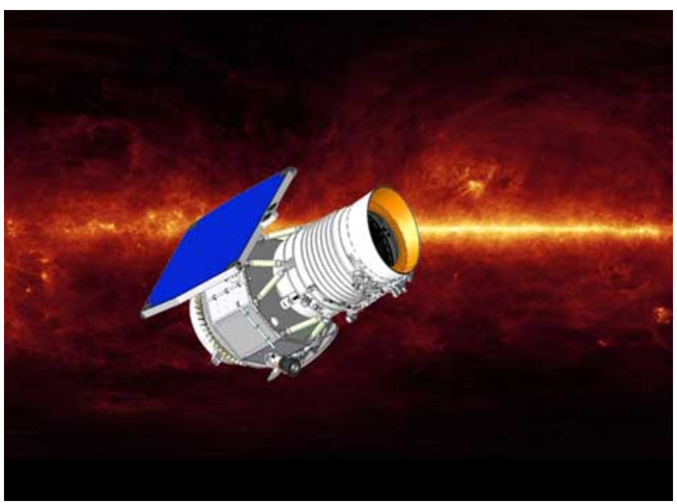


- ~ 5500 Trojans: in situ formation or implantation?
- ~ 3900 Hildas
- Similarity between Trojan clouds → Jupiter migration
- Similarity to other small body populations → supply rate and formation location
- Dominant binary formation mechanism? → dynamic and collisional evolution

WISE observations of Trojans & Hildas

- All-sky Infrared Survey
- Simultaneous 4-band imaging: 3.4, 4.6, 12, and 22 μm
- 3.4 & 4.6 μm: reflected sunlight & thermal emission
- 12 & 22 μm: thermal emission

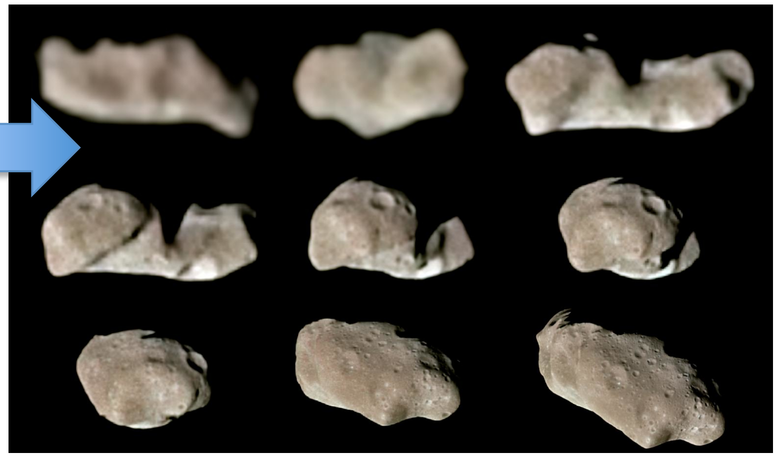




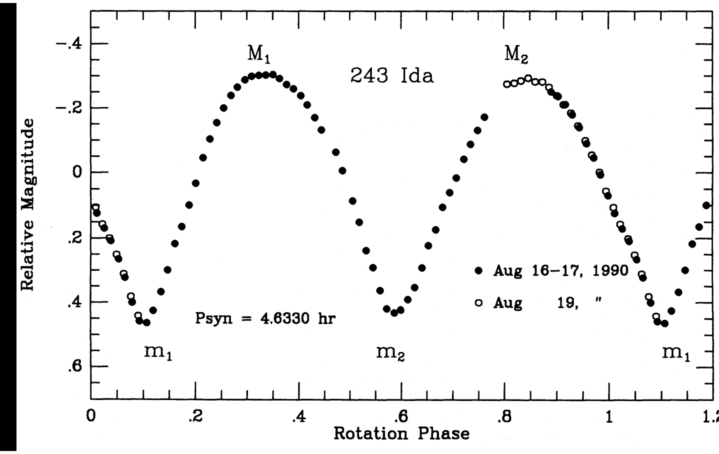
- Albedos & Diameters of ~1800 Trojans, ~1000 Hildas
- ~12 thermal measurements per object over 36 hours → lightcurve most likely defined by shape

Shapes & Binarity through Lightcurves

Elongated MBA (243) Ida

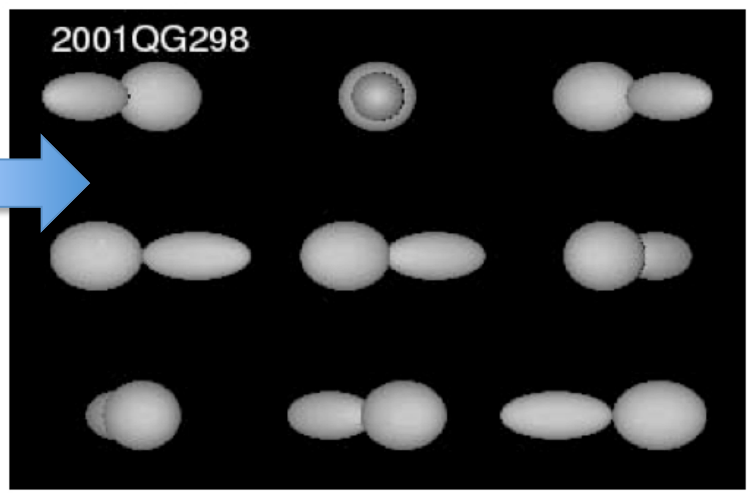


NASA/JPL

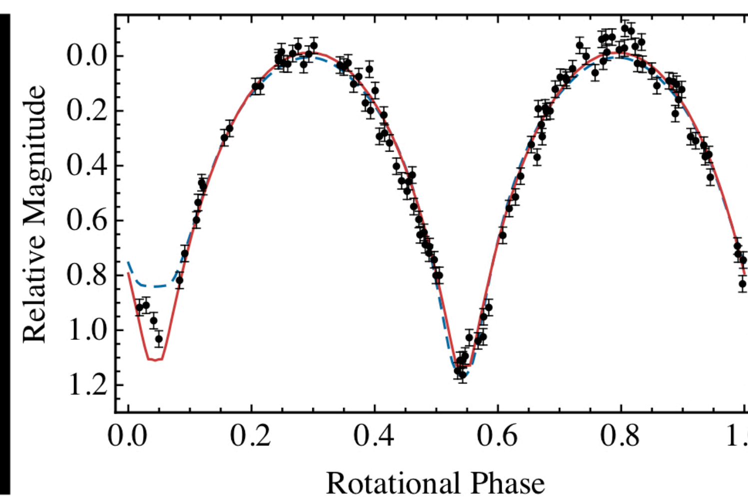


Gonano-Beurer et al. (1992)

Contact Binary TNO 2001 QG_{298}



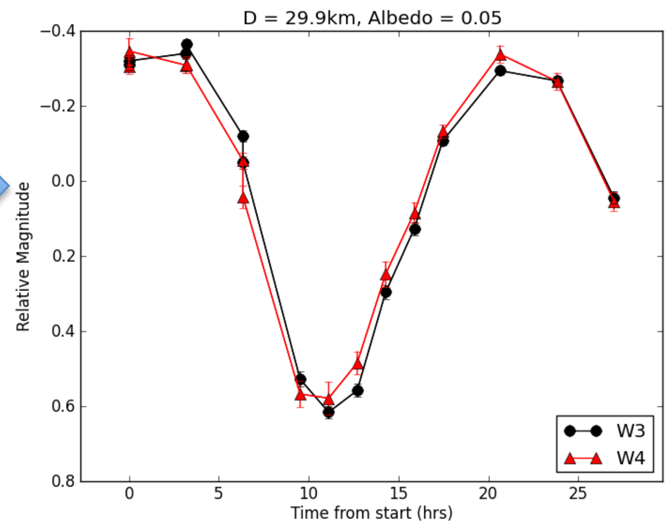
Lacerda & Jewitt (2007)

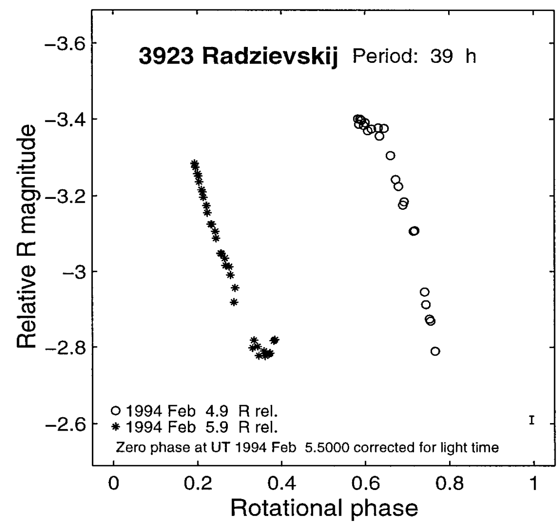


Lacerda (2011); Sheppard & Jewitt (2004)

Sample Binary Candidates

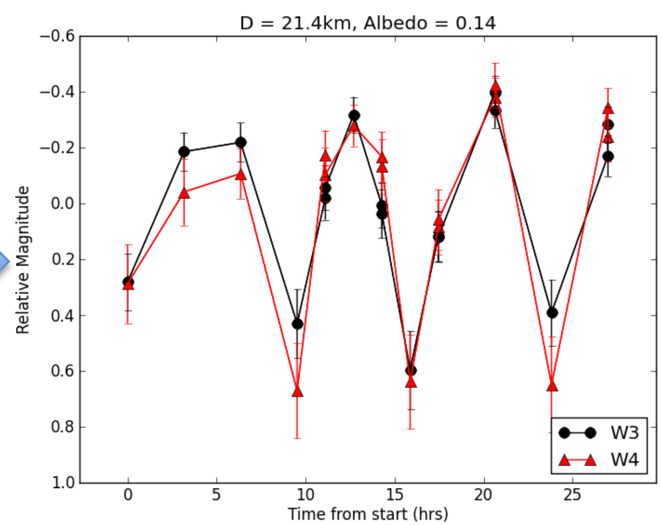
Hilda asteroid
3923 Radzievskij

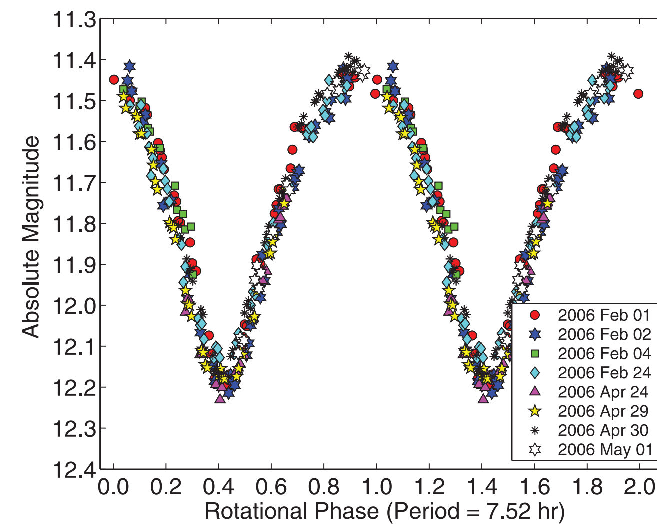




Dahlgren et al. (1998)

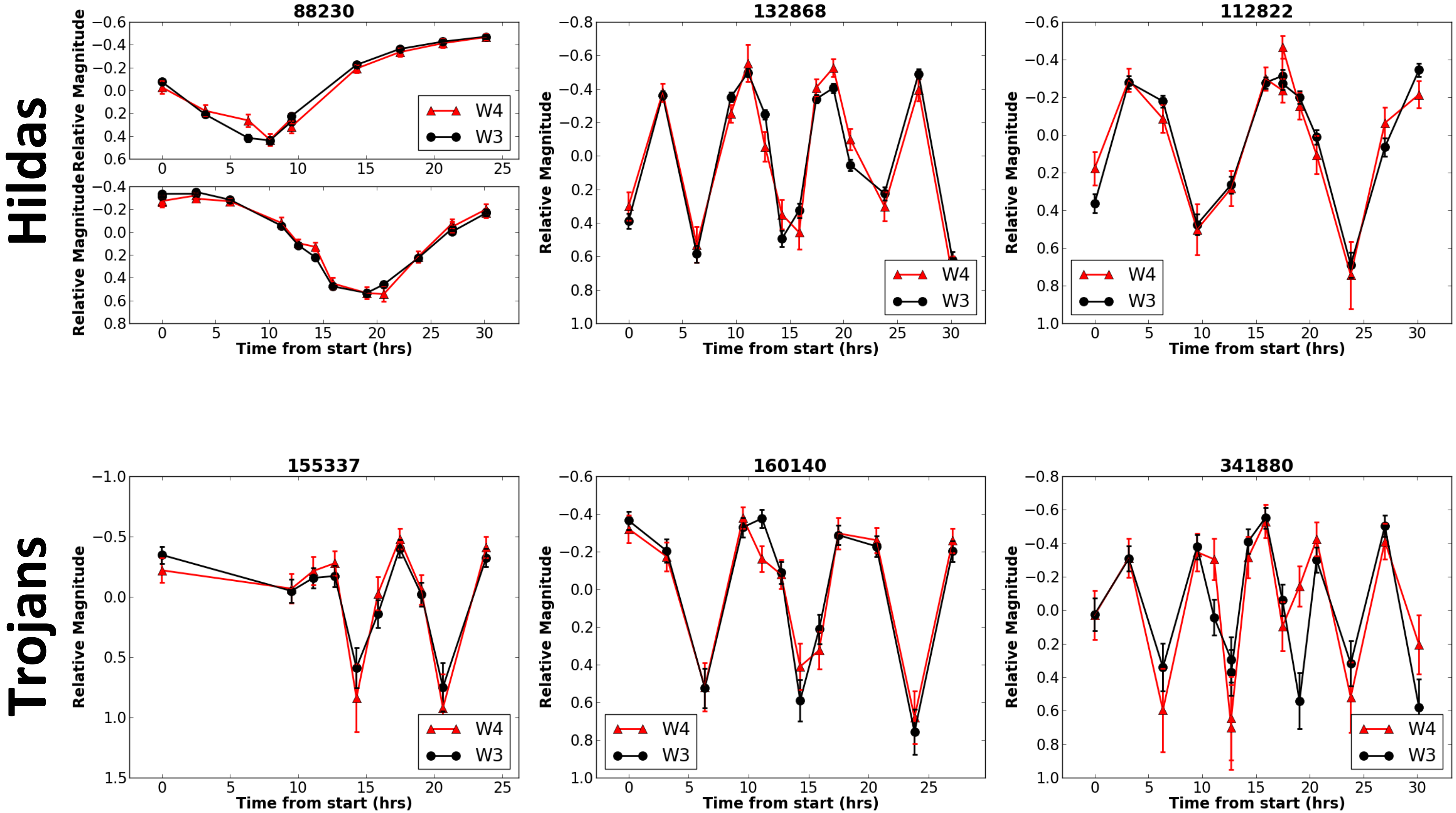
Trojan binary
29314 Eurydamas





Mann et al. (2007)

Sample Binary Candidates



Binary Results before Debiasing

Population	# candidates	Diameter range of candidates	Sample Size	Crude binary fraction
L4 Trojans	21 (1 known)	13 – 150 km	503	14 – 25%
L5 Trojans	16 (2 known)	13 – 45 km	446	12 – 21%
All Trojans	37 (3 known)	13 – 150 km	953	14 – 23%
Hildas	48	4 – 36 km	554	30 – 51%

- Previous Trojan binary fraction: 6 – 10% (Mann et al. 2007)
- Binary fractions include potential false positives
- Trojan sample ≥ 12 km
- Hilda sample ≥ 4 km
- These results in Sonnett et al. (2015)

The Full Debiasing Process

- How likely are we to observe the true lightcurve amplitude given our photometric uncertainties and observing cadence?

- How likely are we to see a large amplitude lightcurve given the orientation of the system?

- How likely is this sample to be representative of the intrinsic binary fraction that should arise?

Questions for Modelers

- At what size regime are we more likely to see elongated monoliths, not elongated rubble piles?

- What is the binary survival fraction for different planetary migration models?

Conclusions

- Our binary search algorithm flagged all known Trojan contact binaries
- Dense lightcurve follow-up needed to confirm binarity
- Upcoming debiased fractions will take into account observing circumstances, object orientation, and Poisson statistics
- Analyzing full sample after debiasing should allow for investigation of axis ratio distributions and comparisons between binary fractions of subpopulations like:

  -- D- vs. C-/P-type Hildas and Trojans
  -- Trojans vs. TNOs
  -- Large vs. Small Hildas and Trojans