The Inner 10 AU of HR 8799

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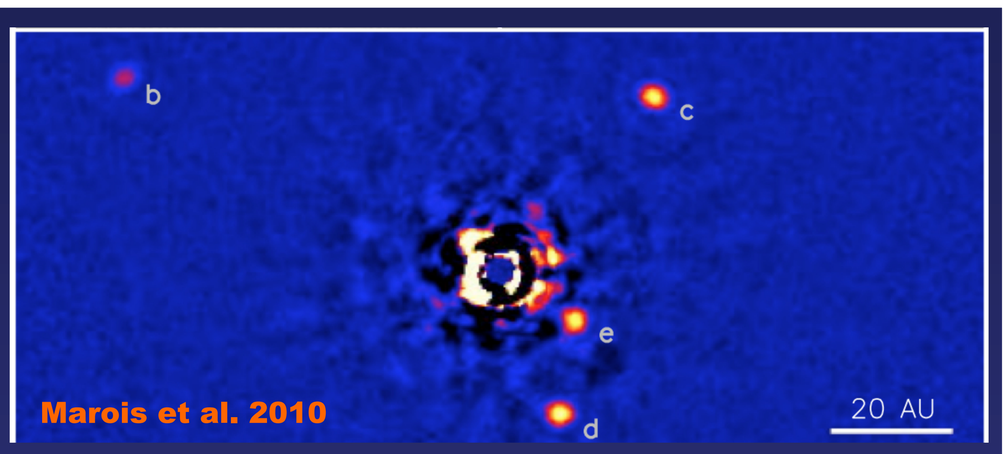
Abstract: We report the results of Keck L'-band non-redundant aperture masking of HR 8799. We use these observations to place constraints on the presence of planets and brown dwarfs at projected orbital separations inside of 10 AU –separations out of reach to more conventional direct imaging methods. No companions were detected at better than 99% confidence between orbital separations of 0.8 to 10 AU. Assuming an age of 30 Myr and adopting the Baraffe models, we place upper limits to planetary mass companions of 80, 60, and 11 M_{Jup} at projected orbital separations of 0.8, 1, and 3-10 AU respectively. Our constraints on massive companions to HR 8799 will help clarify ongoing studies of the orbital stability of this multi-planet system, and may illuminate future work dedicated to understanding the dust-free hole interior to ~6 AU.

Motivation

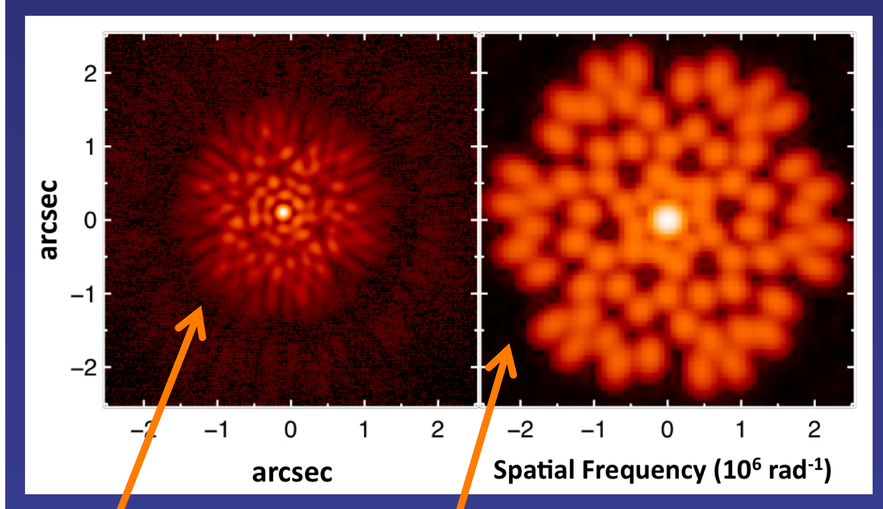
•Need complete knowledge of the system architecture within 10 AU.



Are wide separation planets due to scattering by a massive inner perturber? (e.g. Veras et al 2009).

Is HR 8799 "dynamically packed" like many multi-planet systems? Key to understanding orbital stability.

Observations



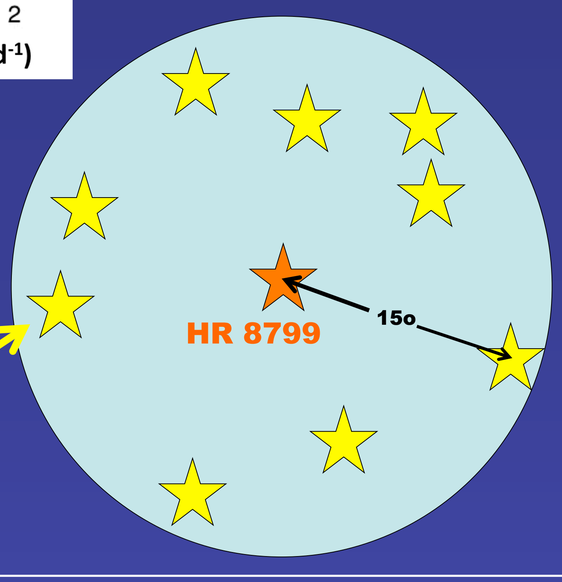
•Mask: 9 small apertures forming non-redundant baselines.

•Phase errors corrected through closure phase.

Nine-hole mask interferogram

Fourier Transform Amplitude

•190 min of Keck L-band AO+NIRC2

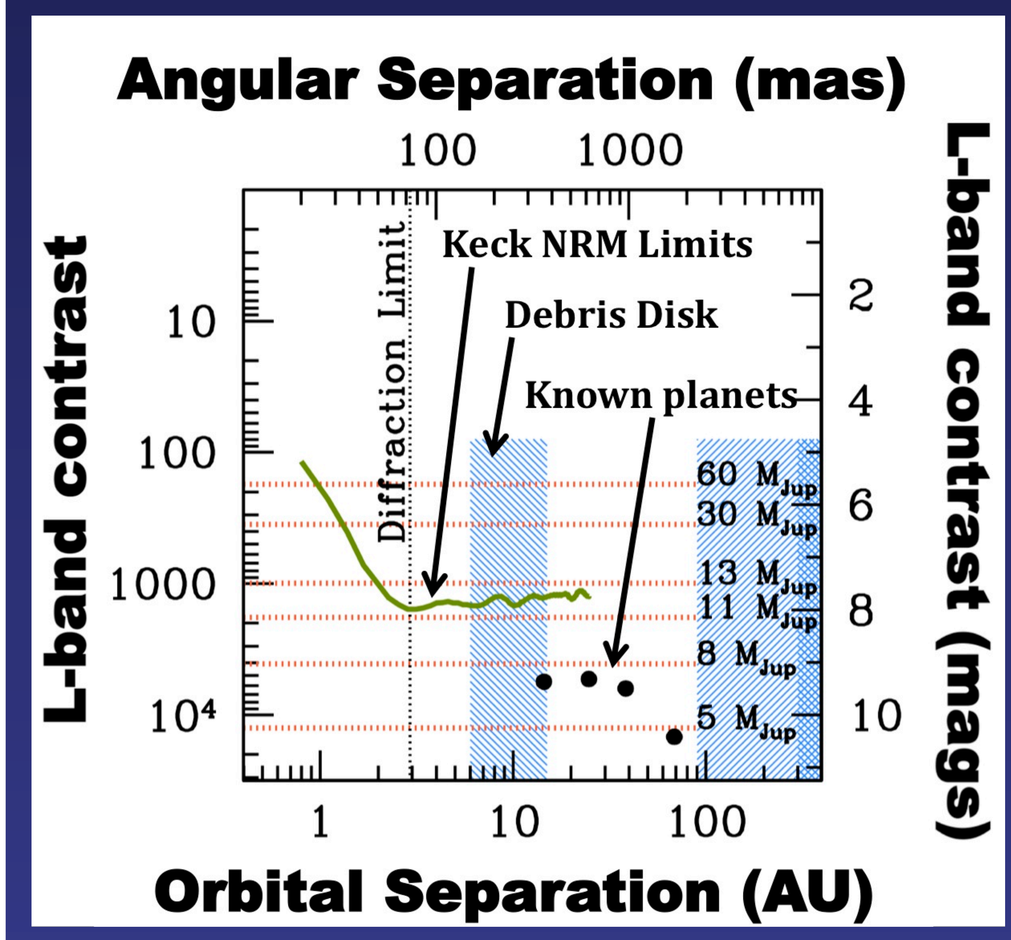


Calibrator Stars

•Unique calibrator star observed between each HR 8799 observation.

•Calibration based on calculating closure phase for calibrator stars.

Results



•Rule out purturber >11-12 M_{jup} from ~3 AU (ice line) to 10 AU.

•Disk clearing within 6 AU: nothing greater than 11-12 M_{Jup} at 3-6 AU.

Sep (AU)	Mass Limit (M_{Jup})
1	60
2	13
3	11

Accurate distribution of system mass becoming clearer.

Future Work

•Multi-wavelength observations will multiply the science return:

•Palomar Project 1640:
Hinkley et al 2011: (PASP, 123, 74).

•JWST: Sensitive to ~Few M_{jup} planets at 10-100 Myr (Doyon et al. 2010, Sivaramakrishnan et al. 2010).

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