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The planet next door: A direct imaging search for Sirius C

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Summary: Astrometric monitoring of the Sirius binary system over the past century has yielded several **predictions for an unseen third system component**, the most recent one suggesting a ≤50 M_{Jup} object in a ~6.3-year orbit around Sirius A (Benest & Duvent 1995). Here we present two epochs of high-contrast imaging observations performed with Subaru IRCS and AO188 in the 4.05 µm narrow-band Br α filter. These **data surpass previous observations by an order of magnitude** in detectable companion mass, allowing us to probe the relevant separation range down to the planetary mass regime (6–12 M_{Jup} at 1″, 2–4 M_{Jup} at 2″, and 1.6 M_{Jup} beyond 4″). We complement these data with one epoch of *M*-band observations from MMT/AO Clio, which reach comparable performance. No dataset reveals any companion candidates above the 5σ level, **allowing us to refute the existence of Sirius C** as suggested by the previous astrometric analysis. Furthermore, our Br α photometry of Sirius B confirms the lack of an infrared excess beyond the white dwarf's blackbody spectrum.

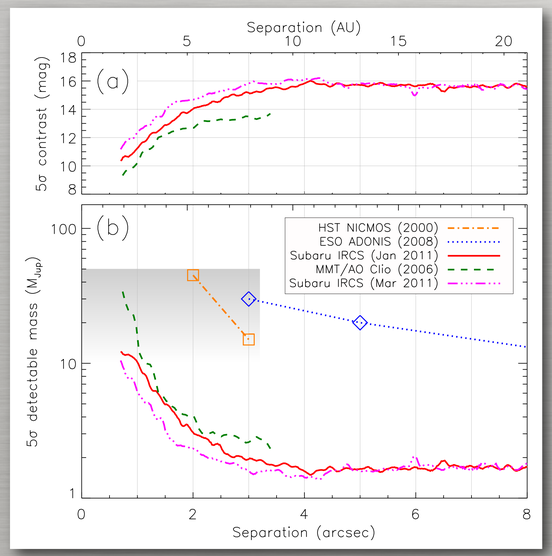

Figure 1: Constraints on companions to Sirius A from high-contrast imaging. Brightnesses are converted to mass using an updated version of the Janson et al. (2007) method based on the COND03 models.

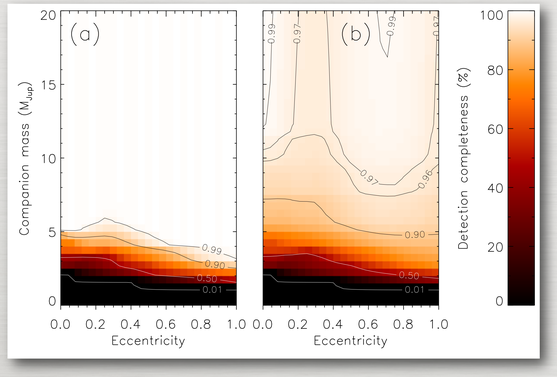

Figure 2: Detection completeness for companions in a 6.3-yr orbit around Sirius A, i.e., the probability that a companion would be detected at least once in our three epochs. (a) The case of orbits coplanar with the Sirius AB system (inclination i = 136.6°). (b) The case of unconstrainted inclination ($p(i) \propto \sin i$). We can reject the Sirius B hypothesis by Benest & Duvent (1995) at false alarm probabilities of 0–4% depending on eccentricity.

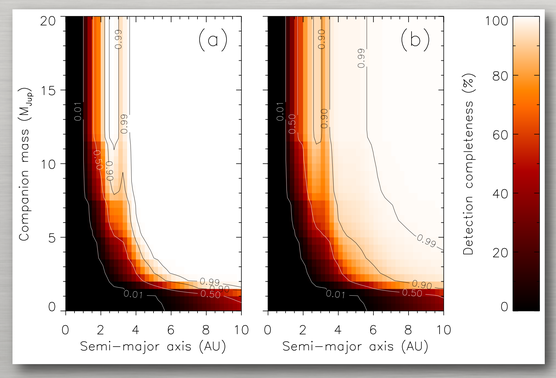

Figure 3: Detection completeness for companions with unconstrained orbital periods around Sirius A. (a) Coplanar case, (b) free inclination. Plenty of unexplored parameter space remains for giant planets within 2 AU. The critical semi-major axis for long-term stability is given as a_c = 2.17 AU in Holman & Wiegert (1999).

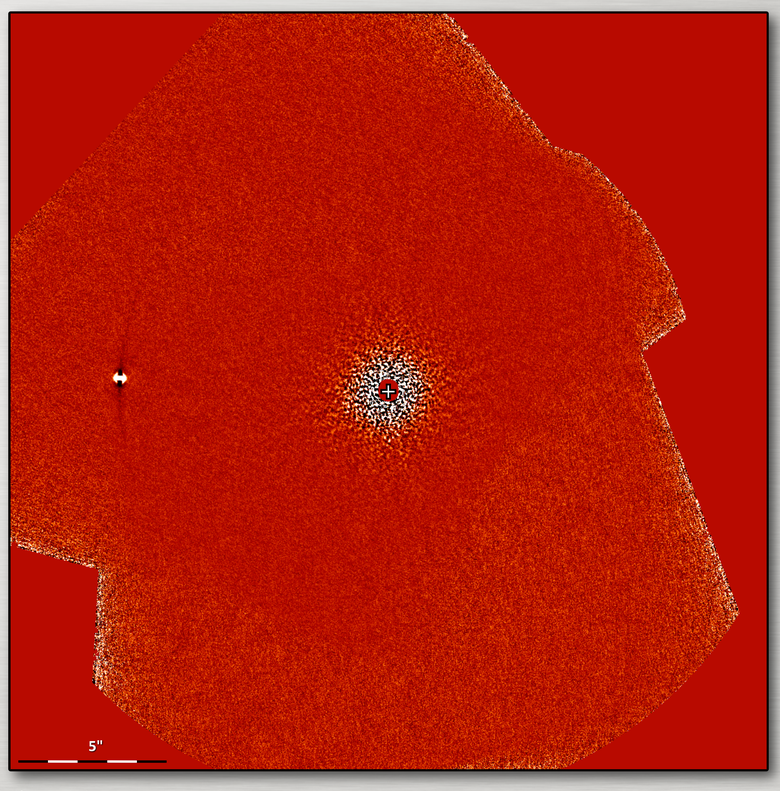

Figure 4: The deepest high-contrast image of the Sirius system, made from the data from two 4.05 µm narrow-band imaging epochs with Subaru IRCS after ADI reduction with the LOCI algorithm (see Lafrenière et al. 2007).

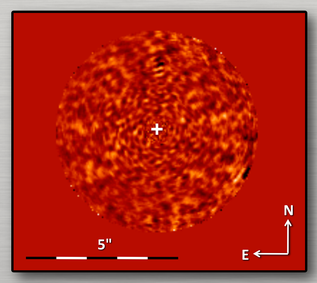

Figure 5: The S/N map of our MMT/AO Clio *M*-band data after ADI reduction with LOCI.

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