Astrophysics > Earth and Planetary Astrophysics

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Worlds Next Door: A Candidate Giant Planet Imaged in the Habitable Zone of α Cen A. I. Observations, Orbital and Physical Properties, and Exozodi Upper Limits

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We report on coronagraphic observations of the nearest solar-type star, \alpha Cen A, using the MIRI instrument on the James Webb Space Telescope. With three epochs of observation (August 2024, February 2025, and April 2025), we achieve a sensitivity sufficient to detect T_{\rm eff}\approx 225-250 K (1-1.2 R_{\rm Jup}) planets between 1"-2" and exozodiacal dust emission at the level of >5-8\times the brightness of our own zodiacal cloud. The lack of exozodiacal dust emission sets an unprecedented limit of a few times the brightness of our own zodiacal cloud-a factor of \gtrsim10 more sensitive than measured toward any other stellar system to date. In August 2024, we detected a F_\nu(15.5 \mum) = 3.5 mJy point source, called S1, at a separation of 1.5" from \alpha Cen A. Because the August 2024 epoch had only one successful observation at a single roll angle, it is not possible to unambiguously confirm S1 as a bona fide planet. Our analysis confirms that S1 is neither a background nor a foreground object. S1 is not recovered in the February and April 2025 epochs. However, if S1 is the counterpart of the object, C1, seen by the VLT/NEAR program in 2019, we find that there is a 52% chance that the S1+C1 candidate was missed in both follow-up JWST/MIRI observations due to orbital motion. Incorporating constraints from the non-detections, we obtain families of dynamically stable orbits for S1+C1 with periods between 2-3 years. These suggest that the planet candidate is on an eccentric (e \approx 0.4) orbit significantly inclined with respect to \alpha Cen AB orbital plane (i_{\rm mutual} \approx 50^\circ, or \approx 130^\circ). Based on the photometry and orbital properties, the planet candidate could have a temperature of 225 K, a radius of \approx1-1.1 R_{\rm Jup} and a mass between 90-150 M_{\rm Earth}, consistent with RV limits.

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