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Bulletin of the AAS • Vol. 54, Issue 5

Could we observe exomoons around ε Eridani b?

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Published on: Jun 20, 2022

URL: https://baas.aas.org/pub/2022n5i102p54

There are more than 200 moons in the Solar System, however no exomoon detection has been confirmed so far. Extrasolar gas giants are expected to host exomoons, which could scale in mass with their parent planet up to Earth radii. Two of the gas giant planet-moon systems are in long-lived mean motion resonances (MMRs) and it is expected that the latter would prevail in extrasolar systems as well. Since tidal dissipation depends on the orbital and physical properties of the system, there is a chance that Tidally Heated Exomoons (THEMs; Peters and Turner 2015) are detectable with current instrumentation / the JWST in infrared (IR) wavelengths.

ε Eridani b is one of the few known exoplanets with mass greater than 1 M_J and angular separation larger than 0.5 arcseconds on the sky. The proximity to Earth makes ε Eridani b a suitable candidate for the search of THEMs in the IR. Taking the Jovian satellites as an archetype for an exomoon system around ε Eridani b, this would mean that an MMR between two or more exomoons could make them detectable for larger timescales.

We explore the parameter space of exomoon orbital and physical properties, conclude which values would make an exomoon around ε Eridani b detectable with MIRI/JWST and investigate the interior structures of the putative exomoon that are consistent with these properties. Our model assumes a layered, radially symmetric moon, consisting of a silicate mantle and a liquid core. We present our results for the Andrade rheology model, different heat transfer mechanisms (mantle convection, heat piping), and constrain feasible interior structures and orbital parameters for several values of (observed) surface heat fluxes.