Contribution ID: **656** Type: **not specified**

Dark Kinetic Heating of Exoplanets and Brown Dwarfs

Wednesday 15 May 2024 16:45 (15 minutes)

Dark kinetic heating of neutron stars has been previously studied as a promising dark matter detection avenue. Kinetic heating can occur when dark matter is sped up to relativistic speeds in the strong gravitational well of high escape velocity objects, and deposits this kinetic energy after becoming captured by the object, thereby increasing its temperature. We show that dark kinetic heating can occur even in objects with low escape velocities, such as exoplanets and brown dwarfs, increasing the discovery potential of such searches. This can occur if there are long-range forces present in the dark sector, which increase the escape velocity of these objects, and can lead to heating rates substantially larger than those expected from neutron stars. We demonstrate existing sensitivity to this scenario using Wide-field Infrared Survey Explorer data on the local brown dwarf WISE 0855-0714, and map out future sensitivity to the dark matter scattering cross section below 10^{-40} cm^2. We compare dark kinetic heating rates of other lower escape velocity objects such as the Earth, Sun, and white dwarfs, finding complementary kinetic heating signals are possible depending on particle physics parameters.

Mini Symposia (Invited Talks Only)

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Session Classification: Dark Matter

Track Classification: Dark Matter