New Mexico Tech
Department of Physics

COLLOQUIUM

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Peeking Towards the Ice-Line: Hunting for Cold Worlds with TESS

The question of whether other planetary systems resemble ours is long-standing in exoplanet science and has significant implications for planet formation theories. Current evidence suggests our solar system is rare, but detection biases complicate this conclusion. This has led the exoplanet community to focus on M dwarf stars for solar system analogs, as their habitable zones are more accessible to current detection methods. Discoveries of compact multiplanet systems like TRAPPIST-1 have further led to the assumption that M dwarf planetary systems form similarly to those around Sun-like stars, just scaled down. This has resulted in the oversight of colder planets and the assumed absence of gas giants around low-mass stars. However, radial velocity and microlensing surveys have found gas giants orbiting M dwarfs, and the TESS and Kepler missions have both discovered systems with cold planets beyond the ice-line. To explore these neglected outer planets further, I use the Transiting Exoplanet Survey Satellite (TESS), which has a comprehensive sample of over 3 million low-mass stars. Most confirmed planets around these M dwarfs orbit within 0.15 AU (less than half of Mercury's orbit), so I developed a pipeline to detect single-transit events and compact multiplanet systems. This will help calculate new occurrence rates for M dwarf planets and constrain outer planet frequencies. Even a null detection of cold planets would be significant and inform planet formation theories. Additionally, I use TESS photometry to hunt for microlensing events with exoplanets, which are often located near the ice-line of their host stars. By searching TESS for known microlensing events, I have found several single-lens events and a planetary system with a super-Jupiter, the first bound microlensing TESS planet. I will present my current results from both the search pipeline and my microlensing hunt. My methods and findings will help determine if M dwarfs are the right place to search for solar system analogs or if they have unique formation pathways, and perhaps inform where else we should be looking.