Constraining the Dense Matter Equation of State with Next-Generation Pulsar Timing Arrays

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Abstract: Radio-frequency observations of millisecond pulsars play a key role in determining the equation of state (EoS) of supranuclear-density matter in neutron star interiors. High-precision timing of massive pulsars provides direct constraints on the EoS, as valid models must explain the existence of neutron stars larger than ~2 solar masses. Pulsar timing array (PTA) experiments, such as the North American Nanohertz Observatory for Gravitational Waves (NANOGrav), provide unique opportunities to conduct these mass measurements for a growing and diverse sample of pulsar binaries. In this talk, I will present a recent mass constraint for PSR J1231-1411 obtained with the Green Bank and Nançay radio telescopes, highlighting the benefit of long-term radio timing campaigns for even poorly-determined neutron star masses. I will then discuss preparations for the new era of PTA science, including a novel gamma-ray PTA. Next-generation observing facilities and new pulsar timing techniques will not only help elucidate the origin of the nHz gravitational background, but will also allow for unprecedented precision in neutron star mass measurements to support further constraints on the dense matter EoS.

Bio: Dr. Thankful Cromartie is a National Research Council Postdoctoral Associate at the U.S. Naval Research Laboratory. Her research concerns millisecond pulsar timing and its application to both the detection of nHz gravitational waves with pulsar timing arrays, as well as constraining the dense matter equation of state. Since 2015, she has been a member of the North American Nanohertz Observatory for Gravitational Waves (NANOGrav) collaboration, and currently serves as chair of its Pulsar Timing Working Group. She received her PhD from the University of Virginia in 2020 and was a NASA Einstein Postdoctoral Fellow at Cornell University. In her spare time, she is an artist and whitewater boater.