

Space Science Seminar
Tuesday, 2022 October 11
10:30 a.m.
NSSTC Room 2096 and NASA/MSFC TEAMS

Towards Precision Measurements of Dark Matter

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Host: Dr. Michelle Hui (Sponsored by NASA/MSFC/ST12)

For more than a century now, our inference of the mass distributions (including dark matter) in galaxies have been based on kinematic analyses, which assume equilibrium. These kinematic estimates can be inaccurate for a time-dependent potential, and there are now many lines of observational evidence that show that our Galaxy has had a highly dynamic history. Recent advances now make it possible for us to carry out extreme-precision time-series measurements of the acceleration of stars that live within the gravitational potential of our Galaxy. I will talk about several different methods of direct acceleration measurements that we have developed, including our recent analysis of compiled pulsar timing data from which we were able to measure the Galactic acceleration for the first time. Given the measured acceleration, we can straightforwardly use the Poisson equation to determine the total density, and the local dark matter density (given an accounting of the stellar density). There are testable differences between popular models of dark matter on small scales, i.e., in their sub-structure. I will discuss the potential for measuring dark matter sub-structure in the Milky Way with pulsar timing and eclipse timing (for both main-sequence stars and double white dwarfs), and for constraining theories of gravity by combining constraints from pulsar timing and extreme precision radial velocity measurements. I will end by discussing our recent work in developing an “acceleration ladder” by calibrating kinematic estimates of the acceleration to direct acceleration measurements.

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