Physics AT QUEENS COLLEGE

Colloquium Notice

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Understanding planet formation and evolution with stars

The formation and evolution of planetary systems remain among the most fundamental questions in astrophysics, requiring comprehensive knowledge of orbital architectures, stellar properties, and early formation environments. My work presents a multi-faceted approach to understanding these processes through the development and application of novel theoretical models, statistical frameworks, and analysis of observational data from both ground- and space- based telescopes. At the core of this work is StarryStarryProcess, a novel photometric model that recovers true three-dimensional stellar obliquities from spot-crossing events during planetary transits while simultaneously modeling the full stellar light curve with rotational modulation. This method extracts both the latitude of starspots and the orientation of the stellar spin axis relative to the orbital plane, enabling the construction of large-scale catalogs of stellar obliquities using photometry alone. This approach is validated through excellent agreement with spectroscopic Rossiter-McLaughlin measurements. To probe the earliest stages of planet formation, I conducted comprehensive three-dimensional hydrodynamic simulations investigating circumplanetary disk formation and detectability, revealing that detectable giant planets may be intrinsically rare at large orbital radii and explaining why only one embedded planet (PDS 70) has been confirmed despite extensive ALMA surveys.

Complementing these theoretical advances, I led observational planning for the Habitable Worlds Observatory, demonstrating that combining radial velocity data with HWO astrometry can recover orbital parameters to within a few degrees, which will establish strategies for understanding how giant planet configurations influence terrestrial world habitability. Collectively, my talk will demonstrate that understanding planetary formation and evolution requires synthesizing information across multiple scales: from stellar surfaces and spot distributions, through system-scale orbital architectures and obliquities, to protoplanetary disk environments. By developing theoretical models and observational techniques that bridge these scales, this work advances our ability to trace planetary systems from their birth through their long-term dynamical evolution.

Monday
April 13, 2026
Starts at 12:15 PM
Coffee at 12:00 PM
Physics Conference Room, SB B326
This talk is accessible via **Zoom** or use
meeting ID 829 2687 2594 and **passcode 866995** to join