Physics Department Seminar

Feb. 21st, Friday at 2 PM in Science Building Room 250

Transforming Galactic Astrophysics with Data Science

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Galactic astrophysics -- the study of the Milky Way and its environment -- has recently evolved from a data-limited to a data-rich science, driven by large-scale surveys with increasingly powerful telescopes. This transformation will accelerate in the coming decade with new facilities, such as the James Webb Space Telescope (JWST), and upcoming facilities, such as the Square Kilometre Array (SKA). In this talk, I will describe three student-oriented research projects that leverage modern data science tools, including machine learning and Bayesian inference, to advance our knowledge of the interstellar medium and Galactic structure. First, we train a neural network to predict the position-velocity distribution of Galactic star-forming regions, develop a simulation-based inference probabilistic model of Galactic morphological structure, and search for structures in the latest star-forming region data. Next, we create simulations of turbulent ionized gas in order to explain recent observations of ionized gas kinematics in Galactic star-forming regions. Finally, I will demonstrate how probabilistic radiative transfer models are essential for inferring the physical conditions of the interstellar medium from spectroscopic observations, and I will motivate future student-led applications to JWST, SKA-pathfinder, and SKA surveys. These projects prepare students for career success by introducing them to concepts such as cloud-based high-performance/throughput computing, statistical modeling, and complex data visualization, while also informing our understanding of the origin and evolution of the Milky Way.