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Séminaire

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Using particle transfer reactions to understand the life cycles of stars

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The life cycle of a star is governed by the nuclear furnace in its core. As a star evolves, stellar material is consumed by nuclear reactions, altering its chemical make-up and internal structure. Understanding this evolution is key to our understanding of the cosmos, how matter evolved since the big bang, and ultimately how the composition of the solar system came to be. To understand nuclear burning in astrophysical environments, reaction cross sections must be known to a high degree of accuracy. Often, these cross sections are too small to be measured directly in the laboratory or require radioactive targets, so novel methods must be employed. One such method involves performing particle transfer reactions. During these reactions, a particle is deposited onto or stripped off of the target to produce the same final states as the reaction of interest. Important quantities of those states can then be inferred, such as their spin, single-particle nature, or decay branching ratios. At NC State and the Triangle Universities Nuclear Laboratory, we perform these experiments by analyzing the reaction products in a high-resolution charged particle spectrometer: the Enge Split-pole Spectrograph. In this seminar, I will outline my group's work with the spectrograph, from building its unique charged-particle detection system to performing world-class high-resolution nuclear structure studies. I'll focus on how we have used our measurements to understand binary stars that explode as classical novae. Two reactions, in particular, have a large impact on the chemical composition of dust ejected from novae that can eventually make its way to Earth. I'll discuss those reactions, and how our measurements have impacted our understanding of novae and their contribution to the chemical composition of the solar system.