The Science and Technology of fusing neutron-rich light nuclei near and below the barrier

Abstract:
The investigation of neutron-rich nuclei both aids our understanding of fundamental nuclear science and provides valuable information for nuclear astrophysics. Of particular interest are the fusion reactions of neutron-rich nuclei which have been hypothesized as the heat source triggering an X-ray superburst. Examining fusion excitation functions for isotopic chains is a particularly sensitive tool in addressing this topic.

While radioactive beam facilities provide beams of neutron-rich nuclei, the intensity of these beams is generally low (<10^6 ions/s) with the most exotic beams available at the extremely low intensities (< 10^3 ions/s). Two approaches to measure fusion excitation functions will be presented and the complementary nature of the approaches discussed. Both methods involve direct measurement of the fusion cross-section through identification of the evaporation residues produced. Use an ETOF technique has allowed us to measure the fusion excitation functions for ^18,19O + ^12C, ^39,41,45,47K + ^28Si, and ^36,40,44Ar + ^28Si. The experimental results will be presented and compared with the predictions of various microscopic models. In order to enable measurement of the fusion cross-section for the most N/Z exotic beams, the design and construction of a new detector, MuSIC@Indiana will be described.