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Stellar Explosions in the Lab: Measurements of Key Nuclear Reactions Driving Nucleosynthesis

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Stellar explosions such as novae, supernovae, X-ray bursts, and neutron star mergers are responsible for the synthesis of a large fraction of the terrestrial elements. Nucleosynthesis in explosive environments is driven by rapid successions of nuclear reactions and decays. In order to understand the dynamics and isotopic yields of stellar explosions, it is essential that the rates of the underlying nuclear reactions be well understood. Hence both direct and indirect laboratory measurements of key nuclear reactions involved in the nucleosynthesis processes are essential for a complete understanding of explosive stellar nucleosynthesis. Many of these reactions proceed away from the valley of nuclear stability, leading to the requirement that radioactive beams be employed for measurements.

In this talk, I will give an overview of recent state-of-the-art efforts to constrain explosive stellar nucleosynthesis through direct and indirect laboratory measurements. In particular, I will focus on measurements pertaining to radiative proton capture reactions that are important in classical novae. This will include a discussion of recent direct measurements using the DRAGON recoil mass separator and radioactive beams from the ISAC-I facility at TRIUMF. I will also discuss a new program under development at the Texas A&M University Cyclotron Institute, targeted at performing indirect measurements of radiative proton capture using re-accelerated radioactive beams.

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