Decay studies of rp-process waiting points ^{96}Cd, ^{98}In, and ^{100}Sn

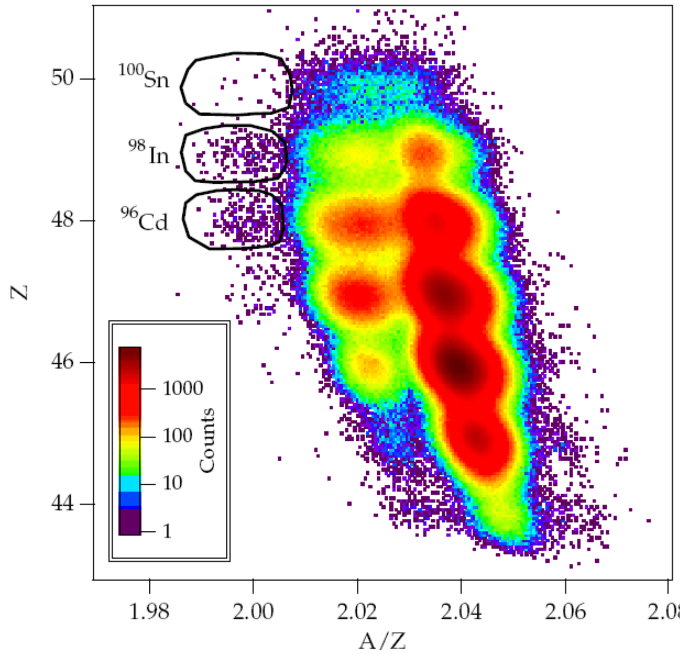

Figure: Identification of isotopes arriving at the experimental station event by event. Z (charge number) is determined by measuring the energy loss in a Si detectors, A/Z (mass number divided by charge number) from the time it takes the ions to arrive at the experiment (velocity).

X-ray bursts are frequently observed explosions of hydrogen and helium on the surface of a neutron star that accretes matter from a regular companion star. They are powered by a rapid sequence of proton captures and beta decays, the so called rp-process. Reliable models of the rp-process in X-ray bursts are needed to interpret burst observations in terms of the underlying physics of the accreting neutron stars, to determine the composition of the burst ashes. The latter defines the neutron star crust composition, and, if ejected, needs to be understood to constrain possible contributions of X-ray bursts to the origin of the elements.

^{96}Cd used to be the only remaining beta-decay along the path of the rp-process that has not been measured. This problem has now been addressed with the first experimental determination of the half-life (1.03 +0.24 – 0.21 seconds) along with an improved measurement of the half-life of ^{100}Sn (0.55 +0.70 -0.31 seconds). The experiment was enabled by the new RFFS separator at NSCL that purifies beams of neutron deficient rare isotopes. Nuclei are identified one by one and then implanted into a detector system that detects then the subsequent beta decays.

The measurement excludes the large half-lives that would have been necessary to produce sufficiently large quantities of ^{96}Ru (the decay product of ^{96}Cd) to explain the mysteriously large amount of this isotope found in the solar system.

Investigators:

D. Bazin, F. Montes, A. Becceril, G. Lorusso, A. Amthor, T. Baumann, H. Crawford, A. Estrade, A. Gade, T. Ginter, C.J. Guess, M. Hausmann, G.W. Hitt, P. Mantica, M. Matos, R. Meharchand, K. Minamisono, G. Perdikakis, J. Pereira, J. Pinter, M. Portillo, H. Schatz, K. Smith, J. Stoker, A. Stolz, R.G.T. Zegers

Michigan State University

Contact: montes@nscl.msu.edu

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