Measurement of β-delayed Neutrons Around the Third r-process Peak*

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Half of the observed solar abundances for the elements heavier than iron is produced by the so-called r process during neutron star mergers or Core Collapse Super Novae. In such scenario a very large neutron flux is present, which produces a wide range of very neutron-rich species on a timescale of few seconds. When the neutron flux ceases these radioactive nuclei decay β^-, in some cases including β-delayed neutrons. These decays deviate the reaction flow back to stability and produce additional neutrons which affect the neutron-to-seed ratio at later phases of the r-process. Calculations [1, 2] of half-lives and βdn-emission probabilities ($P_{\rm n}$ values) show differences of a up to a factor of 10 for regions where no experimental data are available for constraining the models, e.g. at the N=126 shell closure. Therefore new results in this mass region are strongly desired.

The S410 experiment aimed at measuring half-lives and β-delayed neutron branchings of nuclei with A>200 and N>126. A primary beam of ^{238}U and 1 GeV/u from the SIS impinged on a thick Be target and the produced fragments were in-flight selected via the $B\rho-\Delta E-B\rho$ method in the FRagment Separator (FRS) [3]. The nuclei of interest were slowed down and implanted in the Silicon array detector SIMBA (Silicon IMplantation detector and Beta Absorber) [4], that was used for measuring both implants and β-decays. A surrounding polyethylene matrix with 30 ^{3}He proportional counters embedded (BELEN-30 [5]) detected the emitted β-delayed neutrons with $\approx$ 40% efficiency.

Two different production settings were used, one centred on ^{215}Tl and the other on ^{211}Hg. The standard FRS detectors and data acquisition system allowed to identify event-by-event the isotopes arriving at the final focal plane. Fig. 1 shows the cumulative statistics of species implanted in SIMBA during the whole campaign. These data will provide neutron branchings $P_{\rm n}$ and decay half-lives $t_{1/2}$ in the following phases of the ongoing analysis.

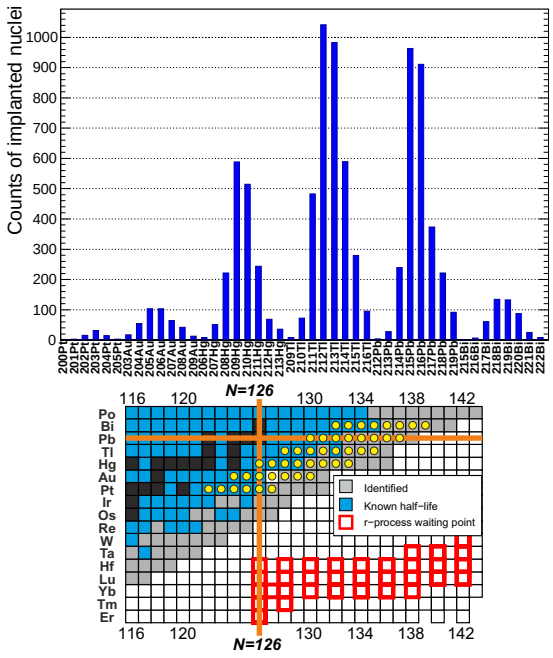

Figure 1: Implanted species during the S410 experiment.

References

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