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

J. Agramunt[1], *A. Algora*[1], *F. Ameil*[2], *Y. Ayyad*[3], *J. Benlliure*[3], *M. Bowry*[4], *R. Caballero-Folch*[5], *F. Calviño*[5], *D. Cano-Ott*[6], *T. Davinson*[7], *I. Dillmann*[8,2], *C. Domingo-Pardo*[1], *A. Estrade*[2], *A. Evdokimov*[8,2], *F. Farinon*[2], *D. Galaviz-Redondo*[9], *A. García-Rios*[6], *H. Geissel*[2], *W. Gelletly*[4], *R. Gernhuser*[10], *M.B. Gómez-Hornillos*[5], *C. Guerrero*[11], *M. Heil*[2], *C. Hinke*[10], *R. Knöbel*[2], *I. Kojouharov*[2], *J. Kurcewicz*[2], *N. Kurz*[2], *Y. Litvinov*[2], *L. Maier*[10], *J. Marganiec*[2], *M. Marta*[2,8], *T. Martinez*[6], *F. Montes*[12], *I. Mukha*[2], *D.R. Napoli*[13], *C. Nociforo*[2], *C. Paradela*[3], *S. Pietri*[2], *A. Prochazka*[2], *S. Rice*[4], *A. Riego*[5], *B. Rubio*[1], *H. Schaffner*[2], *C. Scheidenberger*[8,2], *K. Smith*[14,15,2], *E. Sokol*[16], *K. Steiger*[10], *B. Sun*[2], *J.L. Taín*[1], *M. Takechi*[2], *D. Testov*[17,16], *H. Weick*[2], *E. Wilson*[4], *J. Winfield*[2], *R. Wood*[4], *and P. Woods*[7]

[1]IFIC, Valencia, Spain; [2]GSI, Darmstadt, Germany; [3]Univ. de Santiago de Compostela, Spain; [4]Univ. of Surrey, UK; [5]Universitat Politecnica de Catalunya, Barcelona, Spain; [6]CIEMAT, Madrid, Spain; [7]Univ. of Edinburgh, UK; [8]Justus-Liebig Univ. Giessen, Germany; [9]CFNUL, Centro de Fisica Nuclear da Universidade de Lisboa, Portugal; [10]Technische Universität München, Germany; [11]CERN, Geneva, Switzerland; [12]NSCL, Michigan State University, Michigan, USA; [13]Laboratory Nazionali di Legnaro, INFN, Italy; [14]Department of Physics, Univ. of Notre Dame, Indiana, USA; [15]JINA, Indiana, USA; [16]Joint Institute for Nuclear Research, Dubna, Russia; [17]IPN Orsay, France

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.

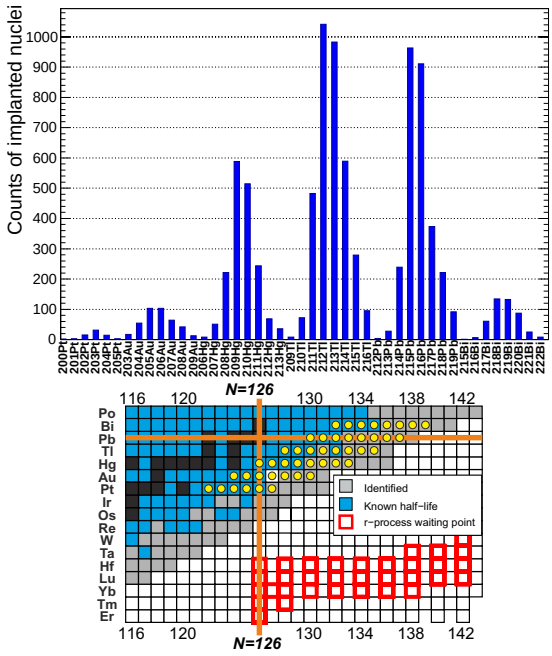

Figure 1: Implanted species during the S410 experiment.

References

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