β-decay of very neutron-rich Rh, Pd, Ag nuclei

K. Smith[1,2,3], *J. Agramunt-Ros*[4], *A. Algora*[4], *J. Benlliure*[5], *R. Caballero-Folch*[6], *D. Cano-Ott*[7], *T. Davidson*[8], *I. Dillmann*[3,9], *C. Domingo-Pardo*[4], *A. Estrade*[3,10], *A. Evdokimov*[9], *T. Faestermann*[11], *D. Galaviz-Redondo*[12], *A. García-Rios*[7], *H. Geissel*[3,9], *R. Gernhäuser*[11], *M.B. Gómez-Hornillos*[6], *M. Heil*[3], *C. Hinke*[11], *R. Knöbel*[3], *J. Kurcewicz*[3], *Y. Litvinov*[3], *G. Lorusso*[13], *L. Maier*[11], *J. Marganiec*[3], *M. Marta*[3,9], *F. Montes*[2,14], *I. Mukha*[3], *C. Nociforo*[3], *A. Parikh*[6,15], *G. Perdikakis*[2,14], *S. Pietri*[3], *A. Prochazka*[3], *S. Rice*[16], *B. Rubio*[4], *H. Schatz*[2,14,17], *C. Scheidenberger*[3,9], *K. Steiger*[11], *B. Sun*[3], *J.L. Taín*[4], *M. Takechi*[3], *H. Weick*[3], *J.S. Winfield*[3], *R. Wood*[16], *and P. Woods*[8]

[1]Department of Physics, University of Notre Dame; [2]Joint Institute for Nuclear Astrophysics (JINA); [3]GSI Helmholtzzentrum für Schwerionenforschung GmbH; [4]Instituto de Física Corpuscular, CSIC-Universitat de Valencia; [5]Universidad de Santiago de Compostela; [6]Departament de Física i Enginyeria Nuclear, Universitat Politecnica de Catalunya; [7]CIEMAT; [8]School of Physics and Astronomy, University of Edinburgh; [9]II. Physikalisches Institut, Justus-Liebig Universität Giessen; [10]St. Mary's University; [11]Department of Physics E12, Technische Universität München; [12]Centro de Física Nuclear da Universidade de Lisboa; [13]RIKEN Nishina Center; [14]National Superconducting Cyclotron Laboratory, Michigan State University; [15]Institut d'Estudis Espacials de Catalunya; [16]Department of Physics, University of Surrey; [17]Department of Physics and Astronomy, Michigan State University

The astrophysical origin of about half of the elements heavier than iron have been attributed to the rapid neutron capture process (r-process). Reliable nuclear physics is needed to link theoretical models with astronomical observations. The region around the $N = 82$ shell closure is of particular interest as it is responsible for the $A = 130$ peak in the solar abundance pattern. The peak is the result of the longer β-decay timescale compared to the neutron capture timescale when the r-process path reaches the shell closure [1] [2] [3].

An experiment to investigate half-lives and β-delayed neutron emission branching ratios of neutron-rich nuclei was performed at the GSI projectile FRagment Separator (FRS) [4]. A 900 MeV/u, ^{238}U beam delivered by the SIS-18 synchrotron impinged upon a 2480 $\mathrm{mg/cm^2}$ thick beryllium target placed at the FRS entrance. Produced fission fragments were selected in flight via the $B\rho - \Delta E - B\rho$ method. The ions were then implanted at the final focal plane of the FRS into the Silicon IMplantation detector and Beta Absorber (SIMBA) [5]. SIMBA detected implants as well as subsequent β-decays which can be correlated in time and position to its respective implant. The silicon arrays were surrounded with the BEta deLayEd Neutron detector (BELEN-30) [6]. BELEN-30 consisting of 30 ^{3}He tubes embedded in a polyethylene matrix which thermalized and detected β-delayed neutrons emission with an efficiency of about 40%.

Several $B\rho$ settings of the FRS were used during the experiment to yield optimum secondary beam intensities of the ions of interest. Preliminary analysis has identified neutron-rich Rh, Pd, Ag, and Cd isotopes in the region close to the $N = 82$ shell closure. The identification of the ions implanted into SIMBA has been completed. Figure 1 shows the separation between different species in the particle identification. Some species identified have no previous measurement of half-life and/or β-delayed neutron emission branching ratio. The determination of the implanted ion's half-lives and branching ratios is currently underway.

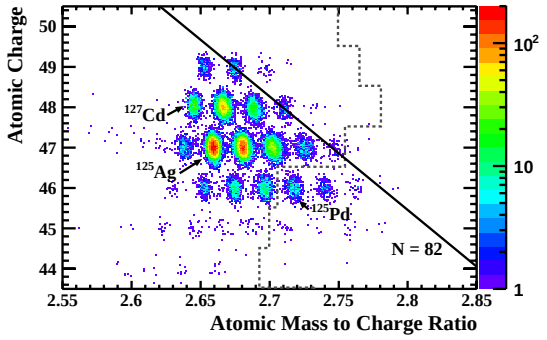

Figure 1: Cumulative Implanted Particle IDentification (PID). Isotopes left of the dashed jagged line have known half-lives. Isotopes along the solid line have $N = 82$.

References

[1] E. M. Burbidge, *et al.*, Rev. Mod. Phys. **29**, 547 (1957)

[2] J. J. Cowan, *et al.*, Phys. Rep. **208**, 267 (1991)

[3] M. Arnould, *et al.*, Phys. Rep. **450**, 97 (2007)

[4] H. Geissel, *et al.*, Nucl. Intr. and Meth. B, 70 (1992) 286

[5] C. Hinke, PhD Dissertation, Technische Universität München (2010); GSI-Diss. 2010-15.

[6] M. B. Gómez-Hornillos, *et al.*, contribution to GSI Scientific Report 2011