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Commissioning of the BRIKEN beta-delayed neutron detector for the study of exotic neutron-rich nuclei

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{\small \it Nuclear Physics in Astrophysics 8, NPA8: 18-23 June 2017, Catania, Italy}

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%%% Authors and affiliations are next. The presenter should be
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{\small \it
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% Enter contact e-mail address here.

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Beta-delayed neutron emission βn is the dominant decay mode of exotic nuclei produced along the path of the rapid neutron capture process. The final abundance distribution of the elements synthesized is affected by this decay mode in a complex way, since it primarily shifts the distribution to lower masses, while the additional neutrons injected in the system after freeze-out induce late neutron captures that shift the distribution to higher masses [1].
Thus a correct description of the observed elemental abundances requires a good knowledge of delayed neutron emission probabilities P_n of these very exotic nuclei.
Moreover for these nuclei with very large neutron excess more than one neutron can be emitted in the decay. Our current understanding of the beta-delayed multiple neutron emission process βxn, in particular of the competition between the different decay modes, is incomplete because of the scarcity of experimental data [2]. Finally the P_{xn} values are sensitive to the nuclear wave function allowing nuclear structure studies through the test of theoretical beta-strength distributions [3].

With these ideas in mind the BRIKEN Collaboration has set up a powerful detection system consisting of: 1) a large neutron counter with 148 ^{3}He tubes that has high and constant neutron detection efficiency [4], 2) the high granularity implantation-decay detection array AIDA [5], and 3) two CLOVER type HPGe detectors. The setup will exploit the very high intensity of secondary radioactive beams available at the focal plane of the BigRIPS separator [6] in the RIKEN Nishina Center to measure implant-beta, implant-beta-neutron and implant-beta-neutron-gamma correlations for nuclei very far from the β-stability valley.

The setup received the first radioactive beam of isotopes close to the doubly-magic ^{78}Ni in Autumn 2016.
In this presentation we will report on the first results of this commissioning run, including an evaluation of the performance of the setup. We will also present preliminary results of P_n values obtained for nuclei in this region including some for which previous values are uncertain or correspond to a single measurement.

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\noindent
[1] A. Arcones and G. Martinez-Pinedo, Phys. Rev. C 83,045809 (2011) ;

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[3] M. Madurga et al., Phys. Rev. Lett. 117, 092502 (2016);

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[4] A. Tarifeno-Saldivia et al., https://arxiv.org/abs/1606.05544, submitted to J. of Instr. (2016);

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[5] T. Davinson et al., http://www2.ph.ed.ac.uk/∼td/AIDA/;

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