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Towards the N=126 r-process waiting point nuclei: isomeric and beta decays of 203Ir, 202Os, 201Re, 200W (and 199Ta?)

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We aim to populate the most neutron-rich N=126 nuclei accessible experimentally. The nuclei will be populated by the fragmentation of a high-intensity E/A=345 MeV 208Pb primary beam. The LoI requesting this development was approved by the RIKEN PAC in 2022. The text below is from the physics proposal, presented to the PAC.

The fragmentation products of interest will be implanted in an active Si stopper, surrounded by a HPGe array. Their decay, both beta and internal, will be recorded. We expect to measure the beta-decay half-life of N=126 nuclei 203Ir, 202Os, 201Re, 200W, and possibly 199Ta. Most likely, the predicted isomeric states with11/2- πh11/2 of 203Ir and the 3/2+ πd3/2 of 201Re and 199Ta will also beta decay. The beta decays will provide information on the excited states of N=125 daughter nuclei and the competition between allowed and first-forbidden beta decays. Information on the structure of N=126 nuclei will be obtained by observing isomeric decays. Based on shell model predictions, and further supported by systematics, Iπ=10+, 7-, 5- isomers with πh11/2^2, πh11/2d3/2 , πh11/2s1/2 configurations are expected in 200W and 202Os. In 201Re and 203Ir in addition to the long-lived 11/2- metastable state, 23/2+ πh11/2^2d3/2 isomers are expected. Additionally the same setting will allow the transmission of the N=127 isotones 204Ir, and 203Os providing an opportunity to explore the production of these (p,n) charge-exchange reactions at E/A=345 MeV. N=127 isotones are important to obtain detailed information on the lowest-lying excited levels in the N=126 nuclei to test the strength of the classic shell closure at N=126 and to shed light on the competition between allowed Gamow-Teller (GT) and first-forbidden (FF) decays in N>126 nuclei. The information gained will be important both for our understanding of the possible shell evolution at the N=126 closed shell and to provide more robust theoretical predictions on the properties of the r-process path N~126 nuclei. We note that the same BIGRIPS setting will allow access to the shape transitional region around 190-194W, and will produce a significant number of isotopes for the first time.

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