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Direct reactions at ISS with Kr and Se beams in batch mode

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Neutron capture reactions on unstable targets are of considerable interest for astrophysical models since a knowledge of their cross sections, combined with an experimental knowledge of the beta decay rates and the isotopic abundances, allows one to determine the neutron flux and, therefore, the environmental conditions for s-process or r-process nucleosynthesis. Unfortunately, since such nuclei are unstable and a neutron target cannot be realized, most of them are out of reach for direct measurements using present RIB facilities. An alternative possibility is to use indirect methods. In this letter of intent we want to propose neutron capture cross sections of astrophysical interest for the s-process using the so-called surrogate method. The surrogate method has largely been used in the past for the study of neutron-induced fission reactions. More recently the method has been extended to the case of neutron capture reactions of astrophysical interest and the conditions for the validity of its use have been determined. The method is based on the use of transfer reactions ((d,p) with conditions on the phase space) as a surrogate for the relevant neutron capture reaction.
85Kr and 79Se beams are two interesting examples. They have both a long half-life allowing a batch mode operation, inserting the gas directly into the ion-source of the ISOLDE Linac. They are both an s-process branching point, located in a region where two scenarios may contribute, the one from massive stars (weak s-process component) and that of AGB stars (main s-process component). Knowledge of the n-capture cross section of 85Kr and 79Se provides therefore a crucial test of our understanding of s-process nucleosynthesis in massive stars and can be achieved through (d,p) reactions using ISS and gamma detections.
85Kr(d,p) is also a very interesting reaction from the nuclear structure point of view. Since 86Kr is located on the N=50 shell closure for neutrons, spectroscopic factors would directly probe the hole states into the shell gap providing a direct test of the stability of the shell closure. If gamma detection will be implemented to ISS, lifetime measurements with the plunger method could also be an additional and very promising possibility.
Being the two radioactive beams realized in batch, those reactions are perfectly suited for operation in shut-down periods or running in parallel with low-energy ISOLDE experiment

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