Two stage 8Li RIB production system at SARAF

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We present a novel scheme for the production of light radioactive ion beams (RIB) by fast secondary neutrons from a 40 MeV deuteron beam impinging on a converter target.
This scheme is found to provide efficient production with exceptionally high yields of light radioisotopes such as 6He and 8Li. These high yields of 6He and 8Li would fulfill the necessary conditions for the realization of the proposed β-beam scheme, and could also be used for performing precise measurements in several possible scientific applications to astrophysics and fundamental interactions. Monte Carlo simulations and activation experiments established the optimal geometry for high production numbers while keeping the release time short compared to the isotopes' half-lives. We have developed LiFTiT, a thick target for fast-neutron production that exploits the high-current deuteron beams available at SARAF Phase I. The fast-neutron spectrum of up to 20 MeV, from bombardment of SARAF 4.64 MeV deuteron beam on LiFTiT, was measured. Based on this intense neutron source, we have constructed a first, fully-optimized apparatus for the production of intense 8Li RIB by two-stage irradiation. The 8Li isotopes are produced in an encapsulated porous B4C target that is heated in a custom-built high temperature vacuum furnace. 8Li atoms are extracted, ionized in a surface ionizer, and then accelerated and manipulated to form a radioactive beam. This apparatus will facilitate, for the first time, a direct measurement of the total efficiency of the proposed irradiation scheme, which will later allow performing a scale-up to SARAF Phase II or SPIRAL2 light RIB yields, and pave the way towards a specific design of a target for SPIRAL2 and possibly beta-beam.