RIB production test at ISOLDE with 600 MeV protons

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Abstract. The energy dependence of production yields for Kr and Cs isotopes has been investigated with 600 MeV, 1 GeV and 1.4 GeV protons.

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1 Introduction

At the end of the running period of the year 2000, CERN's PS-Booster, normally providing a 1 GeV or 1.4 GeV proton beam for ISOLDE, delivered protons with an energy of 600 MeV in a dedicated test run. As an extension of former measurements on the energy dependence of RIB production at ISOLDE with 1 and 1.4 GeV protons [1], the production of neutron-deficient Kr isotopes from a Nb-foil target and of Cs isotopes from a LaC target was studied for the three proton energies mentioned above. This allows a direct comparison with production rates at ISOLDE-2, which used 600 MeV protons from CERN's synchro-cyclotron until the end of 1990.

2 Energy comparison

The ratios between the yields for the different proton energies have been evaluated and compared with predictions of a semi-empirical code [2] and the Monte-Carlo codes for nuclear cascades and evaporation [3] and [4].

In the case of Cs the production close to the production peak is improved by a factor of 1.6 with 600 MeV compared to 1.4 GeV, while for Kr this gain is rather marginal. However, higher proton energies should be used for the more exotic isotopes of both elements. The difference between 1 GeV and 1.4 GeV is not sinificant for the cases studied here. The theoretical predictions describe the general trend fairly well. Silberberg and Tsao [2] seems to fail on the neutron-rich side where increased production rates would be expected with higher energies. However, for general predictions of production rates all codes work very well, especially bearing in mind that the experimental reproducibility from one target unit to another has fluctuations of a factor 2–3 around the production peak, and up to a factor 10 for more exotic nuclei.

3 ISOLDE-2 and Booster-ISOLDE yields

For Kr the yields from ISOLDE-2 are well reproduced at the Booster. For Cs there is a discrepancy for those isotopes with highest production rates, which vanishes with decreasing neutron number. The yield difference can be explained by the fact that the ISOLDE-2 yields were obtained from liquid La targets and that for these thick targets the proton energy loss $\mathrm{d}E/\mathrm{d}x$ becomes an important factor. For nuclei with shorter lifetimes, like the more neutron-deficient Cs isotopes, the time it takes for an atom to be released from the target to the ion source becomes important, due to decay losses. This release time is much shorter from a LaC target than from a liquid La target which therefore compensates the $\mathrm{d}E/\mathrm{d}x$ effect.

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