

Measurement of production cross-section and momentum distribution of isotopes produced from ^{18}O beam

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The production yields and production cross-sections of ^6Li , $^7,^{10},^{11}\text{Be}$, $^8,^{13},^{14}\text{B}$, $^9,^{10},^{11},^{14}\text{C}$, $^{12},^{13},^{17},^{18}\text{N}$, $^{13},^{14},^{15}\text{O}$, and $^{17},^{18}\text{F}$ produced from an ^{18}O beam at 230 MeV/nucleon were systematically measured with the BigRIPS separator.¹⁾ By combining with previously measured cross-sections of other isotopes, the cross-section data of almost all nuclei that can be produced from ^{18}O has been completed, except for some stable nuclei and ^3H . In addition, the momentum distribution was measured for a wide range for ^{10}C .

The secondary beam was produced from the ^{18}O beam on a 2 mm-thick Be target at F0. The momentum slit at F1 was set at $\pm 3\%$. An 8 mm-thick Al achromatic degrader was used at F1 to purify the secondary beam. The particle identification was performed by using the ΔE vs. TOF information in the second stage of BigRIPS. For each cross-section measurement, the $B\rho$ setting was tuned for the peak of the momentum distribution of the target isotope. The production cross-sections were deduced from the measured production rates and the transmission efficiency of the BigRIPS separator estimated with the simulation code LISE⁺⁺.²⁾

The measured production cross-sections are shown in Fig. 1. The upper and lower panels show the results for proton-rich ($A/Z \leq 2$) and neutron-rich ($A/Z > 2$) isotopes, respectively. The filled circles are the measured data at this time, while open circles are previously measured ones. The magenta, blue, and green lines are predictions of EPAX 3.1a,³⁾ EPAX 2.15,⁴⁾ and FRACS 1.1,⁵⁾ respectively.

The measured cross-sections of the proton-rich B–O isotopes are 1/2–1/10 of the EPAX 3.1a predictions. The closer to the proton dripline, the larger the deviation becomes. The results of FRACS 1.1 are almost the same as those of EPAX 3.1a, while EPAX 2.15 underestimates the cross-sections of isotopes near the stability line. For the neutron-rich isotopes, all the models reproduced the measured cross-sections relatively well compared to the proton-rich side.

The momentum distribution of ^{10}C was measured by changing the first $B\rho_{01}$ from -12% to $+12\%$ for the peak momentum value in 3% steps. The yield ratio to the peak value is plotted as a function of the momentum deviation in Fig. 2. The red circles show the measured values. The distribution was not well reproduced by the LISE⁺⁺ calculation with the “Universal parametrization” model⁶⁾ (green line). We need to modify the σ_{conv} and coef parameters, which correspond to the width and low-momentum tail of the distribution, to reproduce the measured distribution (blue line). Detailed analysis is in progress.

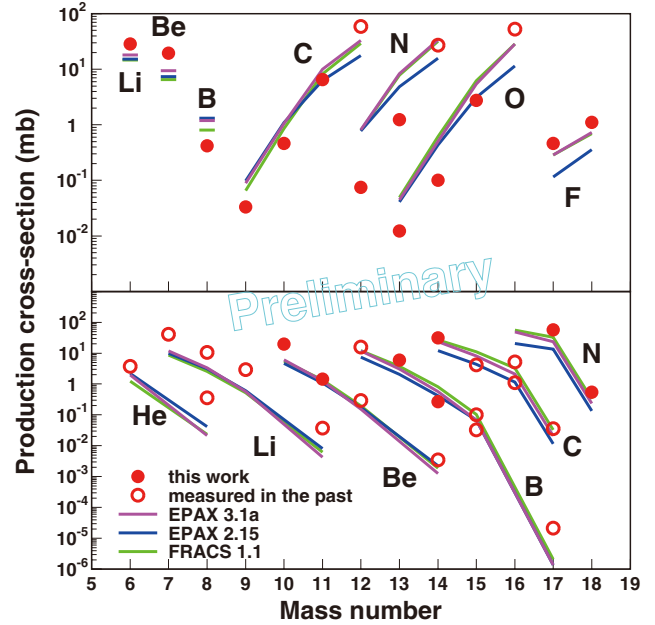


Fig. 1. Production cross-sections of isotopes produced in the $^{18}\text{O} + \text{Be}$ reaction. The upper and lower panels show the results for proton-rich ($A/Z \leq 2$) and neutron-rich ($A/Z > 2$) isotopes, respectively.

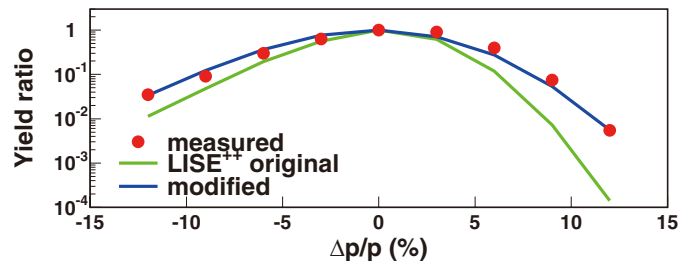


Fig. 2. Momentum distribution of ^{10}C produced in the $^{18}\text{O} + \text{Be}$ 2 mm reaction at 230 MeV/nucleon. The original model (green line) used in the LISE⁺⁺ did not reproduce the measured distribution (red circles) well. Modification of the parameters were needed (blue line).

References

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