Enhanced production of ^{99}Mo in inverse kinematics heavy ion reactions

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Today, radioisotopes are commonly used in medicine, both in diagnosis and therapy [1, 2]. A novel method for the production of important medical radioisotopes has been developed at the Cyclotron Institute at Texas A&M University. After a successful test of the production of the theranostic radionuclide ^{67}Cu ($T_{1/2}$ = 62 h) through the reaction of a ^{70}Zn beam at 15 MeV/nucleon with a hydrogen gas target [3], the production routes were studied for the formation of medically interesting ^{99}Mo with the

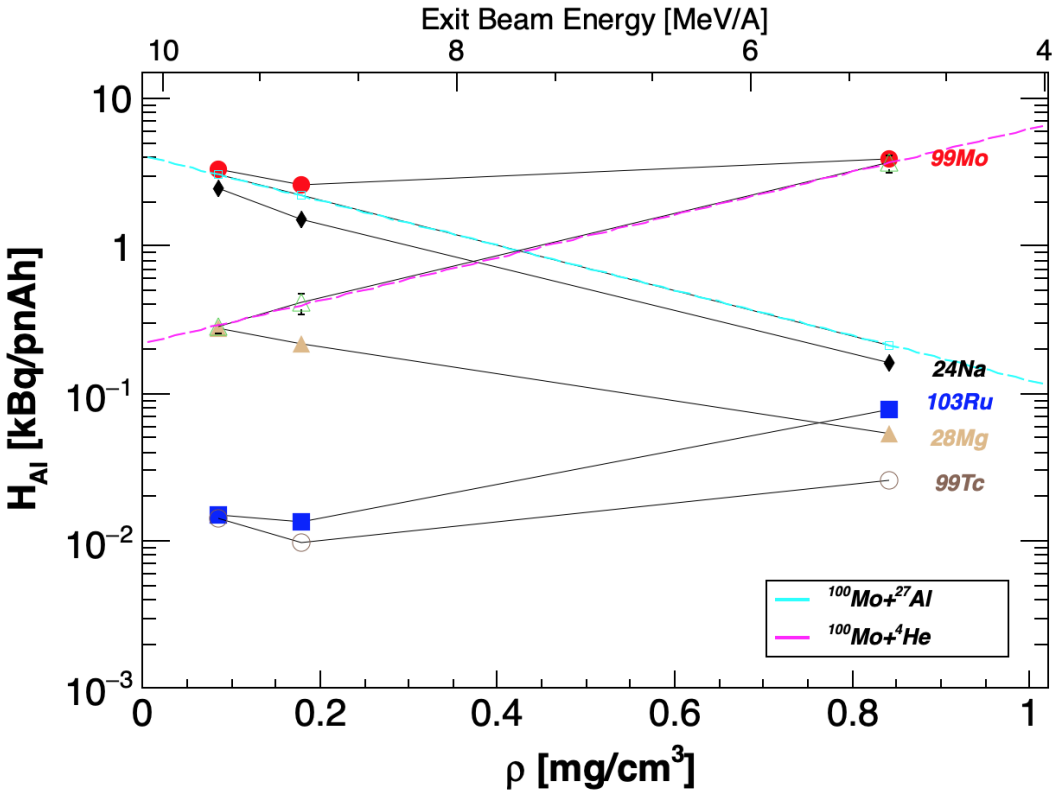

Fig. 1. Experimental activities (full symbols) for the isotopes indicated in the insets. The open symbols refer to ^{99}Mo contributions (open squares) coming from the Al catcher, low gas target density- high beam energy impinging on Al. The difference between the experimental points (solid circles) and the estimated Al contribution (open squares) gives the contributions due to the He gas target (open triangles). The exponential decay slope was estimated from the ^{24}Na production (full diamonds) and the ^{28}Mg production (full triangles) obviously coming from reactions in the Al target. Assuming binary reactions, the partner of ^{28}Mg is ^{99}Tc whose activity for this particular channel can be estimated and is given by the open circles.

use of cyclotrons. The ^{99}Mo was produced with a primary beam of ^{100}Mo accelerated by the K500 with an

energy of 12 MeV/nucleon impinging on a ^{4}He-gas cell target cooled at 77K. Three different runs were performed: a very low gas pressure (102 torr), low beam intensity (I_b=0.067 pnA) and irradiation time t_b=11h35 (source 1); a low gas pressure (213 torr), I_b=0.21pnA and t_b=10h28 (source 2) and a high gas pressure (1008 torr), I_b=0.172 pnA and t_b=7h52 (source 3). The ^{99}Mo alongside other coproduced isotopes were collected after the gas target on an aluminum catcher foil and their respective radioactivities were measured by off-line γ-ray analysis. Fig. 1 presents the activities for different isotopes of interest (full symbols), which were identified using their strongest and independent γ-lines.

[1] S. Takács, Z. Szűcs, and F. Tárkányi *et al.*, J. Radioanal. Nucl. Chem. **257**, 195 (2003); https://doi.org/10.1023/A:1024790520036

[2] S.M. Qaim, Radiat. Phys. Chem. **71**, 917 (2004).

[3] G.A. Souliotis, M.R.D. Rodrigues, K. Wang, V. Iacob, N. Nica, B. Roeder, G. Tabacaru, M. Yu, P. Zanotti-Fregonara, and A. Bonasera, Appl. Radiat. and Isot. **149**, 89 (2019).

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