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Study of Charge-Exchange Reactions for constraining Stellar Electron-Capture Rates

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Charge-exchange (CE) reactions at intermediary energies serve as a direct method for the extraction of the Gamow-Teller (GT) transition strengths, which are of importance for the estimation of weak-reaction rates for a variety of astrophysical phenomena such as core-collapse supernovae (CCSN) and the crustal heating of neutron
stars. In particular, CE reactions in the β^+ direction, like $(t, {}^3\mathrm{He})$ and $(d, {}^2\mathrm{He})$, are essential to determine the electron-capture (EC) rates that play a significant role in the above-mentioned scenarios.\\
Recently, a ${}^{88}\mathrm{Sr}(t, {}^3\mathrm{He} + \gamma){}^{88}\mathrm{Rb}$ experiment was performed at NSCL using the S800 spectrometer in coincidence with the gamma-ray detector array GRETINA. Experimental results provide a constrain of the EC rates on neutron-rich nuclei, around the $N = 50$ line, which
are of importance for understanding the late stages of CCSN.\\
In the future, $(d, {}^2\mathrm{He})$ experiments in inverse kinematics will open up the opportunity to investigate CE reactions of far-from-stability nuclei. The AT-TPC, a detector based on time
projection chamber, provides a unique technique for achieving such experiments. Simulation results show a very good reconstruction of the $(d, {}^2\mathrm{He})$ kinematics and
also indicate that this technique might be feasible for upcoming experiments.\\
Results of the data analysis and perspectives for $(d, {}^2\mathrm{He})$ experiments will be discussed.

Primary authors: Dr ZAMORA, J. C. (National Superconducting Cyclotron Laboratory, Michigan State University, East Lansing, USA); Prof. ZEGERS, R.G.T. (National Superconducting Cyclotron Laboratory, Michigan State University, East Lansing, USA)

Co-author: FOR THE E15112 COLLABORATION, . (National Superconducting Cyclotron Laboratory, Michigan State University, East Lansing, USA)

Presenter: Dr ZAMORA, J. C. (National Superconducting Cyclotron Laboratory, Michigan State University, East Lansing, USA)

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