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Test of Weak Reaction Rates of Importance for Late Stellar Evolution Using Charge-exchange Reactions.¹
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Weak reactions (electron captures and beta decays) on nuclei play an important role in the evolution of pre-supernovae stars and their eventual core collapse. The rates are usually predicted in shell-model and mean-field calculations. Experimental information on Gamow-Teller strength distributions is needed to test these calculations. At the NSCL, the (t, ³He) charge-exchange reaction at 115 MeV/nucleon is employed for such studies. In addition, the (³He,t) reaction at 140 MeV/nucleon (at RCNP, Osaka) is used for detailed studies of the charge-exchange reaction mechanism, which is important for understanding the uncertainties in the experimentally extracted Gamow-Teller strength distributions. Besides a comparison between experimental and theoretical Gamow-Teller strength distributions, the work also includes the calculation of electron-capture rates, so that the sensitivity of the rates on differences between theoretical and experimental rates can be gauged. A significant fraction of the nuclei relevant for late stellar evolution are unstable. Hence, to ensure accurate weak reaction rates for such nuclei, charge-exchange experiments on rare isotopes are crucial, but the techniques have to be developed. At the NSCL, a program has been initiated to study charge-exchange reactions on rare isotopes.

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