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**Charge-exchange reactions and electron-capture rates for presupernova stellar evolution**[1]

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Weak reaction rates such as electron captures and beta decays play major roles in a variety of astrophysical phenomena, such as core-collapse and thermonuclear supernovae and accreting neutron stars. Consequently, the use of accurate weak reaction rates in astrophysical simulations to understand these phenomena is important. Unfortunately, the number of relevant nuclei is typically very large, and, except for a few special cases, it is impossible to rely on experimental results only: theoretical models must be used to estimate the weak reaction rates. These models can then be benchmarked and improved on the basis of a limited number of experimental data. The most important nuclear structure input that is required for calculating weak reaction rates are Gamow-Teller transition strengths. Although these can be extracted from beta and electron-capture decay data, the energy window accessible by such experiments is limited, if accessible at all. However, at the high temperatures and densities that occur in massive stars prior to the cataclysmic demise, transitions to final states at high excitation energies are important. In addition, to properly test theory, full Gamow-Teller transition strength distributions are very valuable. Fortunately, nature is kind: charge-exchange experiments at intermediate energies can provide the relevant strength distributions over a wide energy window and a variety of charge-exchange probes, such as (p,n), (n,p), (d,$^{2}$He) and (t,$^{3}$He) have been used to extract strengths of relevance for astrophysics (and for other purposes). This presentation will focus on efforts to validate electron capture rates calculated based on nuclear structure models for nuclei with masses ranging from A $\sim$ 40-65, and on studies aimed at testing astrophysical sensitivities to uncertainties/deviations in the theoretical rates. These efforts include experiments with unstable isotopes, and special gamma-ray coincidence techniques to localize very weak, but astrophysically important, low-lying Gamow-Teller transitions. Future efforts will focus on heavier nuclei (A$>$65) and nuclei further from stability. For the latter, opportunities provided at the Facility for Rare Isotope Beams (FRIB) will be critically important. In particular, experiments enables by the construction of a High Rigidity Spectrometer will strongly enhance the impact of the data for the validation and improvements of novel theoretical approaches.

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