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Total Absorption Spectroscopy of N=Z nuclei at ISOLDE: weak-decay rates in the rp-process

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Type I X-ray bursts (XRB) are generally suggested as possible sites for the rp-process. These explosive events take place in binary systems in which a neutron star accretes hydrogen-rich material from a low-mass companion star. When the temperature and density in the accreted envelope become high enough to allow for a breakout from the hot CNO cycle, nucleosynthesis eventually proceeds near the proton drip-line via the rp-process. In these scenarios of extremely high gravity, there is no matter released out of the system and the luminosity curve of the emitted x rays is the physical observable to fit by the XRB model calculations. In these calculations some of the main ingredients are the weak decay rates, i.e., the β^+/EC decay rates and the energies released in the process, but these are normally estimated theoretically, and in particular the contribution of electron capture to weak-decay rates has normally been neglected in XRB model calculations. However, theoretical calculations using different models [1-3] show that, in these high-density (˜106 g/cm^3) and high-temperature (1 - 2 GK) scenarios, continuum electron capture rates might play an important role, up to one or two orders of magnitude above β^+ rates for species at and around the N=Z waiting point nuclei ^{64}Ge, ^{68}Se and ^{72}Kr.

In this contribution I will present results on different campaigns of experiments carried out with the TAS at ISOLDE to measure the decay of the nuclei mentioned above, focusing on the most recent IS570 experiment, whose aim was to measure accurately the B(GT) in the beta decay of the waiting-point nuclei ^{64}Ge, ^{68}Se and their N=Z+2 second neighbors ^{66}Ge and ^{70}Se. The goal is to evaluate the β^+/EC rates in global, and the EC to β^+ ratio in particular, to see their influence in the current XRB model calculations. We have used the Total Absorption Spectroscopy method which has shown to be the only possible tool sensible to B(GT) at high excitation energy within the Q$_{EC}$ window of medium mass and heavy nuclei [4]. The data analysis is ongoing, but in this talk I will present preliminary results on the isobaric chain A=64.

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