Cross Section Measurements of ^{23}Na(p,γ)^{24}Mg

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The reaction $^{23}\mathrm{Na}(\mathrm{p},\gamma)^{24}\mathrm{Mg}$ links the NeNa and MgAl cycles in stellar hydrogen burning. Non-resonant capture and three narrow resonance are believed to be the main contributions to the astrophysical reaction rate up to temperatures of 1 GK. For one of these resonances ($E^{\mathrm{c.m.}} = 138\,\mathrm{keV}$) only an upper limit on its strength has been established [1], resulting in large reaction rate uncertainties.

Cross section measurements were performed at the Laboratory for Underground Nuclear Astrophysics (LUNA) and the Nuclear Science Laboratory (NSL) at the University of Notre Dame, in an effort to reduce the uncertainty of the $^{23}\mathrm{Na}(\mathrm{p},\gamma)^{24}\mathrm{Mg}$ reaction rate. The underground location of the LUNA400 accelerator allowed for sensitive studies of the low-energy resonances, and the Sta. ANA accelerator at the NSL was used for measurements at higher beam energies. In measurements deep underground we established the existence of the $E^{\mathrm{c.m.}} = 138\,\mathrm{keV}$ resonance, and determined the strength of another narrow resonance with an improved uncertainty. With these new results, the astrophysical reaction rate at $T = 0.05 - 0.10\,\mathrm{GK}$, relevant for hydrogen shell burning in Asymptotic Giant Branch (AGB) stars, is reduced significantly. The analysis of the data taken on surface is ongoing.

We will present the measurements, with a focus on the results of the underground experiments, and the state of the analysis of the data taken on surface.

[1] J. M. Cesaratto et al., Phys. Rev. C **88**, 065806 (2013).