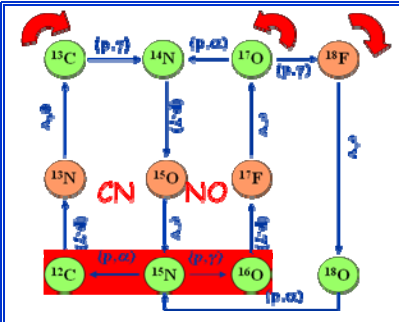
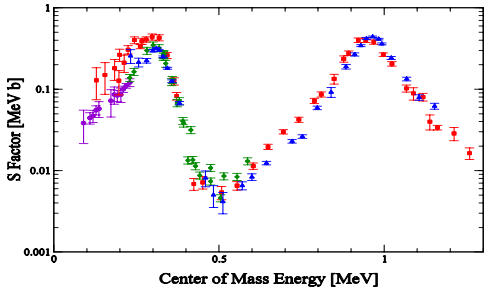
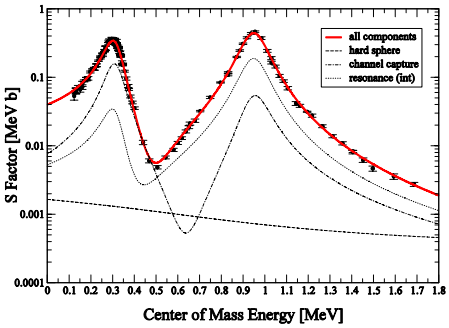
$^{15}N(p,\gamma)$ Experiment and R-Matrix Analysis



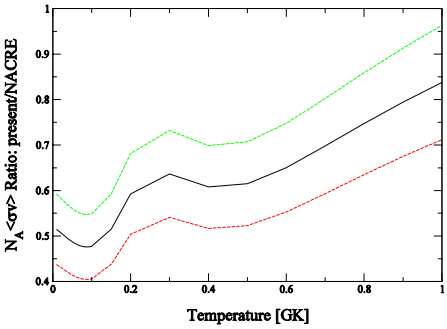


The reaction $^{15}N(p,\gamma)^{16}O$ is an important branching point linking the CN to the NO cycle in CNO hydrogen burning in massive stars. Inconsistency in the various data sets [1-4] along with recent R-matrix fits have led to the re-measurement of the $^{15}N(p,\gamma)^{16}O$ proton capture reaction at the low energy accelerators at Notre Dame and at the LUNA facility at the Gran Sasso underground laboratory in Italy. The reaction is dominated by two broad resonances at E_p = 338 keV and 1028 keV. Previous analyses indicate that the interference of these two resonances in both the low energy region (E_p < 338 keV) and in between the two resonances (338 < Ep < 1028 keV) can dramatically effect the extrapolated value of S(0). Several experiments were therefore preformed, together covering the energy range from E_p =1800 keV down to 130 keV. The R-matrix analysis code, AZURE, has been successfully used to fit the new data, and extrapolate the calculation down to astrophysically relevant energies. The results demonstrate the predictive power of R-matrix techniques in evaluating and extrapolating low energy reaction cross sections. Reaction rate calculations have been performed and are significantly reduced compared with current compilations.

[1] D. Hebbard, Nuclear Physics 15, 289 (1960)
[2] F. Brochard, Le Journal de Physique 34, 363 (1973)
[3] C. Rolfs, Nuclear Physics A 235, 450 (1974)
[4] D. Bemmerer, Journal of Physics G Nuclear Physics 36, 045202 (2009)



AZURE fit to the new $^{15}N(p,\gamma)$ data set. Different components to the total cross section (solid) are resonant (dot), hard sphere (dash), and channel capture (dash-dot).



Ratio of the new rate calculation to the NACRE compilation for the $^{15}N(p,\gamma)^{16}O$ reaction (plotted with uncertainty). BelowT_9=1, there is significant deviation, but above T_9=1.0, the ratio approaches 1.

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