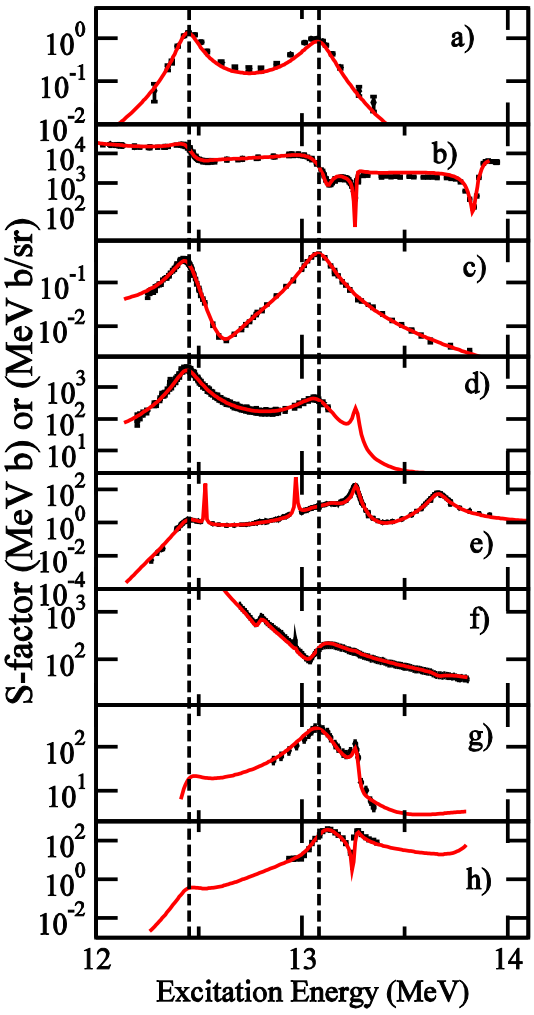
Joint Institute for Nuclear Astrophysics

R-matrix Analysis of ^{16}O Reactions

Three important reactions to nuclear astrophysics populate the compound nucleus ^{16}O. The ^{15}N(p,γ)^{16}O and the ^{15}N(p,α_0)^{12}C reactions form a branch point in the CNO cycle, the energy production mechanism for massive stars. The ^{12}C(α,γ)^{16}O reaction is one of the main reactions during helium burning and has been identified as one of the most critical reactions for understanding stellar nucleosynthesis. All three reactions may be investigated simultaneously using a multiple entrance/exit channel *R*-matrix approach. The JINA *R*-matrix coded, AZURE2, has been used for the calculations.

Fig. 1 – A simultaneous *R*-matrix fit to different reaction channel data sets from the literature above the proton separation energy in ^{16}O. Only a small sampling of the data which was considered is shown.



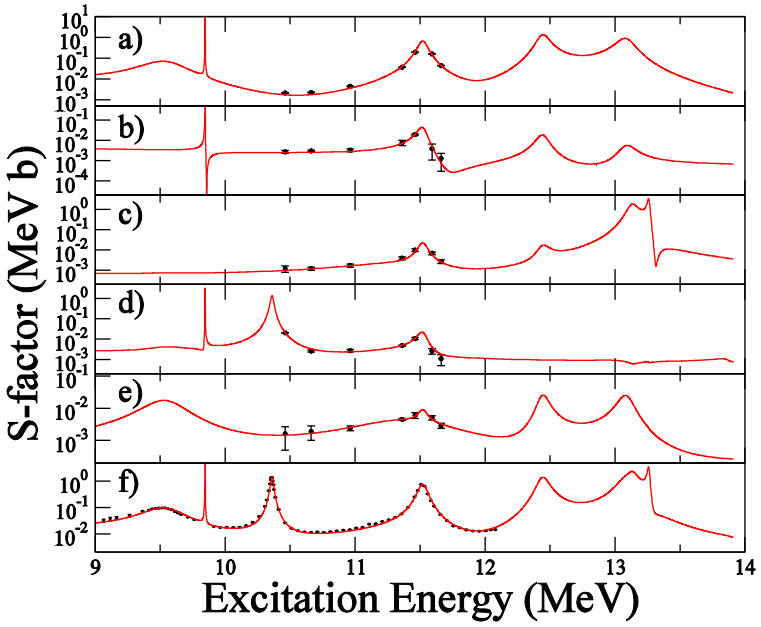


Fig. 2 – Fit to the new ^{12}C(α,γ) cascade data of Schürmann *et al.* (2011).

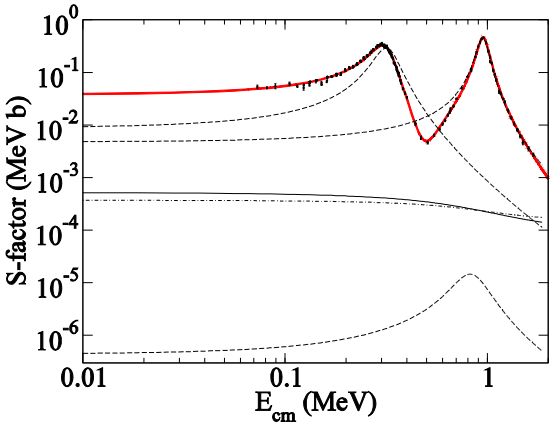


Fig. 3 – Extrapolation of the ^{15}N(p,γ)^{16}O S-factor into the stellar energy range.

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To be Submitted:
Physical Review C