Joint Institute for Nuclear Astrophysics

Photonuclear and Radiative Capture Reactions

Predicting the abundances of the p-process nuclei requires a detailed knowledge of a large number of reaction rates, almost all of which are calculated in the framework of the statistical model. One important source of uncertainty in these theoretical rates comes from the parameterization of the E1 γ strength function. By combining $\langle\sigma_\gamma(E_\gamma)\rangle$ (γ,γ') measurements with a new triple Lorentzian E1 strength parameterization and existing data, a realistic strength function has been constructed for the nuclei ^{92,94,96,98,100}Mo, ^{88}Sr, ^{90}Zr and ^{139}La. Since it is based directly on experimental data, the new E1 strength function (coined EPACS) can be used to directly test the impact of pygmy resonances on photo and radiative capture reactions. Rate predictions from EPACS can also be compared against those obtained from other parameterizations of the γ-strength function.

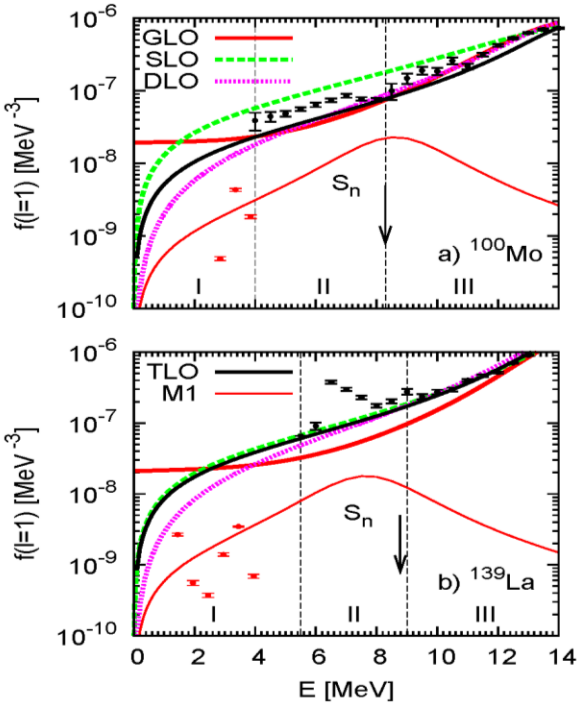


Fig. 1 - $\ell = 1$ strength functions as predicted by the generalized Lorentzian (GLO), Brink-Axel (SLO), double Lorentzian and triple Lorentzian (TLO) models. EPACS is composed of the TLO model in region I, and the data points in regions II and III. A pygmy resonance below Sn is visible in 139La.

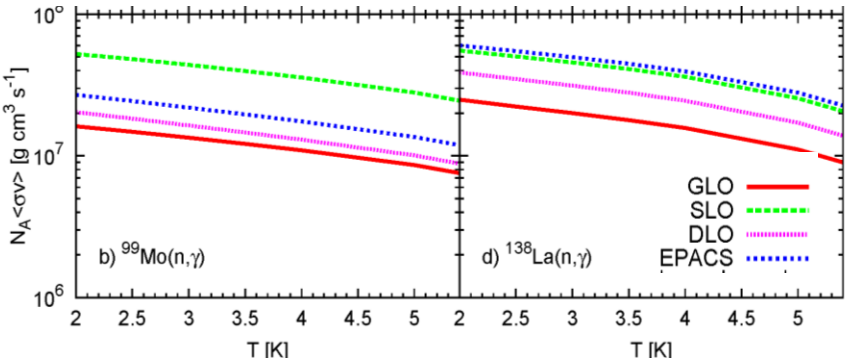
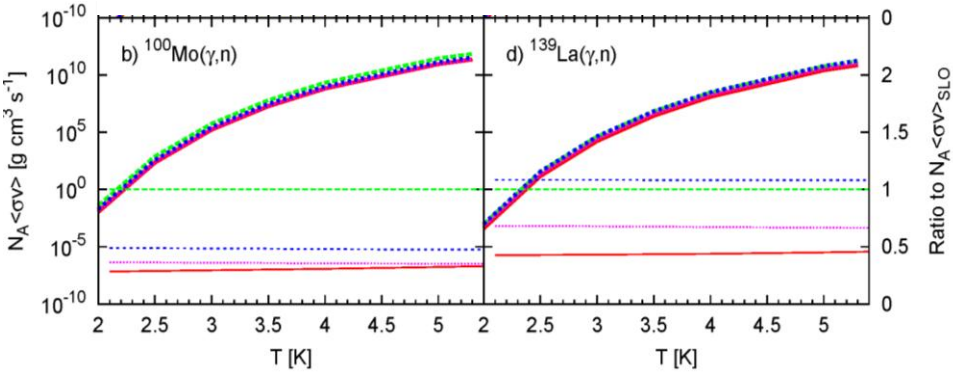


Fig. 2 & 3 – (n,γ) and (γ,n) reaction rates calculated using EPACS and GLO, SLO and DLO models. The pygmy in 139La translates into a modest boost in the reaction rate.



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