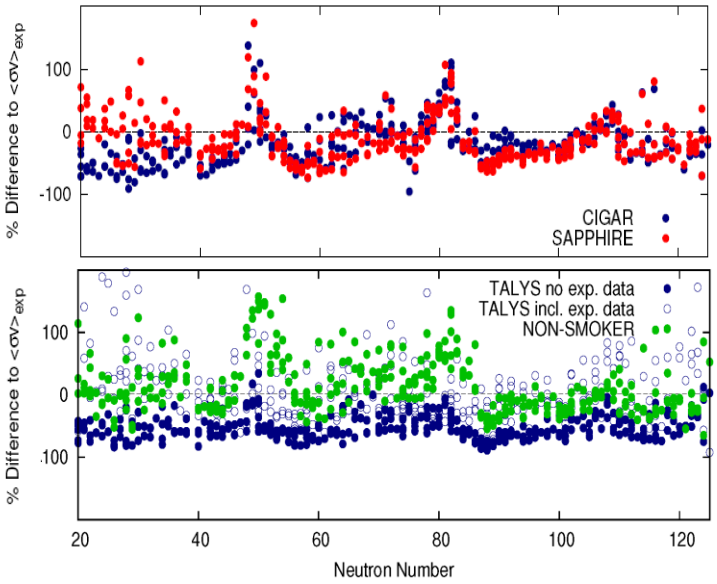
Joint Institute for Nuclear Astrophysics

Comparative Statistical Model Calculations for Radiative Neutron Capture

Though all of the Hauser-Feshbach codes in the literature solve the same mathematical picture, even when exactly the same nuclear physics inputs have been selected there can still be a wide range of results between individual code packages. These variations come from two primary sources: 1) the implementation of details regarding various nuclear physics input models; 2) numerical effects arising from non-model dependent aspects.

Recently two new codes, named **CIGAR** and **SAPPHIRE**, have been developed. The codes have been designed to contain an identical, overlapping set of nuclear physics input models for a user to select between. As a result, the impact on the calculations arising from non-model aspects can be investigated. Using these two codes Maxwellian averaged cross sections have been computed for approximately 345 isotopes. Results from **CIGAR** and **SAPPHIRE** have been compared to data contained in the KADoNiS database, as well as to calculations performed with the codes NON-SMOKER and TALYS.



Figs. 1& 2 - Percentage differences of kT = 30 keV MACS calculated with **CIGAR**, **SAPPHIRE**, NON-SMOKER and TALYS, compared to the KADoNiS database. Since **CIGAR** and **SAPPHIRE** use the same nuclear input models, differences between the calculations can be attributed to non-model effects, such as the truncation of experimental Jπ data used in a calculation, as well as energy binning for the transmission coefficients.

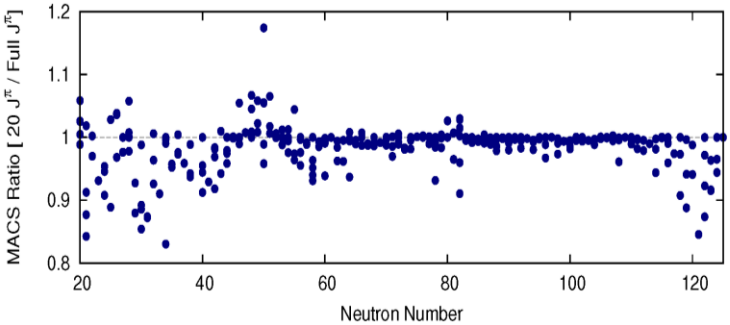


Fig. 3 – Impact of Jπ truncation on kT = 30 keV MACS. Calculated with **SAPPHIRE**.

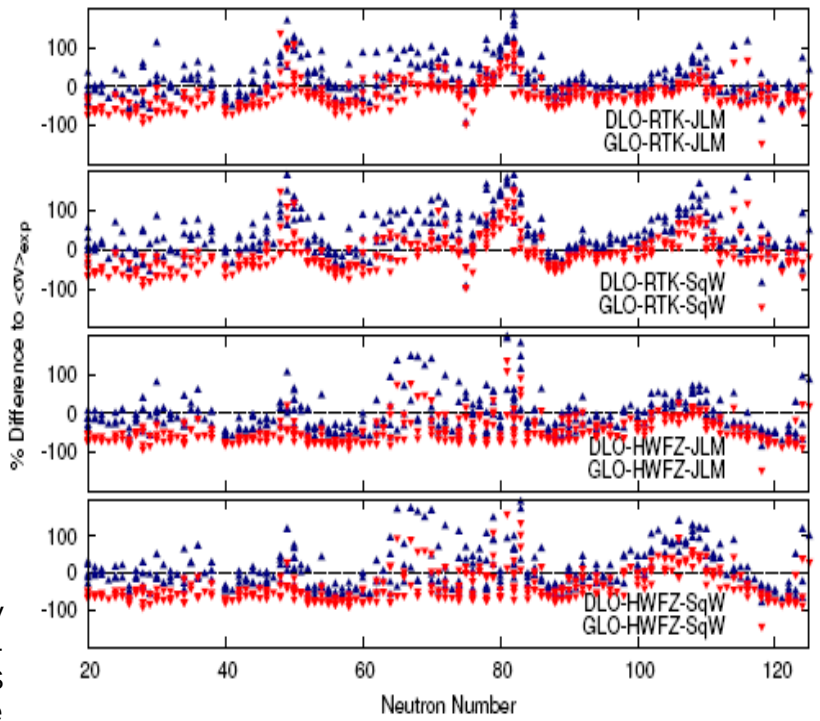


Fig. 4 - Percentage differences of kT = 30 keV MACS, calculated with **CIGAR** and compared to the KADoNiS database, for various nuclear input model combinations. The considered models represent, respectively, γ-strength function, level density and optical models. Calculations are somewhat insensitive the optical model used, but are highly dependent on the level density and γ-strength function model. Consequently, details which are implemented differently in different code packages ostensibly using the same models (i.e, level density, back shift, or giant dipole resonance parameters) can have a significant effect.

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