Characterizing the astrophysical S-factor for ^{12}C + ^{12}C with wave-packet dynamics

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A quantitative study of the astrophysically important sub-barrier fusion of ^{12}C + ^{12}C will be presented [1]. Low-energy collisions are described in the body-fixed reference frame using wave-packet dynamics within a nuclear molecular picture. A collective Hamiltonian drives the time propagation of the wave-packet through the collective potential-energy landscape. The fusion imaginary potential for specific dinuclear configurations is crucial for understanding the appearance of resonances in the fusion cross section. In contrast to other commonly used methods, such as the potential model and the conventional coupled-channels approach, these new calculations reveal three resonant structures in the S-factor, as shown in Fig. 1. The structures correlate with similar structures in the data. The structures in the data that are not explained are possibly due to cluster effects in the nuclear molecule, which are to be included in the new approach.

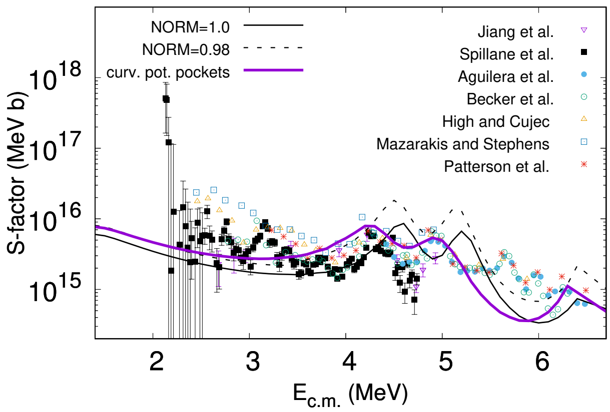

Figure 1: The astrophysical S-factor excitation function for ^{12}C + ^{12}C. Measurements (symbols) are compared to model calculations (lines), indicating that molecular structure and fusion are interconnected. The model calculations are shown for (i) two global factors that multiply the collective potential-energy landscape (thin solid and dashed lines), and (ii) a reduction by 15$\%$ of the curvature of the potential pockets (thick solid line). The latter greatly improves the location of the predicted resonant structures.

References

[1] A. Diaz-Torres and M. Wiescher, 2018, arXiv: 1802.01160 [nucl-th].