Constraining the in-medium nucleon-nucleon cross section from the width of nuclear giant dipole resonance

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By incorporating the stochastic NN collision term into the previous lattice-Hamiltonian Vlasov framework [1], we have solved the Boltzmann-Uheling-Ulenbeck (BUU) transport equation with nuclear mean field obtained from the N3LO Skyrme pseudopotential [2]. With the use of a sufficiently large number of test particles, the present lattice-Hamiltonian BUU (LBUU) method treats the Pauli blocking in the collision term of BUU equation with very high precision and thus significantly increases the accuracy in solving the BUU equation. From the accurately calculated giant dipole resonance (GDR) width of

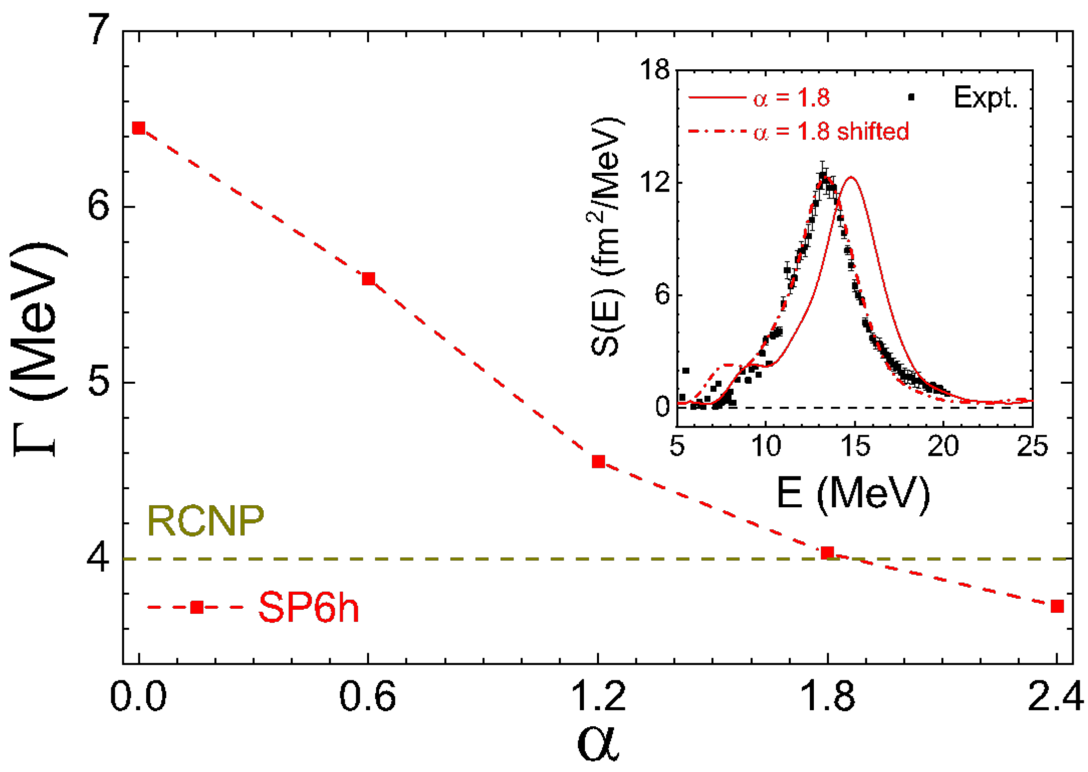

Fig. 1. The GDR width of ^{208}Pb from LBUU calculations for different values of $\boldsymbol{\alpha}$ in $\boldsymbol{\sigma^{*}_{NN}} = \boldsymbol{\sigma^{\mathrm{free}}_{NN}} \mathbf{exp}\left[-\boldsymbol{\alpha}\frac{\rho/\rho_0}{1+(\mathrm{T_{c.m.}}/\mathrm{T_0})^2}\right]$. The horizontal line represents the RCNP experimental value of 4.0 MeV [3]. The inset shows the strength function with $\boldsymbol{\alpha}$ =1.8 (solid line) and the shifted one (dash-dotted line) to match the experimental GDR peak energy.

^{208}Pb, we have found that it depends strongly on the magnitude of the in-medium NN cross section σ_{NN}^{*}, and the experimentally measured GDR width of ^{208}Pb from the ^{208}Pb($\vec{p},\overrightarrow{p'}$) reaction at RCNP [3] can only be reproduced with a NN cross section that is significantly reduced in nuclear medium as shown in Fig.1. The large medium reduction of the free-space NN scattering cross section $\sigma_{NN}^{\mathrm{free}}$ raises challenges to microscopic calculations based on realistic NN interactions. Also, the effects of such a large medium reduction of $\sigma_{NN}^{\mathrm{free}}$ on the widths of other modes of giant resonances in nuclei and on the dynamics of HICs need to be studied as it may significantly affect the extracted information on the properties of nuclear matter at various densities.

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