

Theoretical uncertainties on the extraction of in-medium NN cross sections by different Pauli blocking algorithms

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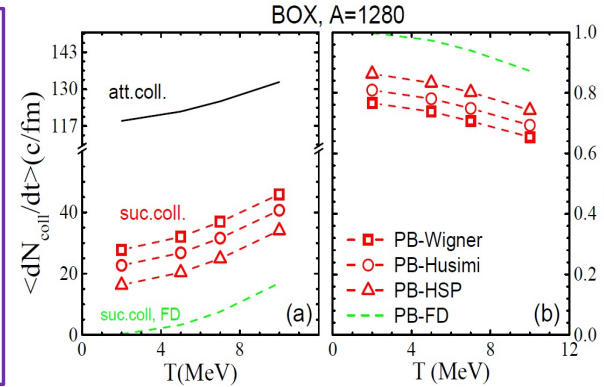
The probability $P_\tau(\vec{p}'_i)$ of the final state \vec{p}'_i occupied by other particles is:

$$1) P_\tau(p'_i) = 4 \sum_{j \in \tau (j \neq i)}^A \exp\left(-\frac{(\vec{r}_i - \vec{r}_j)^2}{2\sigma_r^2} - \frac{(\vec{p}'_i - \vec{p}_j)^2}{2\sigma_p^2}\right) \quad \text{(PB-Wigner)}$$

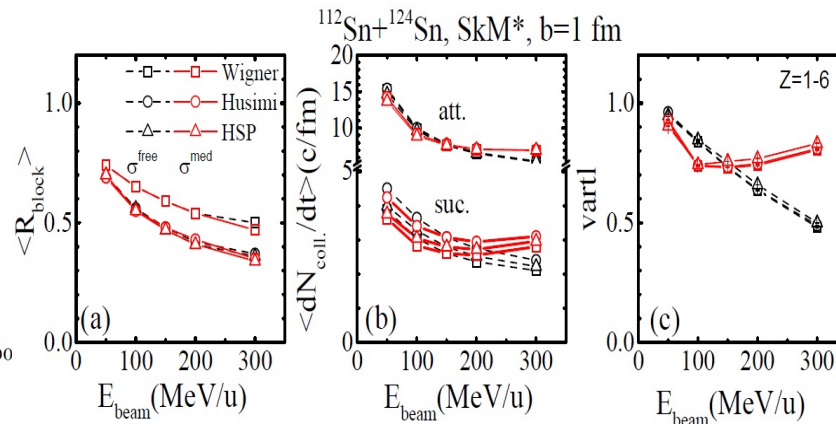
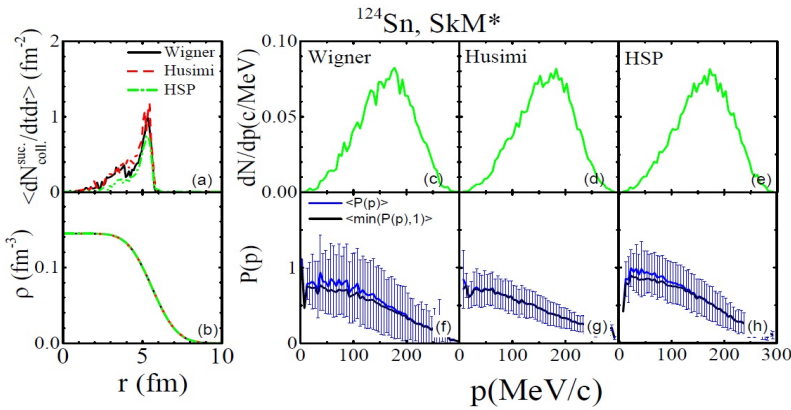
$$2) P_\tau(p'_i) = \frac{1}{2} \sum_{j \in \tau (j \neq i)}^A \exp\left(-\frac{(\vec{r}_i - \vec{r}_j)^2}{4\sigma_r^2} - \frac{(\vec{p}'_i - \vec{p}_j)^2}{4\sigma_p^2}\right) \quad \text{(PB-Husimi)}$$

$$3) P_\tau(p'_i) = \sum_{j \in \tau (j \neq i)}^A (O_{ij}^{(x)}) / \frac{4}{3} \pi R_x^3 (O_{ij}^{(p)}) / \frac{4}{3} \pi R_p^3 \quad \text{(PB-HSP)}$$

where, $\tau = n$ or p , $O_{ij}^{(x)}$ ($O_{ij}^{(p)}$) is the volume of the overlap region of hard spheres with the radius R_x (R_p) of nucleons i and j in coordinate (momentum) space. [More details can be found: Xiang Chen, et al, Chin. Phys. C 45, 074109 (2021).]



- The Pauli blocking ratios $\langle R_{\text{block}} \rangle$: underestimated by 13%-25%.
- $\sigma_{\text{QMD}}^{\text{med}}$ is smaller than its true values, i.e. $\sigma_{\text{QMD}}^{\text{med}} < \sigma^{\text{med}}$.



- The most of the successful NN collisions occur at the **surface** of the nucleus.

- The uncertainty of **stopping power**: less than 5%.
- The **in-medium correction** on NN cross sections is necessary and depends on the beam energy.

- A refined Pauli blocking algorithm must be developed in the future for obtaining **the true values of in-medium cross sections** by comparing the HIC data with the transport model calculations.