# Odd-Even L-Staggering in Heavy-Ion Scattering

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In antisymmetrized theories of heavy-ion collisions, one nucleon exchange and core-exchange are the dominant exchange terms. While one-nucleon exchange is important for all scattering systems, the influence of core-exchange is predicted as dependent on the difference in nucleon number between the fragment nuclei, and should vanish with increasing mass difference. LeMere et al[1] have qualitatively investigated the properties of the core-exchange. As a characteristic feature the core-exchange term, corresponding to a Majorana like effective potential, gives rise to an odd-even $\ell$-staggering of the phase shifts. In turn a parity dependence of the phase shifts reflects a strong contribution of the core-exchange. Until now the validity of these properties was tested only for light systems ($^3$He-$\alpha$,$\alpha$-$^{16}$O) at energies high enough to justify the use of the Born approximation. The present contribution reports about a microscopic study of elastic $^{16}$O scattering on $^{18}$O and $^{28}$Si within the framework of the Generator Coordinate Method (GCM), which allows to test the predicted properties of core-exchange quantitatively for heavier systems and include the low energy region. A detailed description of these calculations is given in ref.[2].

For the $^{16}$O-$^{18}$O system the phase shifts show a pronounced parity dependence as expected. The resonance energies of the even and odd partial waves follow the $\ell(\ell+1)$-rule of an ideal rotator with a parity splitting of nearly 2 MeV. Plotted against $\ell$ the phase shifts exhibit a strong odd-even $\ell$ staggering (fig. 1) reflecting the importance of the core-exchange term. For the $^{16}$O-$^{28}$Si system the

phase shifts exhibit three series of rotational bands without any parity splitting. The two excited bands agree rather well with spin sequences deduced from experimental data[3]. As can be seen in fig. 1, the phase shifts do not show any parity dependence. This points to the core-exchange term being unimportant as expected from the large difference in nucleon number between the fragments.

In conclusion, we have tested the predictions concerning the core-exchange term made by LeMere et al[1] within a qualitative analysis for light systems at high energies. Our GCM calculation supports these predictions of properties of the core-exchange term even for heavy-ion scattering and without the restrictions in energy of ref.[1].

References:

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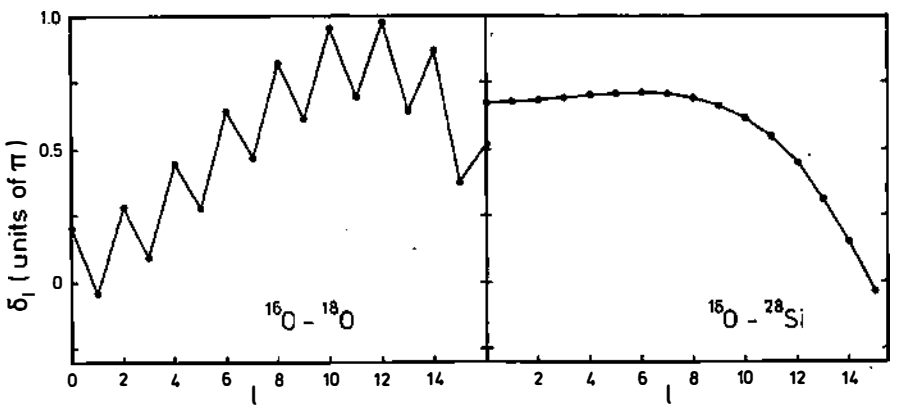


Fig. 1. Phase shifts for elastic $^{16}O$ scattering on $^{18}O$ and $^{28}Si$ at $E_{CM}$ = 25 MeV.