ELASTIC SCATTERING AND THE MOLECULAR TYPE OPTICAL POTENTIAL

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The elastic scattering of 20-50 MeV α-particles from certain light nuclei show a substantial rise in the differential cross-section at backward angles, that cannot be explained by a conventional Woods-Saxon optical potential. However, in the case of ^{40}Ca, it has been shown that a folding potential[1] or a Wood-Saxon potential with an additional degree of freedom[1,2] give excellent fits to the angular distributions. Even the excitation functions were reproduced when the parameters of the potential were allowed to be energy-dependent.

This paper is focusing attention on the use of a molecular type optical potential as already demonstrated[3] in the case of $^{12}C + {}^{12}C$. The difference between this and the conventional potential is the introduction of a repulsive core at small separations of the interacting nuclei. Reichstein and Malik have shown[4] for $^{16}O + {}^{16}O$ that the potential depends crucially on the assumptions made about the densities of the interacting nuclei and of the compound system. Thus, simply superimposing the densities gives a repulsive core, while never allowing the density to exceed the density of the compound nucleus (e.g. ^{32}S) gives a very shallow attractive potential.

Preliminary calculations show that a molecular type optical potential is able to account for the backward rise in the angular distributions of elastically scattered α-particles from ^{28}Si at low energy (12.5 to 18.5 MeV measured at the Åbo Akademi Accelerator Laboratory). A gaussian core with strenght 100 MeV was used together with a shallow attractive and a week imaginary Wood-Saxon potential.

In the future this potential will be applied to α-scattering on different light- and mediumweight nuclei as well as heavy-ion elastic scattering provided experimental data are available.

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