DYNAMICS OF THE ^{12}C-^{12}C SYSTEM IN THE STATIC MOLECULAR MEAN FIELD APPROXIMATION*

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The interaction between two ^{12}C ions at low energy is investigated in the mean field (Hartree-Fock) approximation. We assume adiabaticity for the molecular motion and calculate the interaction energy by the constrained Hartree-Fock method, using the interdistance d separating the two ions as the constrained quantity. This energy is calculated by using the Skyrme SIII force, without spin-orbit. With such a force, the ^{12}C nucleus appears with an oblate deformation.As a consequence, the interaction energy depends upon the mutual orientation of the two nuclei. We have performed the calculation for two distinct configurations. In the first one, the two ^{12}C nuclei approach each other with their axes of symmetry aligned with the collision axis; the corresponding potential is called V1 . In the second configuration, the two nuclei approach each other side by side, i.e. keeping their axes of symmetry mutually parallel and perpendicular to the collision axis. The corresponding potential is called V2 and is depicted in fig. 1, along with potential V1 . As can be seen, the two potentials are quite different. In configuration 2, the nuclear attraction and repulsion set in, as d is decreasing, much earlier than in configuration 1.

In order to use our potentials, we devise a method for calculating from V1 and V2 , quantities of more obvious physical interest, like the interaction energy between two nuclei at a given interdistance and rotating with a definite angular momentum. Our method appears as an approximation of the Peierls-

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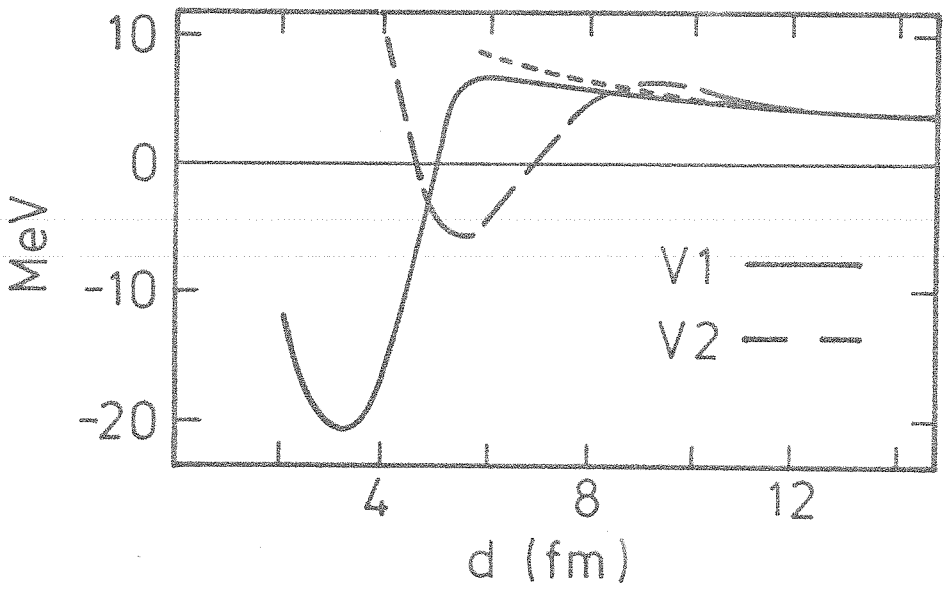

Fig. 1. Potentials V1 and V2 . The dotted curve indicates the Coulomb term for two charged spheres.

Yoccoz procedure. The latter interaction energy can then be used in a coupled-channel calculation of the cross sections. We explicitly introduce the elastic channel and the inelastic channels, where one or both nuclei are excited to their 2^+ (4.43 MeV) level. The detail of the calculation will be given elsewhere[1]) and we only indicate here the main results.

In order to simulate the effect of the neglected channels, we introduce a phenomenological absorptive potential in all the channels that are treated explicitly. Special attention has been devoted to the fusion data[2]), which seem to be very sensitive to the magnitude of the absorption. Although a systematic fit has not been attempted, the following results have been obtained :

(a) The calculation cannot yield a good fit to the fusion data and produce some fine structure (few keV wide) in the elastic and inelastic cross sections simultaneously. Either fine structure is produced and fusion cross section is underestimated or fusion cross section is reproduced and fine structure is washed out.

(b) With an absorptive potential which fits the fusion cross section, the magnitude and the gross structure of the 90° elastic and inelastic excitation functions are satisfactorily reproduced.

These results suggest that the description of the absorption by an imaginary potential is probably inaccurate.

[1]) J. Cugnon, H. Doubre, H. Flocard, to be published
[2]) P. Sperr et al., Phys.Rev.Lett. 37 (1976) 321.