FUSION EXCITATION FUNCTION OF THE $^{40}Ca+^{40}Ca$ SYSTEM NEAR THRESHOLD

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The investigation of the ^{40}Ca + ^{40}Ca system is of particular interest because of the magicity of the two nuclei - The fusion excitation function close to the threshold provides a useful experimental result which has to be reproduced by model calculations. For such a light system and at least at low energies the fusion cross section is practically equal to the evaporation residues cross section due to the vanishingly small fission following fusion cross section - In the past the excitation function of the evaporation residues has been measured by Doubre et al [1)] using a E-ΔE technique and by Barreto et al using a γ rays identification of the residual nuclei - As we can see in the figure the two groups have obtained quite different results especially just above the fusion threshold - We present here the results of a measurement of the ^{40}Ca + ^{40}Ca fusion excitation function which we have performed at the Tandem accelerator of Orsay. The evaporation residues were detected using a large area two dimensional position sensitive ionisation chamber - [3)] It consists of two ΔE and one E and was operated under a pressure around 40-50 Torrs depending upon the bombarding energy - The entrance window of the ionisation chamber consists of several (9) small apertures covering 3° in the horizontal plane and 0.2° in the vertical plane - A 100 $\mu g/cm^2$ mylar foil was stretched on each aperture. These apertures were disposed in such a way that we had a continuous angular measurement extending from around 3° to 25° - Although the elastic scattering was not stopped in the ionisation chamber (the depth of the detector is only 40 cm), it was possible to easily extract it from the E-ΔE plot. This allowed a convenient normalisation of the evaporation residues cross section - The evaporation residues cross section was measured at several bombarding energies : 112.5, 120, 135, 150 and 165 MeV. The results are displayed in the figure - We see that they are in agreement with those of Barreto et al - In this figure is also shown (full curve) the result of a calculation using the interation potential calculated within the energy density formalism of ref 4 and the simple classical formula $\sigma_f = \Pi R^2_{12} \ (1-\frac{V_{12}}{ECM})$

where R_{12} and V_{12} are the position and the height of the fusion barrier for a head-on collision - We see that the agreement with the experiment is not so bad despite the wrong behaviour of the above formula very close to the fusion threshold where barrier penetration effects becomes important.

References :

1) H. Doubre et al Phys. Lett. 73B (1978)135
2) J. Barreto - Thesis Orsay (1980)
J. Barreto et al to be published
3) H. Sann et al Nucl. Inst. Meth 124 (1975) 509
4) H. Ngô et al Nucl. Phys. A348 (1980) 140