THREE DIMENSIONAL TDHF CALCULATIONS FOR $Ca^{40} + Ca^{40}$ AND $O^{16} + O^{16}$

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We have recently studied the collision of O^{16} on O^{16} with the TDHF equations solved in coordinate space in three dimensions (3D). The method and results are presented in Ref. 1. In summary, we have found that at relatively high energy (projectile lab energy of 110 MeV) there is a region of deeply inelastic scattering for small impact parameters, a region of "fusion" for intermediate impact parameters and then a transition to the Coulomb trajectory as the impact parameter increases. The total fusion cross section (.8 barns) is consistent with experiment. Moreover, the triaxiality allowed in the calculation appears to be a significant factor in the energy dissipation process.

Unfortunately, there are no 2D calculations at our energy. We have therefore examined $Ca^{40} + Ca^{40}$ at Elab = 278 MeV both because of its intrinsic interest[3] and becasue 2D[2] calculations exist. We find significant differences relative to the 2D[2] calculations. Particularly, they did not observe any fusion, whereas in 3D there is a wide band of impact parameters for which the system fuses. In addition, although both 2D and 3D have the same large kinetic energy loss for small impact parameters, the 3D calculation has considerably more energy going into "heat" relative to the 2D result once the impact parameter exceeds the maximum for which fusion takes place. It therefore appears that 3D dynamics are required for an adequate descripton of heavy ion collisions once the impact parameter exceeds relatively small values {$\ell = 10$ for $O^{16} + O^{16}$, Elab = 110 MeV; $\ell = 20$ for $Ca^{40} + Ca^{40}$, Elab = 278 MeV}.

References

1) H. Flocard, S. Koonin and M. S. Weiss, in preparation.
2) S. Koonin, et al., Phys. Rev. C 15, 1359 (1977).
3) P. Colombani, et al., Phys. Lett. 55B, 45 (1975).

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