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DIRECT MEASUREMENTS OF HEAVY ION REACTION CROSS SECTIONS

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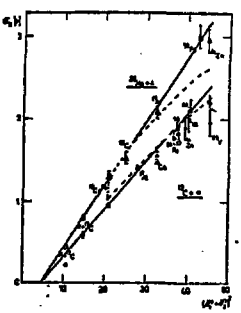
Using the beam attenuation method we measured heavy ion reaction cross sections, σ_R, at three incident energies and for several target-projectile combinations[1]. The systems studied were $^{12}C + ^{12}C$ (at 10 MeV/N), $^{12}C + ^{12}C$ and $^{20}Ne + ^{12}C$, ^{27}Al, ^{58}Fe, ^{64}Zn (at 30 MeV/N) and $^{12}C + ^{12}C$, ^{40}Ca, $^{54,56,57}Fe$, $^{64,66,68}Zn$, ^{89}Y (at 83 MeV/N). The experiments at 10 and 30 MeV/N were performed at the Grenoble cyclotron facility SARA, the 83 MeV/N ^{12}C beam was delivered by the CERN synchrocyclotron. The measured energy dependence of the $^{12}C + ^{12}C$ data agrees well with theoretical predictions by DeVries et al.[2]. In fig. 1 we show the mass dependence of σ_R for the measured projectile-target combinations at 30 and 83 MeV/N. In good approximation there is a linear dependence of σ_R on $(A_p^{1/3} + A_T^{1/3})^2$ at both energies. The difference in slope for the two curves can be interpreted in terms of an energy dependent transparency. Following Karol[3] we compared our data with model calculations using

$\sigma_R = 2\pi \int_0^\infty (1 - T(b))\, b\, db$ where T(b) is the transparency function[3] at impact parameter b.



By identifying T(b) with $T(b) = \exp[-z(b)/\Lambda(b)]$ we extracted values for the mean free path $\Lambda(b)$ of the part of the projectile nucleons overlapping with the target nucleus.
For $^{12}C + ^{12}C$ collisions at b = 5.36 fm we find Λ = 5.3 fm which is in agreement with the value extracted from the imaginary part of the optical model potential.

Fig. 1 : Mass dependence of the reaction cross section at 30 MeV/N (triangles) and at 83 MeV/N (circles). The solid lines are to guide the eye, the dotted lines link model calculations based on the formalism of ref. 3.

References.

1) C. Perrin et al., Phys. Rev. Lett. 49, 1905 (1982).
2) R.M. DeVries et al., Phys. Rev. C22, 1005 (1982).
3) P.J. Karol, Phys. Rev. C 11, 1203 (1975).