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Recent investigations of the deep inelastic collisions (D.I.C.) focused mainly their attention to the shape of the fragment spectra emitted in the heavy ion collisions. For the projectile like fragments the shape of these spectra is governed by two components : the quasi elastic peak on the high energy side of the spectra and the deep inelastic part at much lower energy. The first component is particularly important at forward angles around the grazing angle but only for fragments corresponding to small transfert of nucleons. Unhappily, these two components widely overlap in such a way that it is very difficult to extract pure D.I.C. data. After some previous analysis [1]) done at the Grenoble Cyclotron with ^{20}Ne at 151 MeV on ^{40}Ca then on ^{27}Al and ^{59}Co (to be published), we try to get more accurate results by bombarding, always with ^{20}Ne, a lot of targets ranging from C to Bi and looking from only two angles, 20° and 40°, but with a good statistic. In the paper, we study the final fragment average center of mass energy (TKE) for fragments between Z = 5 and Z = 14 and for some of the targets as illustrated in fig. 1 and fig. 2.

As in the ref. [1]) we consider the total final kinetic energy of a dinuclear rotating system at scission :

$$E_F = V_{coul}(d) + V_{NUCL}(d) + F^2 \frac{li\,(li+1)\hbar^2}{2\mu_F d^2} \qquad (1)$$

where μ_F is the reduced mass of the exit channel, F is the ratio of the exit channel angular momentum to the entrance channel angular momentum li and d is the separation of the two mass center at scission :

$$d = 1.2\,(A_1^{1/3} + A_2^{1/3}) + \delta \qquad (2)$$

where δ is the neck length.

The kinetic energy calculated with V_{nucl} which is taken to be modified proximity potential [2,3]) is then roughly corrected [4]) and so, the atomic number of the emitted fragments, in order to take account for evaporation of nucleons

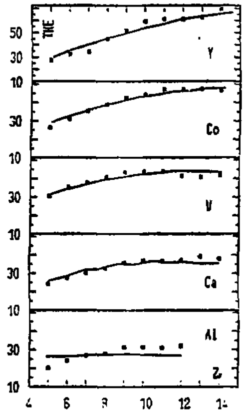

Fig. 1. Relation between the average total kinetic energy of the fragment exit channel and the primary fragment atomic number in the interaction of ^{27}Al, ^{40}Ca, ^{51}V, ^{59}Co and ^{89}Y +151 MeV ^{20}Ne at 40° in the laboratory. The square dots are the experimental points; the solid curves are the best fits, including evaporation corrections, deduced from Eq.(1) using li = lcr + 1 and the values of the neck length δ given in table 1.

and energy loss. Following our previous analysis[1]) we consider that at 40°, far enough from the grazing, as seen on table 1, li is near lcr the critical angular momentum. The fusion cross section data for Al, Ca and Co give for lcr values that are well reproduced by the interaction potential of Ngô [5]) for a critical radius r_o = 0.93 fm ; we thus adopt the values so found for V and Y for which fusion cross sections dot no exist. Calculations with li = lcr + 1 and for a neck length of the order of δ = -0.5 (see table 1) that correspond to an interaction distance of about $d=1.1(A_1^{1/3}+A_2^{1/3})$ are represented on fig. 1. It is clearly noticeable, perhaps with the exception of the Al, that the data are well reproduced by these calculations based on a fully equilibrated dinuclear complex formed by a maximum overlap of the colliding nuclei in the initial stage. The discrepancy found in the Al results may be explained, perhaps, by structure effects still to much pronounced in such a light target, by the symmetry of the entrance channel and also, due to these features, by a great sensibility of the evaporation corrections versus the threshold energy.

At 20°, the situation is quite different ; the collisions are almost at the grazing for Y and Co with an overlap a little bit more important for the other targets. Then, the equilibrium is not yet established enough and the kinetic energy, in that case, is a function of the amount of nucleon transfer. We may think of a transfer that grows with the degree of overlaping and thus varies with the impact parameter and so, with the initial angular momentum. Using the crude model of Simbel and Abul Magd [6]) we get li as a function of Z without any other free parameter, lgr and Rgr being extracted (see table 1) from our elastic scattering results. The best fits represented on fig. 2 are obtained with values of δ(see table 1) of the order of 5 fm ; as already noted [1]) this value that corresponds to the large deformation of the nuclei at scission, is notably larger than δ = 2 fm usually used for fission results. These values will probably still be larger when the work of substracting the quasi elastic component of the spectra will be done. The effect of this component that increases <TKE> is clearly visible, particularly for Y and Co at Z_F = 8, 9 and 10. This effect is moreover mixed with the evaporation ones, in such a way that a precise analysis of the whole process is needed ; this is the work that we are doing at the present.

In conclusion, the present data show that in the deep inelastic collisions and far from the total relaxation, the situation is still ambiguous as already noted by Betts and Di Cenzo [7]. It seems however, that a more precise analysis of the experimental data done for various systems and at different energies may gives, with some more refinements of the theoretical approach, a much better understanding of the deep inelastic collisions mecanism.

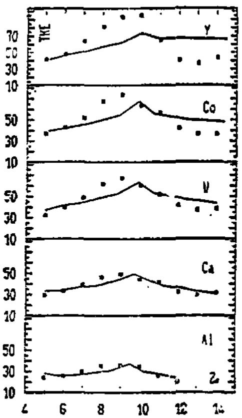

Fig.2. Same as fig. 1 but at 20° in the laboratory and with values of L_g deduced from the calculations of ref. [6].

Table 1

The different parameters used in the present analysis for collissions of $^{20}_{10}Ne$ at 151 MeV on some targets : The grazing angular momentum l_{gr} is deduced from the quarter-point $\theta_{1/4}$; the critical angular momentum l_{cr} is deduced a) from the fusion cross section and b) calculated with the interaction potential of Ngô [5]) for a critical radius r_0 = 0.93 fm ; the values for the neck length δ are extracted from the best fits at 20° and 40°.

target	$\theta_{1/4}$ (lab)	l_{gr}	l_{cr}	δ 40° (fm)	δ 20° (fm)
$^{27}_{13}Al$	6.2	53	36 a)	- 0.47	5.3
$^{40}_{20}Ca$	13.4	65	44 a)	- 0.75	5.5
$^{51}_{23}V$	15.1	71	48 b)	0.02	3.7
$^{59}_{27}Co$	17.5	75	50 a)	- 0.23	4.3
$^{89}_{39}Y$	24.3	84.5	54 b)	- 0.31	3.3

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