THE ENERGY DEPENDENCE OF FRAGMENTATION CROSS-SECTIONS OF RELATIVISTIC HEAVY NUCLEI

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Abstract. We have continued our studies, reported at this conference in the previous paper[1], on the interactions of heavy energetic nuclei by making a further series of runs at the LBL Bevalac. In these runs we used beams of iron, lanthanum and gold nuclei at a number of different energies interacting in targets of polyethylene, carbon, aluminum and copper. These runs will allow us to study the energy dependence of the cross-sections over the limited range of energies available at the Bevalac. Here we report on an initial analysis of the data which shows that we achieved greatly improved charge resolution over that seen before. As a result we expect to be able to make determinations of all the cross-sections needed to make comparisons with the earlier data.

1.Introduction. In our earlier work we found that the cross-sections could be represented as a function of the charge change by either an exponential function, for hydrogen like targets, or by a power law function, for heavier targets. The parameters characterizing these functions appeared to have a strong dependence on the charge of the projectile nucleus, but also showed evidence for a dependence on the energy of projectile. With the data available to us previously we could not separate these two dependencies, and hence we could not make reliable extrapolations to those energies more characteristic of the cosmic ray nuclei observed during the HEAO Experiment.[2]

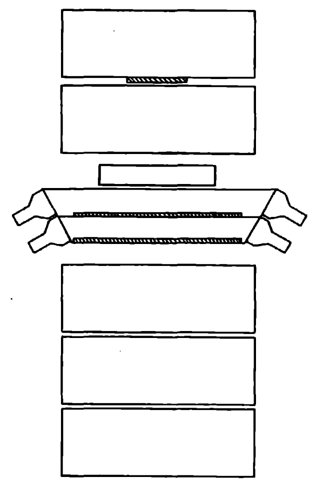

Fig.1. The detector array

Table. Energies and target thicknesses

Beam	Energy MeV/amu	Target thickness in g/cm² polyethylene	carbon	aluminum	copper	lead
gold	1030	1.25	1.52	1.72	1.93	
	850	1.25	1.52	1.72	1.93	
	750	1.25	1.52	1.72	1.93	
	650	1.25	1.52	1.72	1.93	
holmium	1007	1.44	1.76	1.99	2.27	
	850	1.44	1.76	1.99		
	603	1.44	1.52			
lanthanum	1251	1.69	2.06	2.41	2.72	
	1150	1.69	2.06	2.41	2.72	
	989	1.69	2.06	2.41	2.72	
	850	1.69	2.06	2.41	2.72	
	700	1.69	2.06	2.41	2.72	
	577	0.78	0.94	1.10	1.25	
iron	1600		3.58	4.12	4.65	7.45
Densities (g/cm³)		0.926	1.843	2.706	8.93	11.37

2. Detectors. The configuration of the detectors used for these runs is illustrated in Fig.1. Several improvements over the previous setups allowed us to obtain markedly better resolution. In particular two separate Cherenkov counters were used so that interactions in the radiators, which contain most of the material in the detectors, could be directly eliminated by requiring consistency. In addition, new and improved ion chambers were used which showed greatly improved resolution and stability. The beams of nuclei used were incident on the detector with several different energies for each target. The Table shows these energies as well as beams and targets used. Each target was chosen so the energy change in the target was at least a factor of two less than the difference in energy between adjacent exposures.

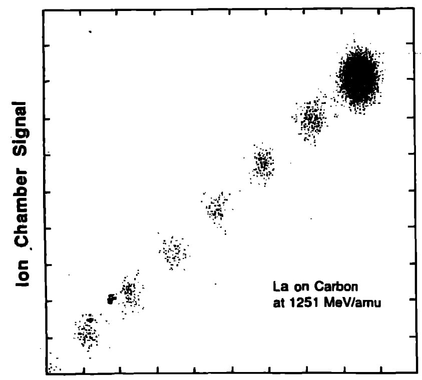

Fig.2. La on carbon at 1251 MeV/amu

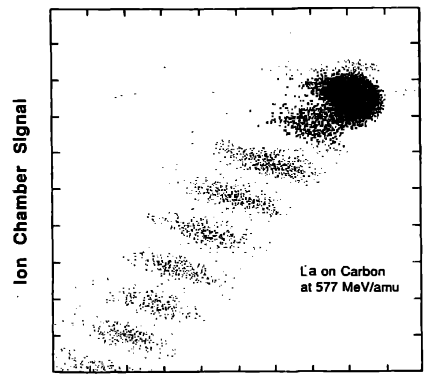

Fig.3. La on carbon at 577 MeV/amu

3. Analysis. Beam nuclei were selected from the signals in I-1 . These particles were then examined after passing through a target by making a cross plot of the Cherenkov and ion chamber signals behind the target. Figs 2 and 3 show such cross plots for La nuclei incident on a carbon target at energies of 1251 and 577 MeV/amu respectively. Clearly the charge resolution depends to a quite different degree on the two types of detector at these two energies, but is excellent in both cases. Figs 4 and 5 show the charge histograms obtained in each case. From these we find a charge resolution with a standard deviation of 0.13 and 0.18 charge units at high and low energy respectively.

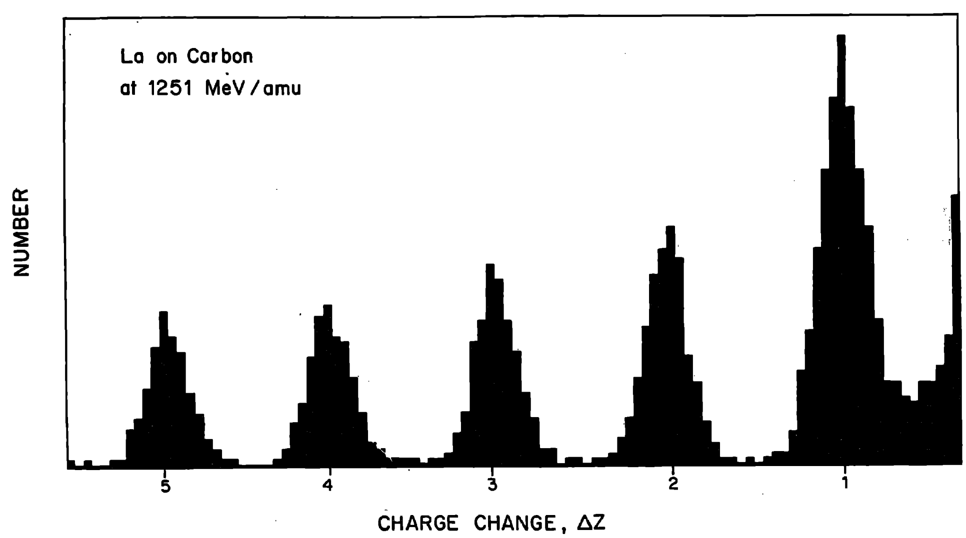

Fig.4. Charge histogram from Fig.2

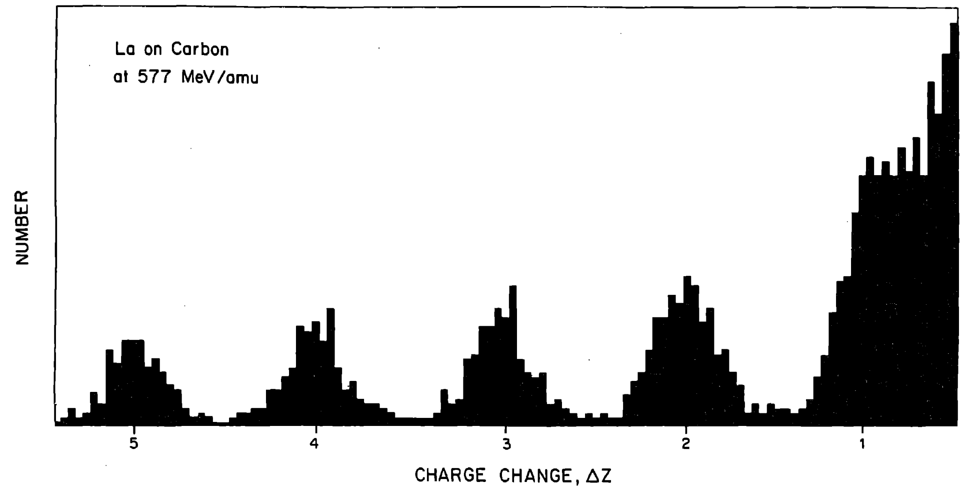

Fig.5. Charge histogram from Fig 3

4. Conclusion. The data from this experiment are of high enough quality to allow us to determine the partial cross-sections as a function of energy in all the runs made. By the time of the conference we hope to be able to report on the energy dependence of the partial cross-sections for at least one of the beams used.

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[1].C.J.Waddington, W.R.Binns, T.L.Garrard, M.H.Israel, M.P.Kertzman, J.Klarmann and E.C.Stone.(1987) OG 7.2-11p, this conference.

[2] W.R.Binns, M.H.Israel, J.Klarmann, W.R.Scarlett, E.C.Stone and C.J.Waddington (1981) Nucl. Instr. Methods, **185**, 415.