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ADDENDUM TO PROPOSAL P223

SEARCH FOR NUCLEI IN HEAVY ION COLLISIONS AT ULTRARELATIVISTIC ENERGIES

SACLAY-SATURNE COLLABORATION

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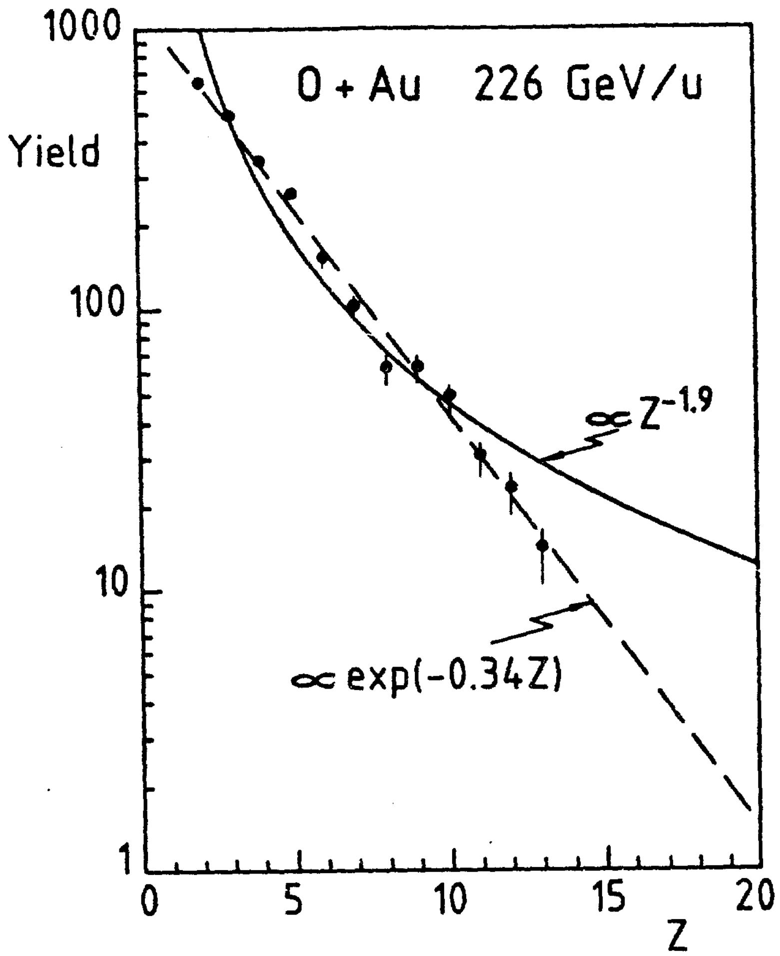
Our experiment with the $^{16}_{8}O$ beam at 226 GeV/u has been successful. We wanted to see if nuclei are still present at large angles in a collision between a very energetic $^{16}_{8}O$ projectile and a $^{197}_{79}Au$ target. We detected nuclei with atomic numbers up to Z ~ 13 (even up to Z = 18 but with a small efficiency). Their atomic number distribution decreases as Z increases and is shown at 226 GeV/u in the figure. In proton induced collisions, in the same energy range, it has been found that the mass yield[1] varies like $A^{-\tau}$,



where A is the mass of the fragment, with $\tau \approx 2.6$. The figure also shows a best fit with a $Z^{-\tau}$ function which leads to $\tau \approx 1.9$. However the agreement with the data is not as good as with the exponential. The experimental results are therefore different from those associated to protons and are very likely to be an indication that the multifragmentation mechanism is different in both cases. The kinetic energy of most of the products is below 30-40 MeV which indicates that it comes essentially from the coulomb repulsion between the fragments.

This fragment production is expected to originate from the target spectators which are left practically at rest in the laboratory system after the collision. These spectators are expected to have a very distorted shape due to the projectile which gouge a hole through the target. When the system reorganizes, the deformation energy (essentially in the surface degrees of freedom) is converted into thermal excitation. Little compressional energy might also be present. Furthermore, as in proton induced reactions, fast particles coming from the participant region might cascade through the spectator volume, create holes and weaken the bonds between the nucleons. As a final result the spectator nucleus break up into several pieces (multifragmentation). These results could be interpreted as a critical phenomenon, and in particular can be explained within a percolation approach[2)].

The results obtained at 60 GeV/u during the few shifts provided by the SPS give similar results but the production cross section seems to be larger by a factor of the order of two.

In view of the above results, we would like to pursue the experiment, which is parasitic to NA38, using a heavier projectile like $^{32}_{16}S$. The aim is the same as in the previous experiment, i.e. see if nuclei can still survive in an ultrarelativistic heavy ion collision. Furthermore, we would like to check if a similar behaviour of the mass yield is observed and if it is even steeper. Indeed in proton induced reactions the mass yield has been found to vary like $Z^{-\tau}$ with $\tau \approx 2.6$ whereas here it varies like $e^{-0.34Z}$. This difference indicates that the process inducing a multifragmentation of the projectile spectators is different for heavy ions at very large bombarding energies compared to the proton case. As a matter of fact one observes more collectivity in heavy ion collisions. A bigger projectile would therefore be useful to study this evolution.

The experimental set up we would like to use is the same as in the previous experiment with the following modifications :

1- we would like to decrease our energy detection threshold because the kinetic energy of the nuclei emitted at large angles is small. For this reason we would like to use two telescopes consisting of 2 gas-ΔE sections followed by 2 silicon ΔE detectors (150 μm and 500 μm). The gas ΔE part has 10 cm depth and will be operated under a pressure of about 50 Torrs of CF_4 (an inert gas). The volume of the gas in each telescope is of the order of a few hundred of cm^3 and is at a low pressure. An automatic set up, which stops the gas circulation, will be installed in case of any leak.

2- We shall use a faster acquisition system based on several 8088 processors which are working in parallel.

1) A.S.Hirsch et al Phys. Rev. C29 (1984) 508

2) J.Nemeth et al Z. Phys. A325 (1986) 347