Coulomb Fission of Uranium

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Electromagnetic dissociation (EMD) is a process that occurs when a nucleus is excited above its particle emission threshold by the electromagnetic field of the collision partner. It is called Coulomb fission if fission is the exit channel.
In a recent experiment with the ALADIN spectrometer fission of uranium projectiles at 1 GeV/u was investigated. Seven different targets made of beryllium, carbon, aluminium, copper, indium, gold and uranium were used.
With the MUltiple Sampling Ionization Chamber TP - MUSIC III the charge and the position of the fission fragments were determined. Individual charges were resolved. Neutron multiplicities were measured with the LAND detector. The multiplicity for light particles emitted from the interaction zone was detected with a Si - CsI hodoscope.

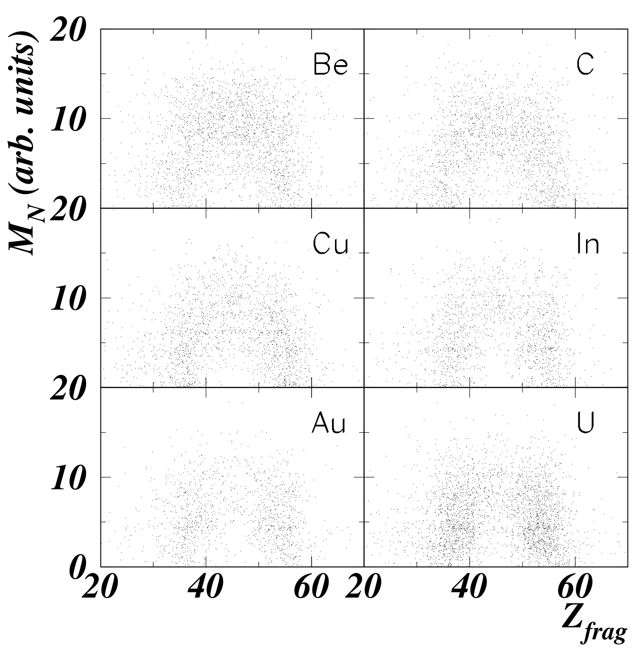

Figure 1: *Correlation between the number of neutrons and the charge of the fission fragments for different targets under the condition that the light particle multplicity $M_{CsI} = 0$.*

Since Coulomb fission proceeds predominantly through the excitation of the giant resonance very low excitation energies are expected while nuclear interactions show a broad distribution. The cross section for Coulomb fission is approximately proportional to Z^2_{target} [1] [2].
In the following we will consider only events where the sum of the charge of the two fragments equals 92 and where the multiplicity of the light particles in the hodoscope is 0. This selection should enhance contributions from Coulomb fission.
In figure 1 the correlation between the number of neutrons observed in the LAND detector and the charge of the fission fragments detected in the TP - MUSIC III is shown. With increasing charge of the target the ratio between the number of events with low and with high neutron multiplicities increases.
Figure 2 shows the charge spectrum of the fission fragments for small and high neutron multiplicities M_N for the indium target. For small neutron multiplicities an asymmetric fragment charge distribution with a large peak to valley ratio is observed. This is a strong indication for a very low excitation energy as expected for Coulomb fission. With increasing neutron multiplicity the charge distributions of the fragments become more and more symmetric due to higher excitation energies caused by nuclear background from lower impact parameter collisions.

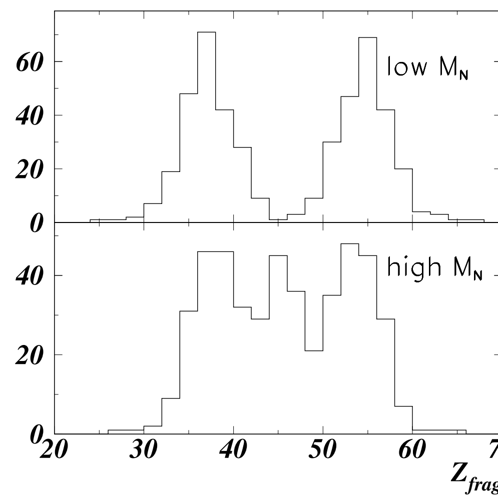

Figure 2: *Charge distributions of the fission fragments for low and high neutron multiplicities for the indium target*

In figure 3 we show the charge distributions for the fission fragments for different targets. The magnitude of the asymmetric component in the fragment yields is sensitive to the excitation energy imparted to the fissioning system. With increasing target charge we observe an increase in the peak-to-valley ratio. This increase of the asymmetric component with the charge of the target nucleus can be attributed to Coulomb fission.
The determination of cross sections for the selected Coulomb fission events is in progress. Further analysis will allow to test the predictions for these reactions at relativistic energies.

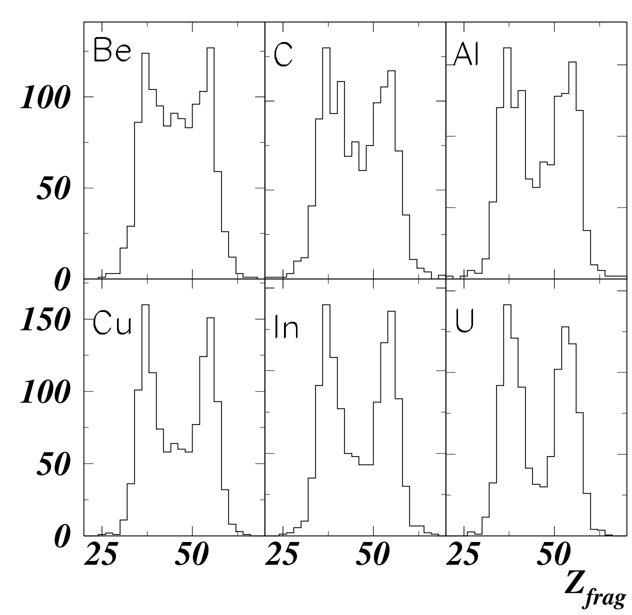

Figure 3: *Charge distributions of the fission fragments for several targets. The asymmetry increases with the atomic number of the target.*

References

[1] M. L. Justice *et al.*, Phys. Rev. **C 49**(1994) R5

[2] J. W. Norbury, Phys. Rev. **C 43**(1991) R368 and references therein