NOTIZEN

Fission Fragment Charge Distributions in Mass Chains $A = 132, 133$ and 134 as a Function of Fragment Kinetic Energy

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(Z. Naturforschg. **22 a**, 1808—1809 [1967]; received 28 September 1967)

Nuclear charge distributions for the fission fragment mass chains A=132, 133 and 134 have been measured as a function of fragment kinetic energy. The fractional yields of nuclei with the magic neutron number $N=82$ are shown to increase with fragment kinetic energy.

Previous measurements [1] by this group have shown a pronounced influence of the closed nuclear shells, $N=82$ and $Z=50$, on the nuclear charge distributions of fission fragments from the fission of U^{235} induced by thermal neutrons. The aim of this work was to investigate the nuclear charge distributions for the mass chains $A=132$, 133 and 134 more thoroughly, particularly as a function of fragment kinetic energy. For fragments having high kinetic energy, in which case there is a relatively small amount of energy available for fragment excitation, it is expected that the energy gain in the formation of magic nuclei should become more apparent through a higher yield, just as the relative energy gain of even nuclei due to the pairing effect appears in the mass chain $A=138$ charge distributions [2].

The method used was essentially the same as in ref. [2]. Fission fragments, separated by a mass spectrometer [3, 4] according to mass and kinetic energy, were caught in nuclear emulsion plates. The processed emulsions were scanned under the microscope and the number, n, of beta particle tracks emerging from the end

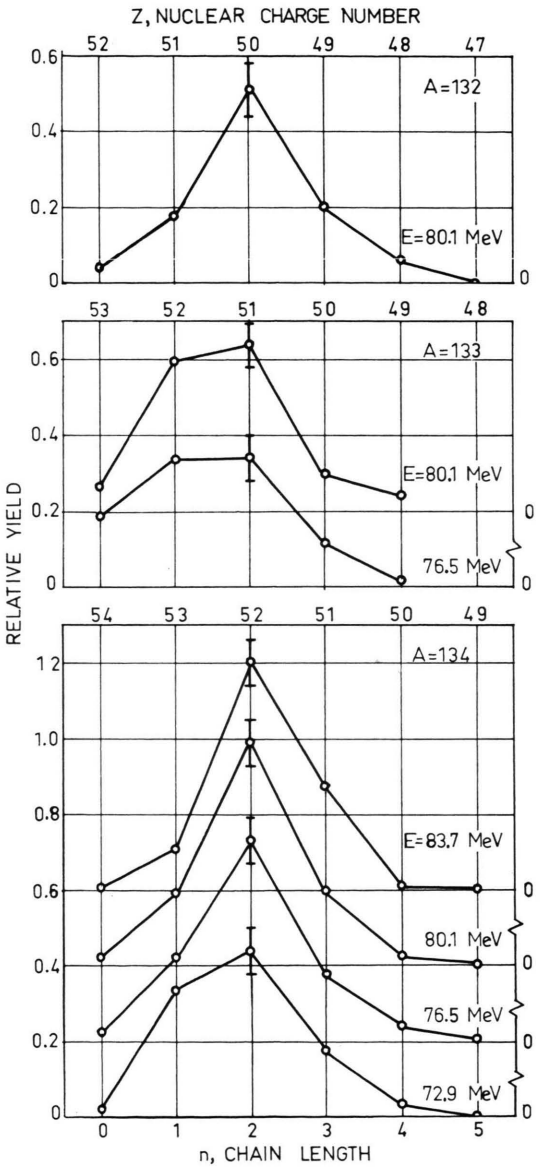

Fig. 1. Chain length distributions for mass numbers 132, 133 and 134, as a function of fragment kinetic energy. For better survey the zero lines of the distributions corresponding to the same mass are displaced by 0.2 units each. Each distribution is normalized to 1.0. For the abscissa, the lower scale gives the number n of emitted beta particles. The upper scales give the corresponding nuclear charges, $(Z_{st}-n)$.

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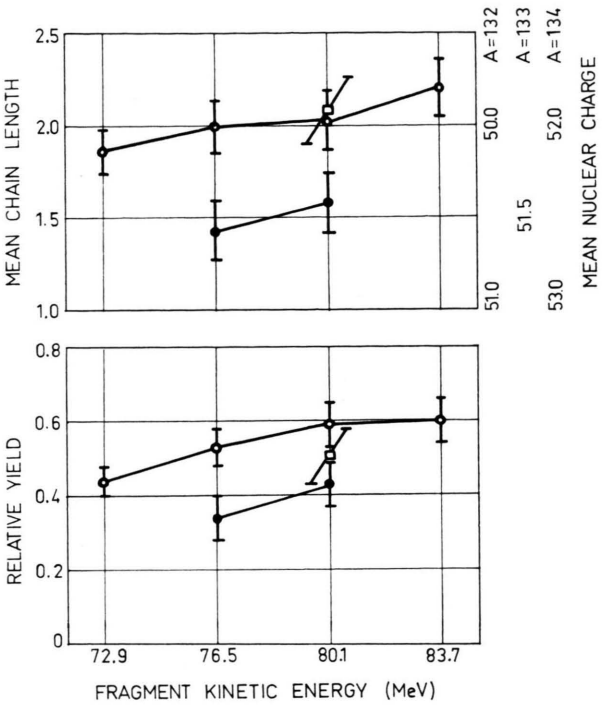

Fig. 2. *Top:* Mean chain lengths (left-hand scale) and mean nuclear charge (right-hand scales) for fission fragment masses $A=132$ (□), $A=133$ (●) and $A=134$ (○), as a function of fragment kinetic energy. *Bottom:* Fractional yields of the magic nuclei $^{132}_{50}Sn^{82}$ (□), $^{133}_{51}Sb^{82}$ (●), $^{134}_{52}Te^{82}$ (○) within the mass chains $A=132$, 133 and 134, respectively, as a function of fragment kinetic energy.

of each individual fission fragment track was determined. The simple relationship between the primary fragment nuclear charge, Z_p and n is $Z_p = Z_{st} - n$, where Z_{st} is the known charge of the stable end product of the mass chain under investigation.

Fig. 1 shows the charge distributions for masses $A=132$, 133 and 134; Fig. 2 shows the average charge, Z_p (top) and the relative contribution of the magic nuclei $^{132}_{50}Sn^{82}$, $^{133}_{51}Sb^{82}$ and $^{134}_{52}Te^{82}$ (bottom) as a function of fragment kinetic energy. With increasing kinetic energy the magic nuclei are formed with higher probability. Due to the relatively low intensity of particles with mass numbers 132 and 133 in connection with the separation principles of the mass spectrograph [4], the data in these cases were taken for only one and two energies, respectively.

The low value of Z_p for $A=132$ corresponds to a high yield of the doubly magic nucleus with $N=82$, $Z=50$.

The results are consistent with the average values of Z_p as given in ref. [1] but are in contradiction to the recent radiochemical measurements of Strom et al. [5] who obtain $Z_p=51.07$. The low value of Z_p for $A=132$ in the present measurement could be caused, in principle, by improperly including in the chain length determination a large number of conversion electrons which are indistinguishable from beta particles in the nuclear emulsion. However, preliminary results of a measurement by H. Rösler of this group, in which a 4π proportional counter is used to determine the chain lengths, indicate that the influence of conversion electrons is small.

The authors wish to thank Professor H. Ewald for his continuous support of this work, Professor H. Maier-Leibnitz and Dr. H. Vonach for the possibility of using the Munich research facilities and the staff of the Munich reactor for their cooperation.

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The Kinetic Energy of Autoionization of Helium

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(Z. Naturforschg. **22 a**, 1809—1810 [1967]; received 25 September 1967)

A surprising difference between the kinetic energy distribution of He^+ ions and D_2^+ ions formed by electron impact above 60 eV has been observed. The experiments were performed on a MS-2 mass spectrometer of AEI-Manchester, and the kinetic energy distribution was measured by the deflection plate method. The apparatus and technique are described by Taubert and Fuchs [1]. The source makes use of a continuous electron beam with collimating magnetic field, and a continuous repeller field so that only nominal electron energies can be given. The cathode is a strip of tungsten. The ion extraction slit is parallel to the electron beam. In order to minimize instrumental effects the kinetic energy distribution of He^+ and D_2^+ were measured successively, with pressures adjusted to give equal ion currents at the multiplier. Experimental series were run with the repeller voltage, collimating magnetic field and pressure varied within the limits, $50-160$ V per cm, $90-320$ Gauss and $0.7-5\times10^{-6}$ torr. The fraction of the ions which undergo bimolecular collision before extraction from the source is negligible. The source temperature was measured by a thermocouple on the cage, and was found to be stable to better than ±1 degree over a run of several hours. The half width of the kinetic energy distribution curves were normalized to 450 °K.

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