

## Charge Deviation of Fission Products in the Proton-Induced Fission of $^{238}\text{U}$

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## I. 5. Charge Deviation of Fission Products in the Proton-Induced Fission of $^{238}\text{U}$

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The charge distribution of fission products in the proton-induced fission of  $^{238}\text{U}$  has been studied by the use of IGISOL. The incident proton energies were 24 MeV, 18 MeV and 13 MeV. Yields of fission products were determined by gamma-ray spectrometry. The analysis was performed by assuming a Gaussian charge distribution with representative parameters  $Z_p$  and  $C$ , where  $Z_p$  is the most probable charge of a given mass chain and  $C$  is the width of the distribution. The ratios of the observed yields were taken for the same element of different mass chains in order to eliminate the difference in transport efficiency in IGISOL, which may differ element by element. By assuming a constant width ( $C=0.97$ ) of the charge distribution<sup>1)</sup>, We could obtain the differences of  $Z_p$ 's of different mass chains rather than their absolute values.

The obtained differences ( $dZ_p$ ) of the  $Z_p$ 's between the neighboring mass chains at the proton energy of 24 MeV are shown in Fig. 1 where  $dZ_p$  is defined as ( $Z_p$  higher mass -  $Z_p$  lower mass). On the average, as the values of  $dZ_p$  is positive,  $Z_p$  of higher mass chain is larger than those of lower mass chains and the averaged  $dZ_p$  has a similar value as expected from UCD model (dotted line). However, it was found that the most probable charge does not increase steadily with increasing fragment mass number but the trend in the most probable charge has some structure. If the charge equilibration in fission process is fast enough to equilibrate just after the determination of mass splitting, the charge distribution of fission products may correspond to the formation Q-value. To see the relationship of  $Z_p$  and formation Q-value, the energetically most favorable  $Z_p$  is estimated for each mass chain after correcting evaporation neutrons<sup>2)</sup>. The result is shown in the figure as connected lines. It is found that the  $dZ_p$ 's expected from Q-value fairly represents the experimental ones, although some are quite different. This relation is more clearly seen when the experimental  $dZ_p$  is plotted as a function of the expected one. The result is shown in Fig. 2. This figure includes  $dZ_p$ 's obtained for more than one mass number difference. It is found that the experimental  $dZ_p$  correlates with the expected ones. In the vicinity of the magic number of the fragment, the deviation from the expected value is large. This is probably the result of smearing out of

the effect of shell structure in estimation of expected ones because the formation Q-values come from the sum of mass excesses of a magic nucleus and its highly-deformed complimentary one. These results suggest that the charge distribution of fission products are strongly influenced by the Q-value of the corresponding mass splitting.

## References

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- 2) Strecheker M. et al. Phys. Rev. C 41 (1990) 2172.

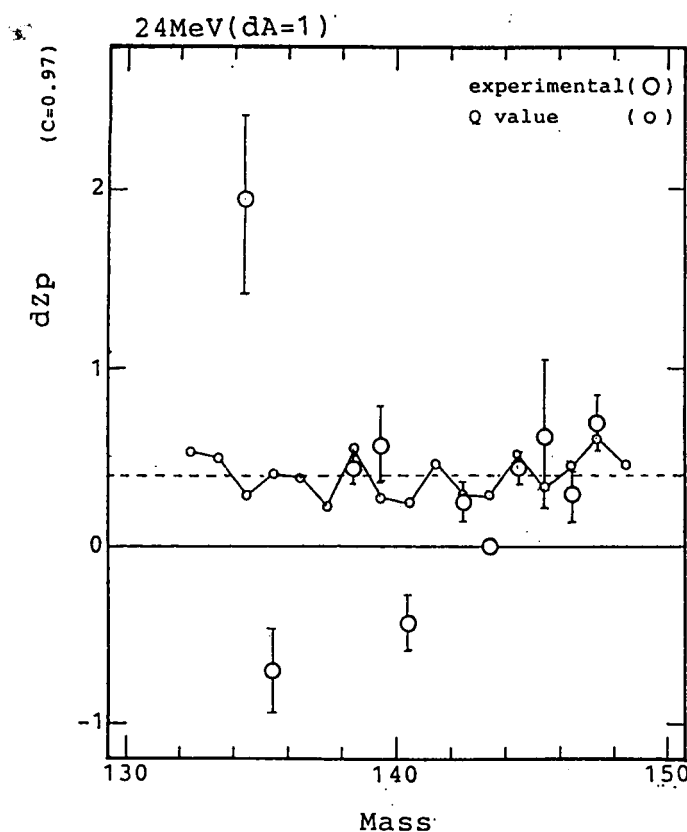


Fig. 1. Difference of the most probable charge of fission products in 24 MeV proton-induced fission of  $^{238}\text{U}$ . Small circles connected by lines are estimated from formation Qvalue. Dotted line represents the value expected from UCD model.

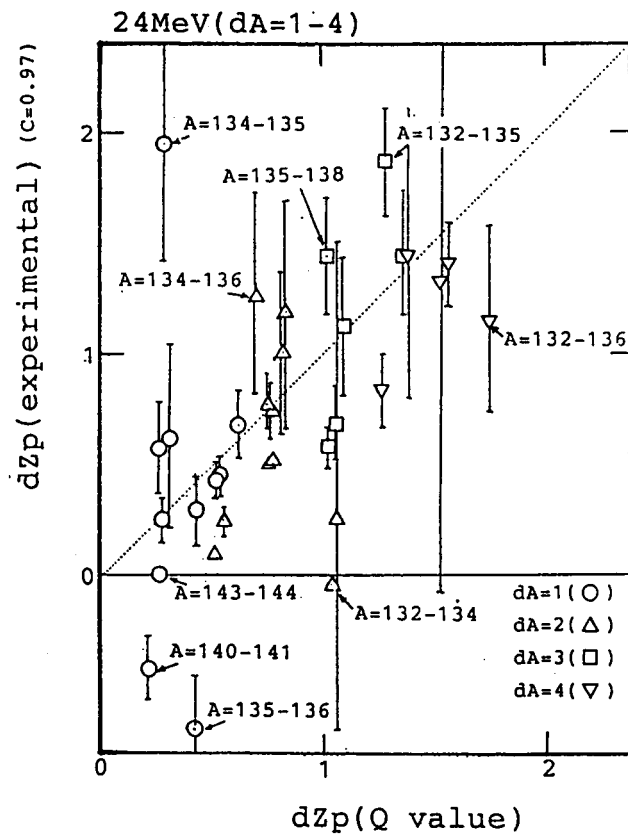


Fig. 2. Difference of the most probable charge vs. those expected from formation Q-values.