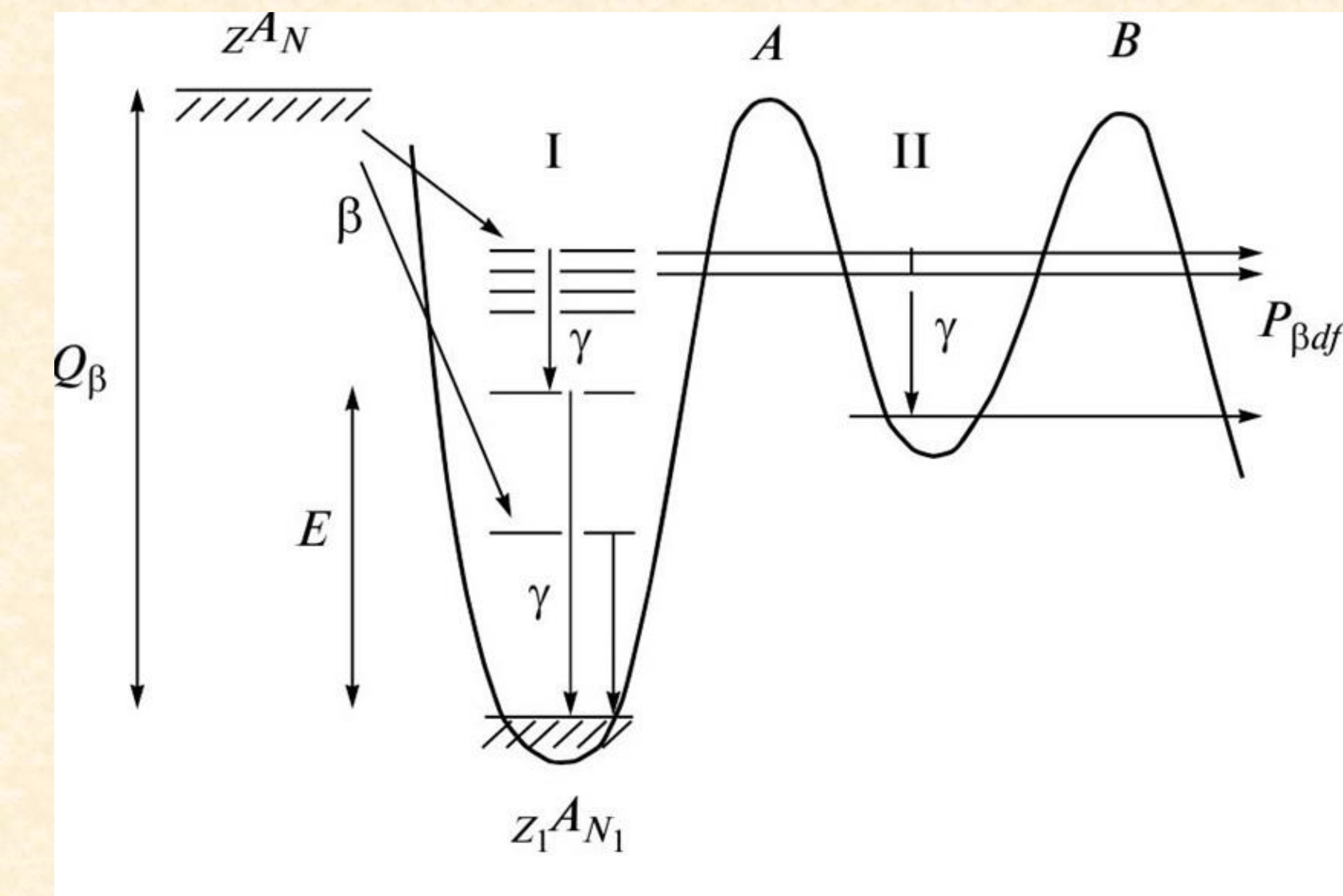# NON-STATISTICAL EFFECTS IN BETA & GAMMA DECAYS AND BETA-DELAYED FISSION ANALYSIS
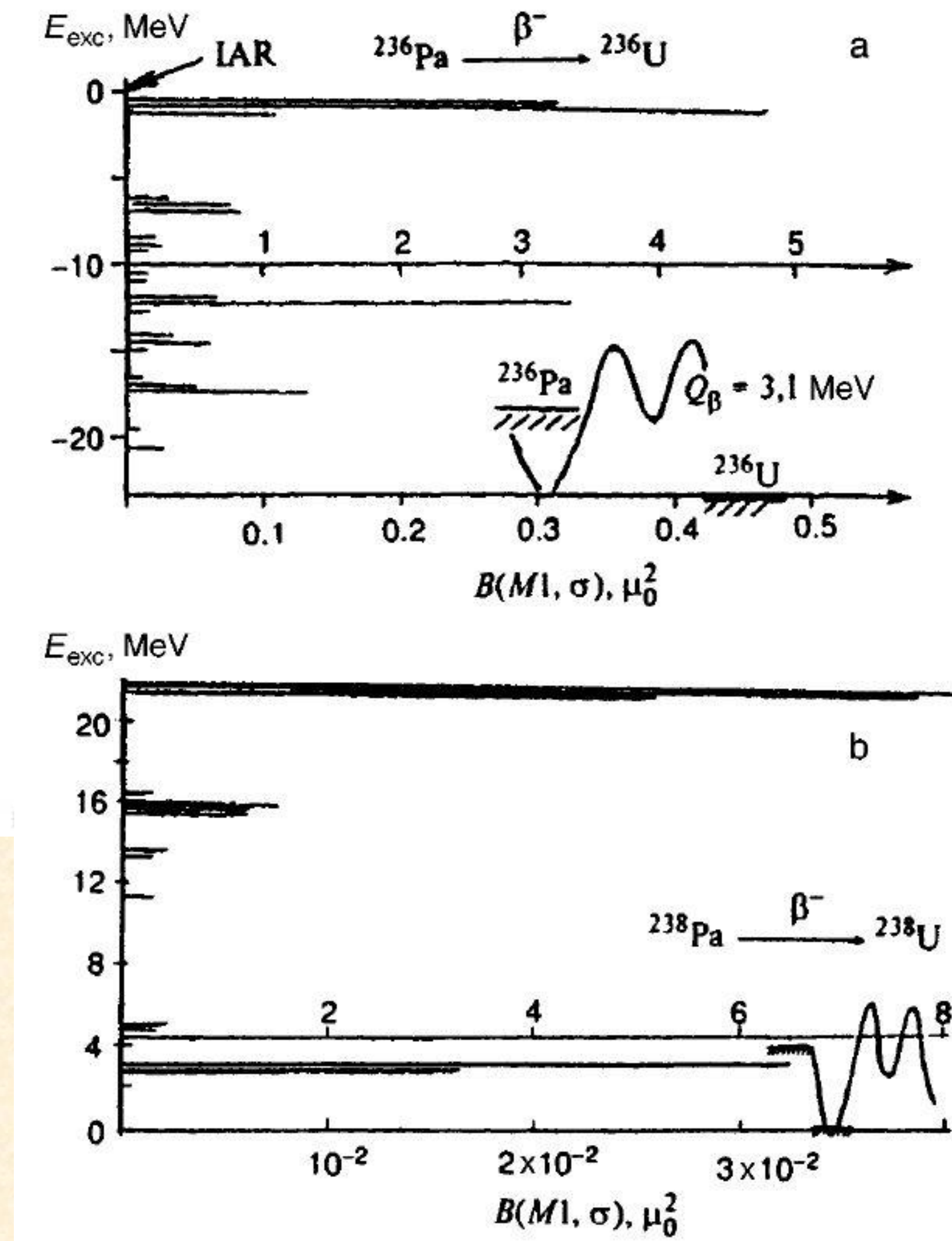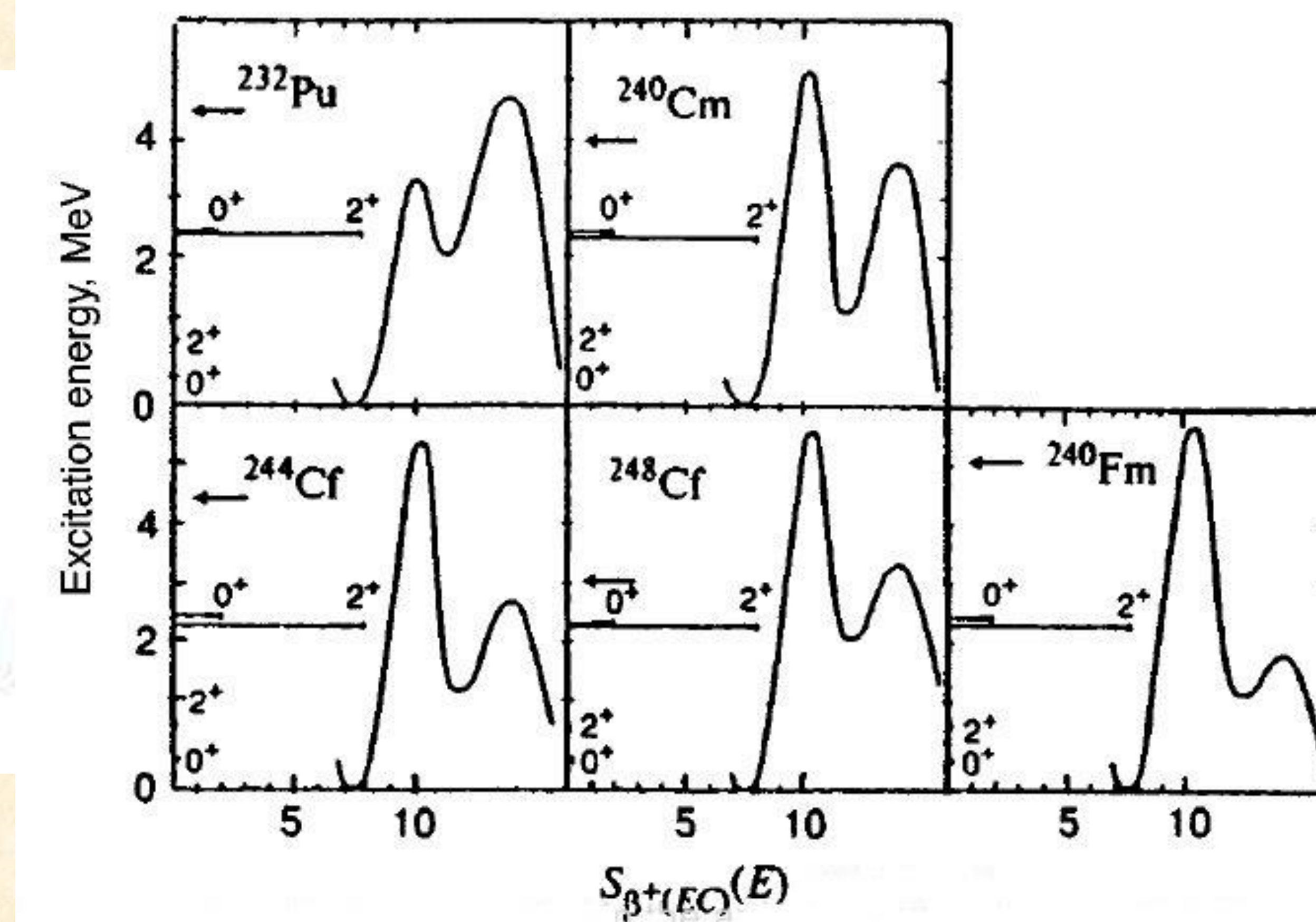
I. N. Izosimov, *Joint Institute for Nuclear Research, 141980 Dubna, Russia*

The probability $P_{\beta d}$ of β-delayed process is :

$$P_{\beta d} = \frac{\int_0^{Q_\beta} S_\beta(E) f(Q_\beta - E) \Gamma_d(E)/\Gamma_{tot}(E)\, dE}{\int_0^{Q_\beta} S_\beta(E) f(Q_\beta - E)\, dE}$$

where $\Gamma_d(E)$ – delayed process width, $\Gamma_{tot}(E)$ – total width.

The β–transition probability is proportional to the product of the lepton part described by the Fermi function $f(Q_\beta - E)$ and the nucleon part described by the β-decay strength function $S_\beta(E)$, $\Gamma_{tot} = \Gamma_d + \Gamma_\gamma$ and $\Gamma_d = \Gamma_f$ for delayed fission. The delayed fission probability P_{df} substantially depends on the resonance structure of the $S_\beta(E)$ both for β⁻ and β⁺/EC decays. The analysis of the experimental data on delayed fission demonstrated that the P_{df} can be correctly described only by using the **non-statistical $S_\beta(E)$**, reflecting nuclear-structure effects (I.N. Izosimov, Yu.V. Naumov, *Bulletin of the Academy of Science USSR, Physical Series*, **42,** 25 (1978). https://www.researchgate.net/publication/322539669)

In β-decay the simple (non-statistical) configurations are populated and as a consequence the non-statistical effects may be observed in γ-decay of such configurations. In delayed fission analysis the **γ-decay** widths Γ_γ **calculated using the statistical model**, which, in general, can only be an **approximation** (I.N. Izosimov, *Physics of Particles and Nuclei*, **30**, 131 (1999). DOI: 10.1134/1.953101)
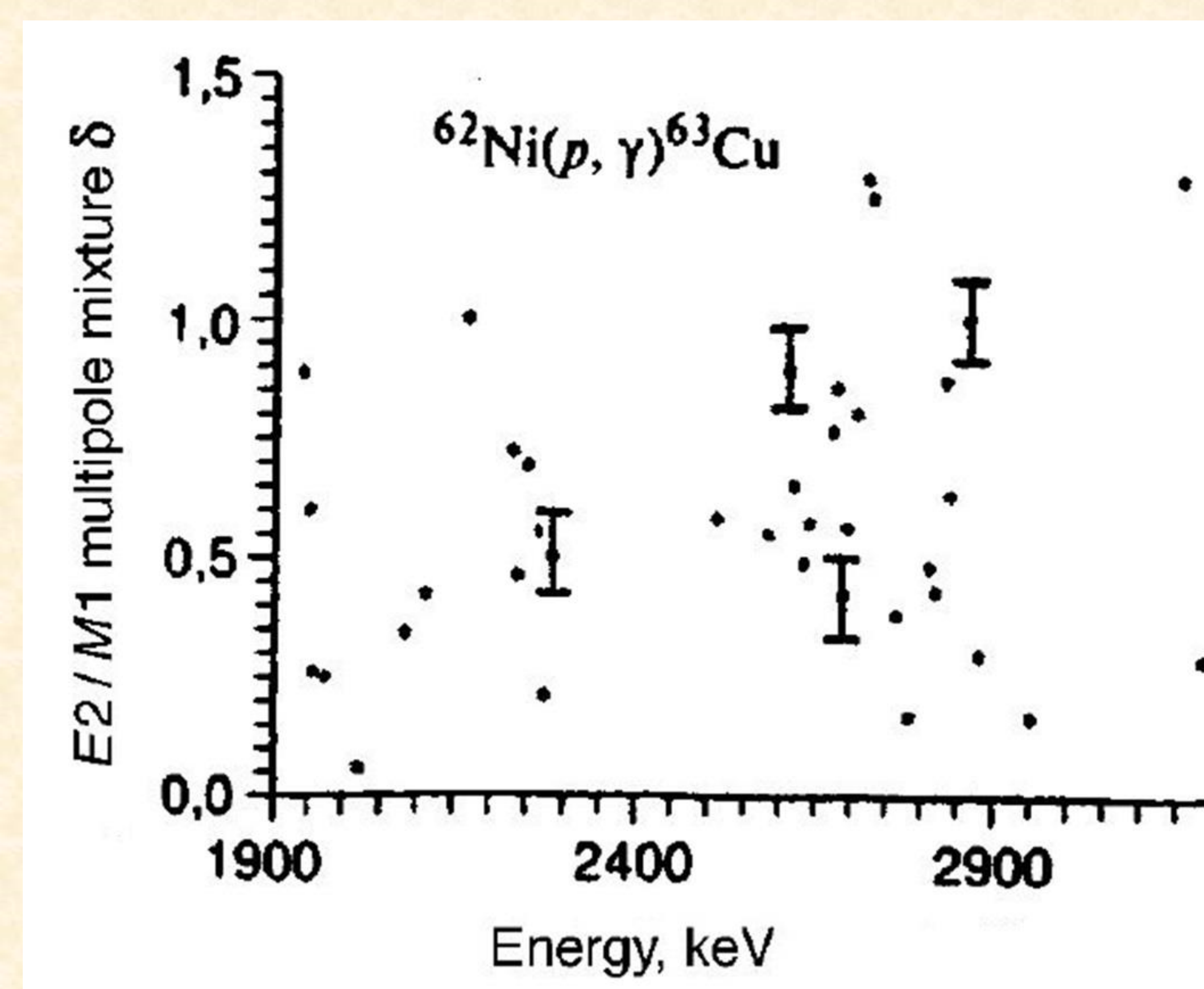
Dependence of the multipole mixture δ on the incident-proton energy for nonanalog resonances with $I^\pi = \frac{3}{2}^-$ in ^{63}Cu. The excitation energies of resonances in ^{63}Cu ranged from 8040 to 9250 keV. The average value of δ is $\langle\delta\rangle = (0.6 \pm 0.1)$, while the statistical model gives $\langle\delta\rangle = 0$.

Non-statistical effects in (p,γ) nuclear reactions in the excitation and decay of the non-analog resonances, for which simple configurations play an important role, were analyzed. The strong non-statistical effects were observed both for $M1$ and $E2$ γ-transitions.

CONCLUSION

1. For correct calculations of the beta-delayed processes probabilities $P_{\beta d}$ it is necessary to have experimental information and systematic both on $S_\beta(E)$ structure and Γ_γ values. Only after proper consideration of non-statistical effects both for β-decay and γ-decay it is possible to make a **quantitative** conclusion about fission barriers.

2. For non-statistical effects study in delayed fission both for β-decay and γ-decay it is necessary to measure first of all the $S_\beta(E)$ structure for delayed fission nuclei. We are interesting in collaboration for such experiments.