P-ODD AND *P*-EVEN EFFECTS IN FRAGMENT ANGULAR DISTRIBUTIONS OF ^{235}U FISSION INDUCED BY MONOCHROMATIC POLARIZED NEUTRONS WITH ENERGIES 0.06< E_n <0.8 eV

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Using the crystal diffraction monochromator of polarized slow neutrons situated on the horizontal beam of the reactor WWR-M the energy dependences of the asymmetry coefficients for ^{235}U fission fragment angular distributions have been measured for the first time

$$W(\Theta, \varphi) = 1 + \bar{\alpha}_{nf}(\vec{\sigma}_n \vec{p}_f^{\,L}) + \bar{\alpha}^{lr}_{nf}\, \vec{p}_f^{\,L}\, [\vec{\sigma}_n \times \vec{p}_n]. \qquad (1)$$

In this equation $\vec{\sigma}_n$, p_f^L and $\vec{p}_n$ are the unit vectors of neutron polarization and momenta of light fission fragment and neutrons respectively. In the frame of approximation of only two mixing *s*- and *p*-resonances with total and partial widths $\Gamma_{s,p}$, $\Gamma^n_{s,p}$, $\Gamma^f_{s,p}$ and phase difference $\Delta\varphi_{sp}$ the asymmetry coefficients have the following forms [1,2]:

$$\bar{\alpha}_{nf} \approx Q_{sp} \cdot v \cdot \sqrt{\frac{\Gamma^f_p}{\Gamma^f_s}}\ \mathrm{Re}\left\{\frac{\exp(-i\Delta\varphi_{sp})}{(E-E_p)+i\Gamma_p/2}\right\},$$
$$\bar{\alpha}^{lr}_{nf} \approx Q'_{sp} \sqrt{\frac{\Gamma^f_p \Gamma^n_p}{\Gamma^f_s \Gamma^n_s}}\ \mathrm{Im}\left\{\frac{(E-E_s)+i\Gamma_s/2}{(E-E_p)+i\Gamma_p/2}\ \exp(-\Delta\varphi'_{sp})\right\}. \qquad (2)$$

Here Q_{sp}, Q'_{sp} — spin factors, v — matrix element of the NN-weak interaction.

The fast multiplate ionization chamber filled by isobutan and containing ~160 *mg* of ^{235}U had been used as a fission fragment detector. The time characteristics of the system for collecting and processing data have been improved as compared with our first work [3].

The resonance type dependences of asymmetry coefficients $\alpha_{nf}(E_n)$ and $\bar{\alpha}^{lr}_{nf}(E_n)$ have been obtained as a result of experiments and presented in the figure. The widths of the peculiarities in the neutron energy dependences of coefficients were found to be close to the mean total widths of low energy resonances in fission cross-sections of ^{235}U ($\Gamma \approx 0.2\ eV$). Before the similar peculiarities in energy dependences of $\bar{\alpha}_{nf}$ and $\bar{\alpha}^{lr}_{nf}$ coefficients had been observed for the first time for ^{233}U fission in our work [3] and up to now that observation has been the only conformation of the importance of compound level mixing in the process of P-odd effect appearance in fission [1,2].

However in the case of ^{233}U fission [3] as compared with ^{235}U fission studied in this work $\bar{\alpha}_{nf}(E_n)$ coefficient changed the sign in the vicinity of $E_n \approx 0.14\ eV$ and $\bar{\alpha}^{lr}_{nf}(E_n)$ coefficients has a bell shaped form of dependence.

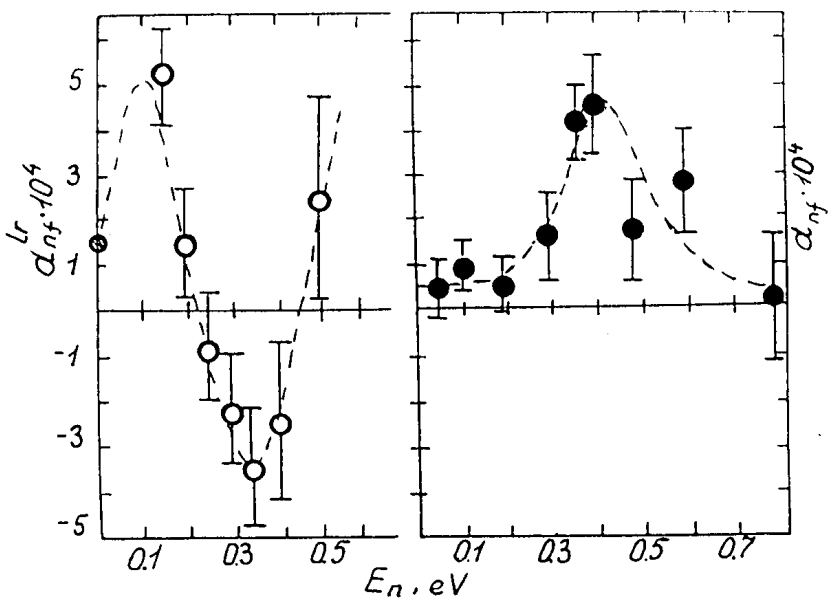

Fig. Dependences of P-even left-right asymmetry coefficient $\bar{\alpha}_{nf}^{lr}$ (left side) and P-odd asymmetry coefficients $\bar{\alpha}_{nf}$ (right side) on the energies of polarized neutrons in ^{235}U fission. Shaded point gives the value of $\bar{\alpha}_{nf}$ coefficients for the neutrons with $\bar{\lambda} \approx 2$Å [4]

These important differences in neutron energy dependences of asymmetry coefficients can be understood if one would suppose the different values of the phase difference $\Delta\gamma_{sp}$ for two fissile targets or state unsufficiency of two level approximation in the cases of ^{233,235}U fission where the level spacing between two mixing levels $\overline{D} \sim \overline{\Gamma}$. In any case our results for ^{235}U fission will give a chance to estimate weak interaction matrix element value for one more complex fissile element.

References

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