# *P*-EVEN INTERFERENCE EFFECTS IN ANGULAR DISTRIBUTIONS OF LIGHT FRAGMENTS IN NEUTRON INDUCED FISSION OF $^{233,235}U$

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Neutron energy dependence of $P$-even left-right and forward-backward asymmetries of light fission fragment emission relative to vectors $[\vec{\sigma}_n \times \vec{p}_n]$ and $\vec{p}_n$ has been investigated in

$^{233}U$ and $^{235}U$ fission using a neutron crystal diffraction spectrometer at a WWR-M reactor (PNPI) [1] and neutron pulse reactor IBR-30 (JINR, Dubna).

The investigations of angular distribution containing the odd spherical harmonics

$$W(\theta,\varphi) = 1 + \bar{\alpha}^{lr}_{nf} \cdot \vec{\sigma}_n \cdot [\vec{p}_n \times \vec{p}_f] + \bar{\alpha}^{fb}_{nf} \cdot (\vec{p}_n \cdot \vec{p}_f)$$

are of interest to fission because of some similarities in its emergence mechanism with the space parity violating correlation of the following type $(\vec{\sigma}_n \cdot \vec{p}_f)$ [2, 3].

Here $\vec{\sigma}_n$, $\vec{p}_n$ and $\vec{p}_f$ are unit vectors of neutron polarization and momenta of neutrons and light fission fragments respectively.

Moreover, as it has been shown in the works [4, 5], investigations of all these correlations may be considered as a new way of search and study of weak low energy $p$-resonances, which are invisible in total and partial neutron cross sections.

But performance of such investigations has been restrained by low intensity of resonance polarized neutrons ($P$-odd and left-right asymmetry experiments) and by difficulties of forward-backward asymmetry measurements with a high precision. The measurements of the first types have been performed only in rather narrow energy intervals up to now. The investigations of resonance neutron energy dependence for $\bar{\alpha}^{fb}_{nf}(E_n)$ asymmetry coefficients became possible only after a new measurement method has been developed in PNPI RAS at a neutron time-of-flight spectrometer GNEIS [5, 6].

Results of repeated measurements of the $\bar{\alpha}^{lr}_{nf}(E_n)$ neutron energy dependence in the $^{233}U$ fission are presented in Fig.1.

The results of the investigations of the resonance neutron energy dependencies for the forward-backward asymmetry coefficients $\bar{\alpha}^{fb}_{nf}(E_n)$ in $^{235}U$ and $^{233}U$ fission are shown in Figs.2,3. At the bottom of Figs.2,3 the fission cross sections (in arbitrary units) are presented for both fissile elements. The $\bar{\alpha}^{lr}_{nf}(E_n)$ neutron energy dependence (Fig.1), obtained with the improved accuracy, was in a good agreement with the results of the first measurements [4].

These results can be explained if, at least, two weak admixed $p$-resonances are disposed inside the neutron energy range investigated, whereas only one of them takes part in the $P$-odd effect formation [4].

The $\bar{\alpha}^{fb}_{nf}(E_n)$ coefficients show very complex dependencies on the resonance neutron energies (Figs.2,3) with the bright expressive irregularities in the vicinities of the strong isolated $p$-resonances, or, most likely, the groups of $p$-resonances, which can not be observed in neutron cross sections.

It is important to underline a rich variety of these irregularities' forms, which can not be explained in the frames of two mixed levels approximation [2, 3]. It can be because of the high $s$- and $p$-levels density in the fissioning systems such as $^{234,236}U$ or (and) the variety of the phase factors values for the different resonances [2, 3].

The $\langle\bar{\alpha}^{fb}_{nf}\rangle$ asymmetry coefficients averaged over all neutron energy interval investigated in both cases are equal to zero (in the limits of statistical accuracy) in accordance with the theory expectations for the interference effects in the fission fragments angular distributions.

The measurements of the $\bar{\alpha}^{fb}_{nf}(E_n)$ coefficients are carried out under support of the RFFR (Grant №93-02-3979).

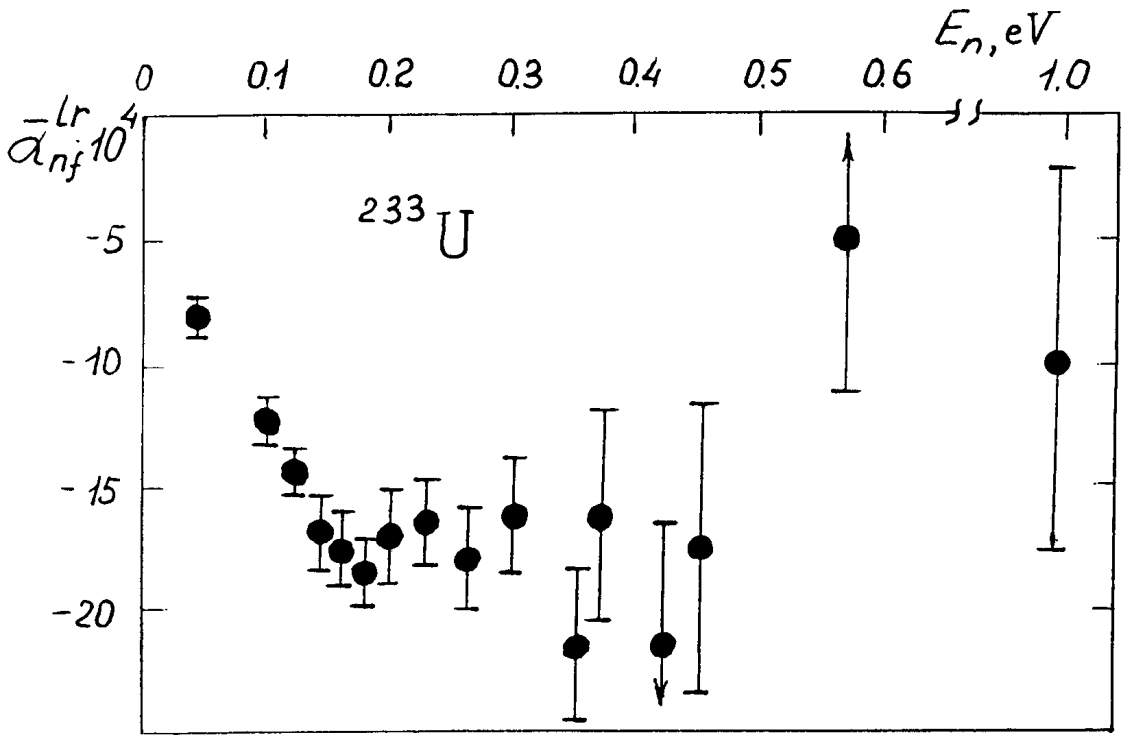
$E_n$, eV
0
0.1
0.2
0.3
0.4
0.5
0.6
1.0
$\bar{\alpha}_{nf}^{lr}$ 10$^4$
-5
-10
-15
-20
$^{233}$U

Fig.1

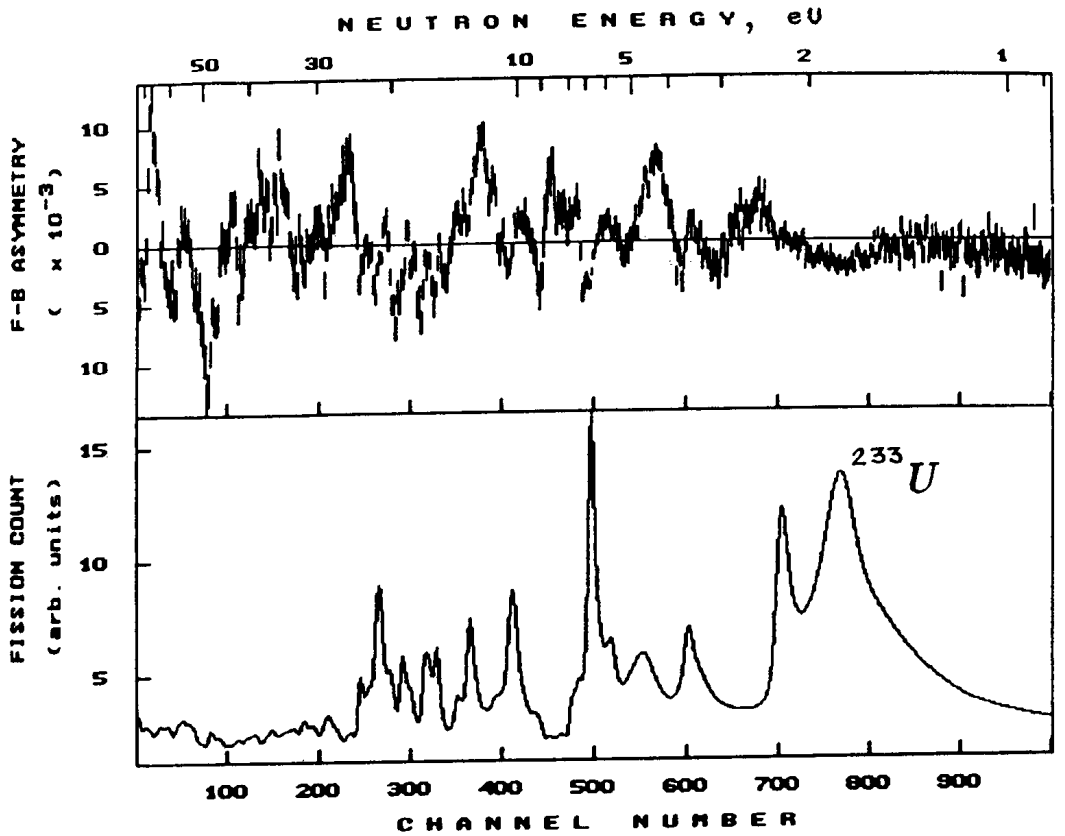
NEUTRON ENERGY, eV
50
30
10
5
2
1
F-B ASYMMETRY
( x 10$^{-3}$)
10
5
0
5
10
FISSION COUNT
(arb. units)
15
10
5
$^{233}$U
100
200
300
400
500
600
700
800
900
CHANNEL NUMBER

Fig.2

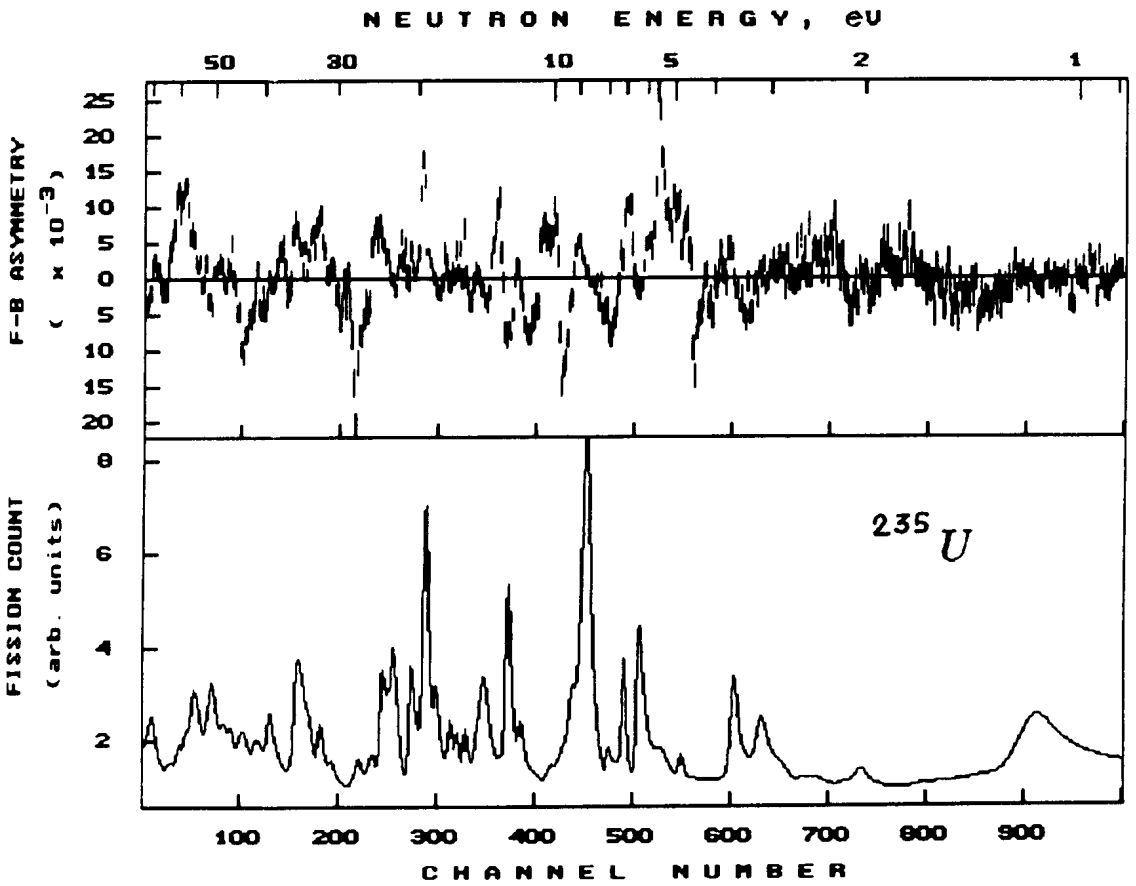


Fig.3

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