P-ODD ASYMMETRY OF LIGHT FRAGMENT EMISSION IN POLARIZED COLD NEUTRON FISSION OF SOME HEAVY NUCLEI

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There investigations have been performed with the aim to extend the field of P-odd effect observation and to obtain information about *P*-odd asymmetry coefficient dependence on fission process characteristics.

P-odd correlation between momentum of light fission fragment ($\vec{p}_f$) and cold neutron polarization ($\vec{\sigma}_n$)

$$W(\Theta) = 1 + \overline{\alpha}_{nf}(\vec{\sigma}_n \cdot \vec{p}_f),$$

has been measured for ^{229}Th, ^{233}U (standard), ^{237}Np, ^{241}Pu, ^{241}Am fission on the special neutron beam SN-7 of ILL high flux reactor (Grenoble, France).

P-odd left-right asymmetry coefficient $\vec{\alpha}_{nf}^{LR}$ has been measured additionally for the cases of ^{233}U (standard) and ^{299}Th fission because of probable similarity of forming mechanism for these both effect [1].

Experimental installation has been made in LNPI. It consisted of fast isobutan multi-plate ionization chamber with 8 double — sided fissile targets and 16 separate spectrometers lines and personal computer IBM PC-AT for complete automatization of measuring process and preliminary data evaluation.

The fissile targets have been prepared in Leningrad Radium Institute and purified from admixtures with relatively high fission cross sections so that their possible influence on the asymmetry coefficient values for the isotope of interest could be no more than 20% (^{229}Th case).

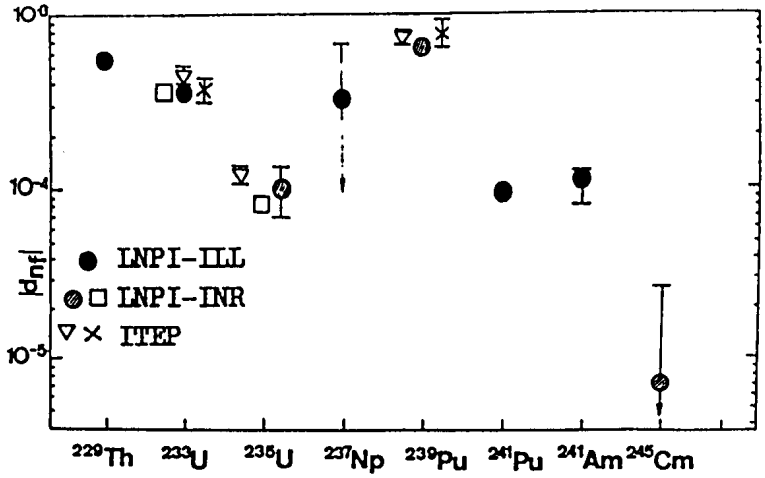

Fig. Absolute values of P-odd asymmetry coefficients for heavy nucleus fission fragment emission. LNPI-ILL — results of this work; LNPI-INR— results obtained before on the reactor of LNPI; ITEP— results of ITEP

All false asymmetries have been eliminated up to the level $\leq 3 \cdot 10^{-6}$ by using the special law of neutron polarization switching and periodical change of guiding magnetic field direction through ionization chamber.

Besides, false asymmetries have been controlled both during the main measurement cycle and in special zero experiment with depolarized neutron beam ($\bar{\alpha}_{nf}^{contr}$ and $\bar{\alpha}_{nf}^{dep}$ coefficients).

All the experimental results obtained in the course of 50 days measurements are presented in the table.

Table

$\alpha \cdot 10^4$	^{229}Th	^{233}U	^{237}Np	^{241}Pu	^{241}Am
$\bar{\alpha}_{nf}$	−5.6 ± 0.2	3.67 ± 0.06	−3.3 ± 3.7	−0.89 ± 0.04	−1.00 ± 0.25
$\bar{\alpha}_{nf}^{contr}$	0.05 ± 0.2	−0.02 ± 0.06	3.2 ± 3.7	0.02 ± 0.04	−0.25 ± 0.25
$\bar{\alpha}_{nf}^{dep}$	—	0.12 ± 0.12	−0.5 ± 7.2	0.04 ± 0.07	−0.01 ± 0.47
$\bar{\alpha}_{nf}^{LR}$	2.14 ± 0.33	−2.33 ± 0.25	—	—	—

Absolute values of P-odd asymmetry coefficients obtained in these experiments together with the most precise data of other authors are shown in the fig.

The big value of $\bar{\alpha}_{nf}$ coefficient for ^{299}Th fission and tendency to abrupt decrease of this coefficient near ^{235}Cm may be the first experimental evidence for an importance of transition state proporties in fission (for example, an octupole pear-shape deformation) for P-odd effect formation.

To support this conclusion of great interest and to observe P-odd effect for subbarier fission (for example, in the case of ^{237}Np) the continuation of these investigations is desirable and is planning in the nearest future for fissile nuclei near ^{245}Cm.

The results of this work have been presented at VI International School on Neutron Physics in Alushta.

References

1. Sushkov O.P., Flambaum V.V. //Usp.Fiz.Nauk., 1982. V.136. P.3.

2. Petrov G.A. //VI International School on Neutron Physics: Lectures: Alushta, 8—18 October 1990 / JINR. Dubna. 1991. N.1. P.221.