INTENSIVE PULSE SOURCE OF SLOW NEUTRONS ON STATIONARY NUCLEAR REACTOR

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In connection with the high flux reactor PIK creation and in accordance with a scientific program of investigations at it [1] a multirotor chopper-monochromator of the resonance neutrons has been constructed, tested and put into operation at horizontal beam of WWR-M reactor.

This installation is planned to be used for investigations of various neutron reactions (e.g. fission reaction) in the vicinities of low energy ($E_n \leq 20$ eV) s- and p-resonances. In the assembly with polarized proton and nuclear targets this set-up may be successfully used for search and investigation of P and T-invariance effects in neutron reactions, especially taking into account relatively low price of neutrons from stationary nuclear research reactors, long-term cycles of it's work and rather high intensity of low energy resonance neutrons, comparable with the intensities of the best pulse neutron sources at electron and proton accelerators.

The multirotor chopper-monochromator for the PIK reactor has been created by scientific groups of PNPI and ITEP on the base of many years and fruitful ITEP experience in development of the systems with massive, synchronized in relation to velocities and phases rotors [2], spinning in vacuum with velocities up to 18000 rot/min.

The installation includes four identical modules with rotors of 30 cm in diameters vertically hanging in magnetic fields. Ten rectangular through going slits 0.8×3.0 cm^2 were perforated in each rotor to transmit low energy resonance neutrons.

These modules with the systems of hanging, stabilization and synchronization of its space position and with the optical systems of the time units are disposed one after another along the collimated neutron beam of the reactor (Fig.1).

Twenty narrow neutron flushes arise at the exit of this system during every rotation of the rotors. Mean energy and the width of every identical neutron energy intervals are determined by the relative phases and velocity of the rotors. The energies of the resonance neutron inside separated range can be measured by the time-of-flight method.

Testing the full-scale model of the four rotor shoppermonochromator at the horizontal radial channel №7 (⌀ 60 mm) of the WWR-M reactor was carried out with the reactor power 9.5 MW, rotors velocities 4800 rot/min and flight path length 5.8 m.

As a result of these measurements the main parameters of the system have been found to be in general accordance with the theoretical estimates. Resonance neutron intensity in the detector position (9 m from the center of the first rotor) was found to be equal

$$\Phi_n \simeq (2.8/E_n) \cdot 10^4 \ (1/\mathrm{cm}^2 \cdot \mathrm{s} \cdot \mathrm{eV})$$

As the thick Pb filter (10 cm) was former disposed against γ-ray background at the top of the neutron beam, the measured resonance neutron intensity can be increased more then 3 times after its removing. Some additional increase of the neutron intensity can be achieved in the course of further installation optimization.

General views of the time of flight spectra inside one of twenty flushes for the case of the mean neutron energy in vicinity of In resonance (1.45 eV) are show in Fig.2 (with (a) and without (b) In-filter in beam).

The background for the neutrons with energies outside separated range does not exceed 0.5%. γ-ray background was practically absent at all.

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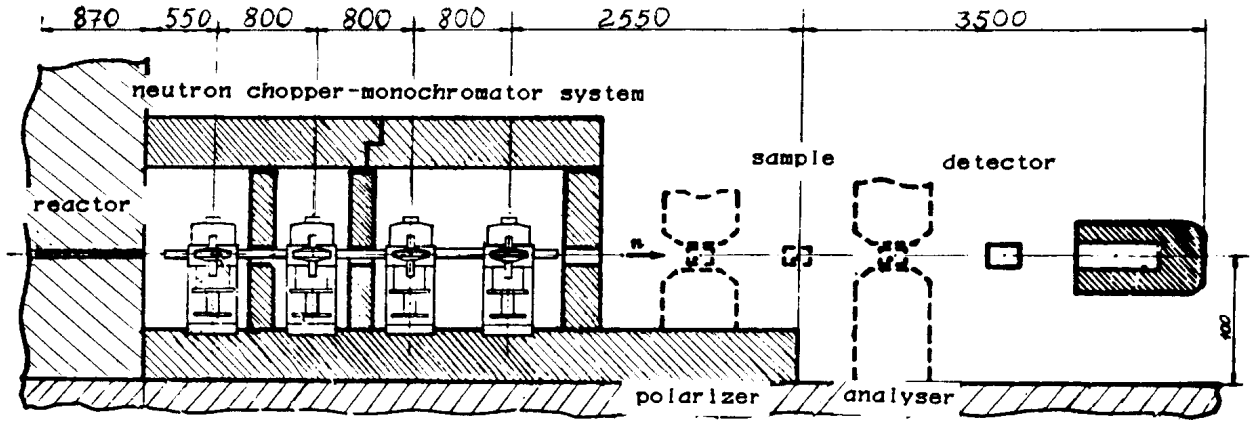

Fig.1

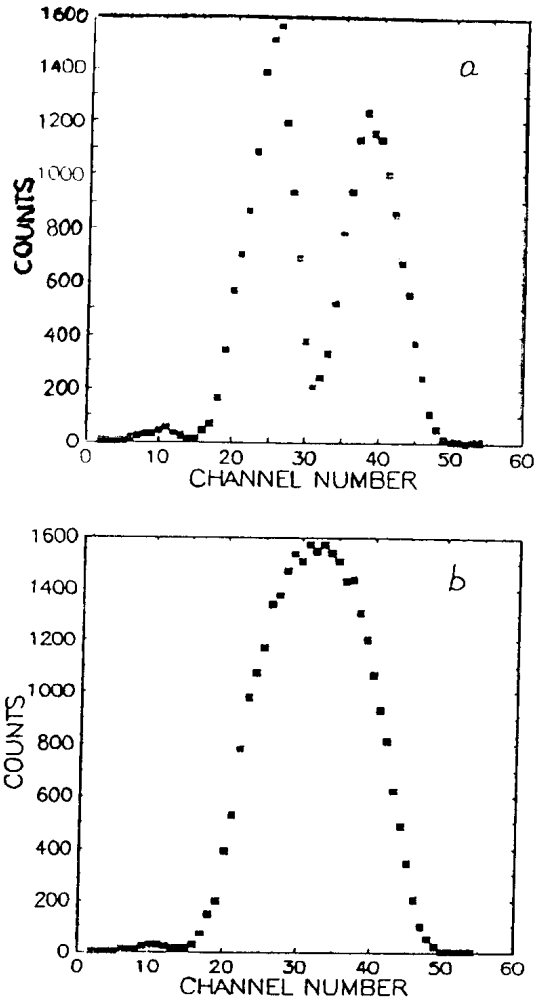

Fig.2

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