Optical neutron spin rotation in a crystal without center of symmetry

V.V. Voronin[a], V.V.Fedorov[a], E.G. Lapin[a], S.Yu. Semenikhin[a]

[a] *Petersburg Nuclear Physics Institute Gatchina, St.Petersburg, 188300 Russia,*
E-mail: vvv@pnpi.spb.ru

Effect of neutron-optic spin rotation in a noncentrosymmetric crystal was experimentally observed. The effect is caused by Schwinger interaction of neutron, passing through the crystal far from any Bragg condition, with a crystal interplanar electric field and depends on a direction and energy of neutron.
For α-quartz crystal it is shown, that the value of resultant electric field affecting on a neutron is $|\mathbf{E}_{sum}| \approx (1-10)\cdot 10^4$ V/cm for broad band of neutron wavelengths and corresponding value of the angle of neutron spin rotation may reach $\pm 2\cdot 10^{-4}$ rad/cm (see Figure 1). The measured effect has well coincided with the theoretical one.
Observation of this effect may be interesting for the search of the neutron electric dipole moment [1]. In addition, there is a proposal for searching the T-odd part of nuclear interaction for energies, close to the P-wave neutron resonance [2], that can be made only for large deviations from Bragg condition, because it is impossible to observe dynamical diffraction for neutron with energy ~ 1 eV due to crystal imperfection.

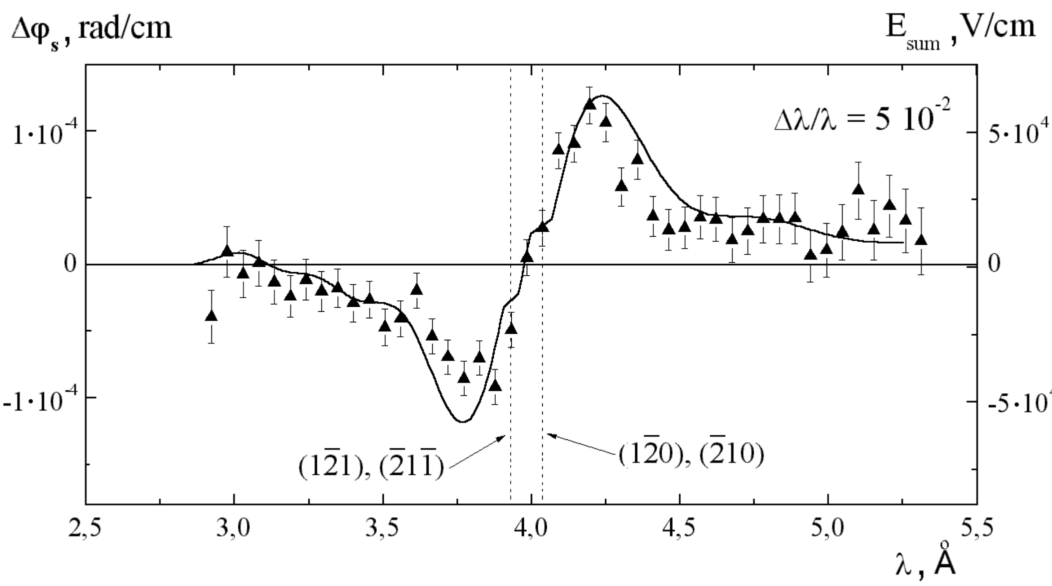

Figure 1: Spectral dependence of an angle of neutron spin rotation in a quartz crystal.

References

[1] V. V. Fedorov, E. G. Lapin, S. Yu. Semenikhin, V. V. Voronin, Physica B: Physics of Condensed Matter **297** (2001) 293–298.
[2] V. G. Baryshevsky, J.Phys. G: Nucl. Part. Phys. **23** (1997) 509–515.