transverse magnetoresistance [4]. Since clarification of the nature of this oscillation is of theoretical interest, we investigated this coefficient for n-InAs in the region of the zero maximum of the transverse magnetoresistance. We see from Fig. 2 that the Hall coefficient of n-InAs exhibits near the zero maximum of $\Delta\rho_{\perp}/\rho_0$ ($H > 30$ kOe) a similar oscillation (12%) as n-InSb. Two other maxima on the R(H) curve (at H = 15 and 8 kOe), with smaller amplitudes, appear quite distinctly, with the R(H) curve showing an appreciable phase shift relative to the magnetoresistance curve [5].

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CRITICAL SCATTERING OF POLARIZED NEUTRONS IN NICKEL

G. M. Drabkin, E. I. Zabidarov, Ya. A. Kasman, and A. I. Okorokov
A. F. Ioffe Physico-technical Institute, USSR Academy of Sciences
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A study of the critical small-angle scattering of neutrons is a very effective means of investigating phase transitions.

In the case of ferromagnets, the space-time spin correlation motions, which are responsible for the dynamics of the phase transitions, are directly related to the neutron scattering cross section [1]. Some parameters of the space-time correlations were determined in [2,3], where it was shown that scattering near the Curie point is connected with magnetization fluctuations. These investigations were made with unpolarized neutrons, and yielded naturally only an averaged picture of the phenomena.

To obtain more complete information we deemed it advisable to investigate the critical scattering of polarized neutrons. We present in this article the results of the first stage of this research.

The measurements were made with the aid of a previously described installation [4]. A single-crystal nickel sample was placed in a ~10 Oe magnetic field. The sample temperature was kept accurate to ±0.07°. The beam of the incident neutrons is characterized by the following parameters: wavelength ~5.1 Å, polarization after reflection from the analyzer 80%, horizontal divergence ±1.5 min, vertical ±10 min.

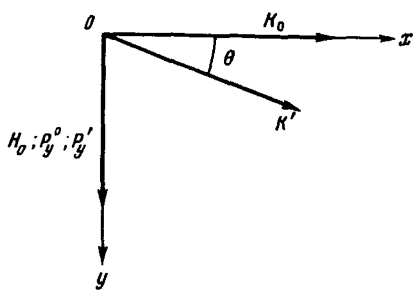

Fig. 1. Kinematic diagram of the experiment.

$\vec{K}_0$ and $\vec{K}'$ are the wave vectors of the incident and scattered neutrons, θ - scattering angle, equal to 10.2 minutes, H_0 the direction of the magnetic field vectors, and P_y^0 and P_y' are the polarizations of the incident and scattered neutrons, respectively.

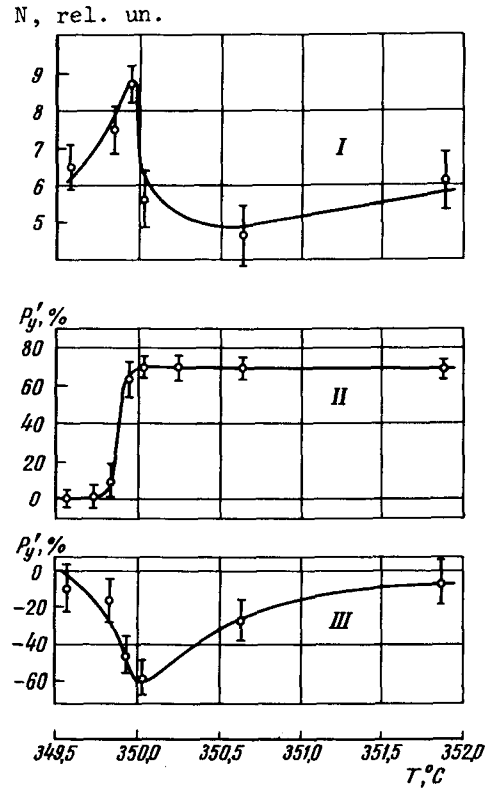

Fig. 2. I - Intensity of the neutrons scattered through an angle θ = 10.2 min.; II - polarization of transmitted neutron beam (θ = 0); III - polarization of neutrons scattered through θ = 10.2 min.

Figure 1 shows the kinematic diagram of the experiment. We determined in the experiments the P_y' components of the polarization of the neutrons passing through the sample and of the neutrons scattered through 10.2 minutes of angle. The results of the experiments are shown in Fig. 2. The Curie point was determined from the maximum scattering cross section (curve I of Fig. 2). Curve II of Fig. 2 shows data on the polarization of the transmitted neutron beam. When $T \approx T_C$ the course of this curve is connected with the development of magnetization fluctuations. The magnetic fields of these fluctuations give rise to non-coherent precession of the spins of the neutrons passing through the sample. This precession is just the cause of the depolarization. An analogous case of passage of polarized neutrons through magnetized domains was considered theoretically in [5].

Let us consider in greater detail the polarization of neutrons scattered through 10.2 minutes of angle (curve III, Fig. 2).

We call attention first to the fact that the sign of this polarization is the opposite of that of the incident neutrons, and its absolute value is a maximum at $T = T_C$, when $|P_y'| \approx |P_y|$. According to [6]

$$P_y' = -P_y^0 \theta^2 \left(\int dE' \frac{d\sigma}{d\Omega\, dE'}\right)^{-1} \int dE' \frac{d\sigma}{d\Omega\, dE'} \left[\left(\frac{E' - E}{2E}\right)^2 + Q^2\right]^{-1}.$$

The fact that $P_y' \approx P_y^0$ at $T = T_C$ can be understood by assuming that the rms energy transfer $|E' - E|^2$ is small compared with $4E^2\theta^2$. In our case $E = 10^{-3}$ eV and $\langle |E' - E| \rangle \lesssim 10^{-5}$ eV. A temperature rise of only 1° reduces the polarization noticeably. It follws therefore that

$\langle E' - E\rangle \geq 2E\theta$. These data point out the important fact that the neutron scattering is quasi-elastic near the phase transition point. It is interesting to note that a direct determination of such a change in the scattered-neutron energy is beyond the capabilities of modern experimental techniques.

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SCATTERING OF POLARIZED NEUTRONS IN MAGNETS NEAR THE PHASE-TRANSITION POINT

S. V. Maleev
A. F. Ioffe Physico-technical Institute, USSR Academy of Sciences, Leningrad
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Drabkin et al. [1] investigated the scattering of neutrons in nickel at temperatures close to the Curie temperature. We consider in this note the question of the information that can be derived from experiments of this kind.

Using standard methods (see [2]) we can represent the scattering and polarization cross sections in the form

$$\frac{d\sigma}{d\Omega dE'} = 2Q_1 + [1 - (\vec{e}\cdot\vec{m})^2]Q_2 + 2(\vec{P}_0\cdot\vec{e})(\vec{m}\cdot\vec{e})Q_3,$$

$$\frac{d\sigma}{d\Omega dE'}\vec{P}(\vec{q},\ \omega) = -2(\vec{e}\cdot\vec{m})\vec{e}\ Q_3 - 2(\vec{e}\cdot\vec{P}_0)\vec{e}\ Q_1 \tag{1}$$

$$- \{\vec{P}_0[1 - (\vec{e}\cdot\vec{m})^2] + 2[(\vec{P}_0\cdot\vec{e})(\vec{m}\cdot\vec{e}) - (\vec{P}_0\cdot\vec{m})][\vec{m} - (\vec{e}\cdot\vec{m})\vec{e}]\}Q_2.$$

The quantities Q_i are connected with the atomic-spin correlator as follows:

$$r_0^2\gamma^2\,\frac{p'}{p}\,\frac{1}{2\pi\hbar}\int_{-\infty}^{\infty} d + \exp[i(\omega t/\hbar)]\sum_{ll'} F_l^*(\vec{q})F_{l'}(\vec{q})\langle S_l^\alpha(t)\exp(-i\vec{q}\cdot\vec{R})_l{}^{(t)}S_{l'}^\beta(0)\exp(i\vec{q}\cdot\vec{R})_{l'}{}^{(0)}\rangle$$

$$= Q_1(\vec{q},\omega)\delta_{\alpha\beta} + Q_2(\vec{q},\omega)m_\alpha m_\beta - iQ_3(\vec{q},\omega)\epsilon_{\alpha\beta\gamma}m_\gamma + Q'_{\alpha\beta}(\vec{q},\omega). \tag{2}$$