abrupt change in the probability for recoilless resonance absorption f′. The jumps in f′ have unusually large values. For example, for a solid solution of 50% $BiFeO_3$ – 50% $SrSnO_3$,

$$\frac{f'(T \geqslant T_c)}{f'(T \leqslant T_c)} = 4.1.$$

The abrupt change in f′ which was observed is caused by the transition of the solid solution from the paraelectric to the ferroelectric state. In fact, x-ray photos of the samples with 20—45 mole % $SrSnO_3$ confirm this conclusion. Figure 2 shows the dependence of the transition temperature, as determined from the resonance absorption, on the $SrSnO_3$ concentration. The crosses on the graph show the Curie temperatures for the samples from 20 to 45 mole % of $SrSnO_3$. The slight difference in the Curie points determined by the two methods may be explained by the fact that the x-ray method determined the upper limit of the transition region (Curie region), whereas in treating the results of the resonance absorption measurements we used values for the transition temperature corresponding to the middle of the transition regions. We should also mention that the widths of the transition regions reach sizeable values, and increase with the $SrSnO_3$ content.

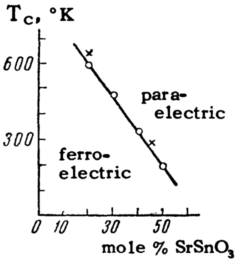

FIG. 2. Phase diagram of solid solutions of $BiFeO_3$–$SrSnO_3$

The character of the change in f′ at $T \approx T_C$ indicates that there is a first-order phase transition at T_C, and that the appearance of the spontaneous polarization at this point is accompanied by a sharp decrease in the effective elastic constants of the crystals. From the thermodynamic point of view, in the transition from paralectric to ferroelectric there is, in our opinion, a discontinuous decrease in the part of the internal energy associated with the thermal motion of the lattice. This has as a direct consequence the lowering of the "effective" upper limit of the phonon spectrum and, consequently, a marked drop in f′. For example, if we approximate the phonon spectrum in these crystals by a crude Debye model, at the transition from the paraelectric to the ferroelectric phase for the (50%$BiFeO_3$ – 50%$SrSnO_3$) solution there is an extremely sharp drop in the Debye temperature from 290 to 110° K.

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CONTRIBUTION OF REGGE POLES TO THE TOTAL CROSS SECTIONS AT HIGH ENERGIES

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In this paper results are presented of a simultaneous analysis of the experimental data on the total cross sections for the π^-p, π^+p, K^-p, K^+p, pp, $\bar{p}p$, and pn interactions, undertaken to assess the contribution of Regge poles to the imaginary part of the amplitudes of the corresponding processes for t = 0 (where t is the square of the four-momentum transfer in the c.m.s.). Results of experiments carried out at energies greater than 3 BeV [1-5] were used for the analysis.

If we limit ourselves to the contribution of the quasi-vacuum ω and ρ poles, the total cross section can be written in the form:

$$\sigma(\pi^-p) = (aE + bE^q + cE^\rho)/\sqrt{E^2-\mu^2}, \quad (1)$$

$$\sigma(\pi^+p) = (aE + bE^q - cE^\rho)/\sqrt{E^2-\mu^2}, \quad (2)$$

$$\sigma(K^-p) = (eE + fE^q + gE^\omega - hE^\rho)/\sqrt{E^2-m^2}, \quad (3)$$

$$\sigma(K^+p) = (eE + fE^q - gE^\omega + hE^\rho)/\sqrt{E^2-m^2}, \quad (4)$$

$$\sigma(pp) = (kE + lE^q - nE^\omega - rE^\rho)/\sqrt{E^2-M^2}, \quad (5)$$

$$\sigma(\bar{p}p) = (kE + lE^q + nE^\omega + rE^\rho)/\sqrt{E^2-M^2}, \quad (6)$$

$$\sigma(pn) = (kE + lE^q - nE^\omega + rE^\rho)/\sqrt{E^2-M^2}, \quad (7)$$

where E is the laboratory energy of the incident particle; μ, m, and M are the masses of the π meson, K meson, and nucleon, respectively; and q, ω, and ρ are the values of the quasi-vacuum, ω and ρ trajectories at $t = 0$. The coefficients of the powers of E are functions of the residua of the corresponding poles.

A correction for the screening of the neutron by the proton in the deuteron has been applied to the values for pn obtained from the difference $\sigma(pd) - \sigma(pp)$.[5,6]

To the best χ^2 correspond the following values of the required parameters:

$$q = 0.31 \pm 0.18,\quad \rho = 0.66 \pm 0.15,\quad \omega = 0.50 \pm 0.06,$$
$$a = 22.33 \pm 1.04,\quad b = 17.88 \pm 2.50,\quad c = 1.96 \pm 0.72,$$
$$e = 18.61 \pm 0.84,\quad f = 10.71 \pm 2.79,\quad g = 20.08 \pm 13.58,$$
$$h = 8.24 \pm 12.37,\quad k = 39.75 \pm 2.38,\quad l = 38.89 \pm 5.94,$$
$$n = 26.42 \pm 3.37,\quad r = -0.69 \pm 0.58$$

(the dimensions of the parameters a, b, c, etc., which are not given, can be easily established from Eqs. (1) — (7).

Using relations of the type [7,8]

$$\sigma(\pi K)\,\sigma(NN) = \sigma(\pi N)\,\sigma(KN), \qquad (8)$$

we obtain, for $E \to \infty$

$$\sigma(\pi\pi) = 12.5 \pm 1.2 \text{ mb}; \quad \sigma(\pi K) = 10.5 \pm 0.9 \text{ mb};$$
$$\sigma(KK) = 8.7 \pm 1.1 \text{ mb}.$$

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SOME METHODS FOR POLARIZATION AND ANALYSIS OF POLARIZATION OF INTERMEDIATE ENERGY NEUTRONS

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GETTING information about the spin state of levels of the compound nucleus which are formed after neutron capture is a very important problem in the study of nuclear structure. The most general method for determining spins of levels is the use of beams of polarized neutrons and targets containing polarized nuclei.[1] Many experiments with thermal [2,3] and resonance [4,5] neutrons have been done by this method. A necessary part of the equipment is a neutron polarizer.

The familiar methods for polarizing thermal and resonance neutrons are based on the use of interference between magnetic and nuclear scattering of the neutrons, which in principle cannot be pushed to neutron energies greater than 30—50 eV, and in practice not above 10—12 eV because of the sharp drop in intensity.

The present note discusses some possibilities for polarization and analysis of polarization of neutrons with resonance and higher energies, based on the spin dependence of the nuclear interaction. These methods, which were known in principle long ago,[6] have become attainable because of the successful development of the dynamical method for polarization of protons [7-10] and the method of polarizing He^3 nuclei by optical pumping.[11]

Upon transmission of unpolarized neutrons through a target containing polarized nuclei with spin ½, the transmitted beam has a polarization equal to

$$f_n = \operatorname{th}\left[\tfrac{1}{4} f_N n (\sigma_s - \sigma_t) d\right], \qquad (1)^*$$

where f_N is the nuclear polarization, n is the number of nuclei per cc, d is the target thickness and σ_s and σ_t are the neutron-nucleus interaction cross sections in the singlet and triplet states, respectively.

For protons, the polarization cross section, $\frac{1}{4}(\sigma_s - \sigma_t)$ is

$$\frac{1}{4}(\sigma_s - \sigma_t) \approx \frac{16.7\,(1 - E/7000)}{(1 + E/134)\,(1 + E/4000)}\ \text{b}, \qquad (2)$$

where E is the neutron energy in keV (it is assumed that $1 \text{ eV} < E < 3 \text{ MeV}$).