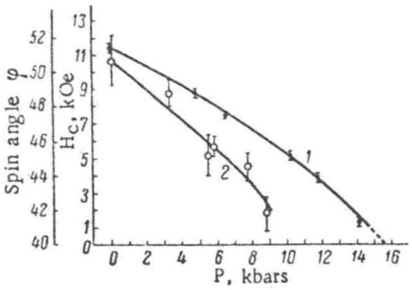

Fig. 4. Curves of threshold magnetic field H_c (1) and spin angle φ(2) versus pressure at room temperature.

TABLE 1

P, kbars	φ°	H_c, kOe	n_1, °K	n_2, °K
1 bar	50.7	11.4	25.1	−9.9
3.31	48.8	9.5	24.7	−9.4
5.79	45.7	8.0	28.8	−10.3
7.72	44.5	6.8	27.7	−9.7
8.83	41.8	6.1	32.8	−11.0

3. DISCUSSION OF RESULTS

Helicoidal magnetic order is regarded as the result of competition of ferromagnetic and antiferromagnetic exchange interactions through conduction electrons [7]. According to theory, the equilibrium value of the helicoid angle φ is determined by the equation

$$\cos\varphi = -\frac{n_1}{4n_2}, \quad (1)$$

where n_1 is the energy of positive exchange interaction between manganese atoms lying in adjacent planes; n_2 is the energy of negative exchange interaction between manganese atoms lying in more widely separated layers.

Theory gives an equation connecting the threshold magnetic field H_c, the equilibrium angle, and the energy of negative exchange interaction. In order to estimate values of n_1 and n_2 along the c axis for each pressure we used the relation between the angle φ and pressure, determined by neutron diffraction [8], and the relation between threshold magnetic field and pressure, determined by us. The magnetic moment of the Mn atom in $MnAu_2$ was taken to be $\mu_0 = 3.38\,\mu_B$ [9].

The results of the calculations are given in Table 1.

If it is assumed that the decrease in threshold magnetic field with increasing pressure is due to decrease in the negative or increase in the positive exchange interaction along the c axis, raising the pressure should increase n_1 or decrease n_2. Table 1 shows that this does not take place. Evidently, the model of competing interactions does not correspond to the nature of helicoidal order in $MnAu_2$.

From the results we drew certain conclusions regarding the antiferromagnetic–ferromagnetic transition in a magnetic field, as well as under pressure. Measurement of magnetostriction in the given transition in a magnetic field gives $\Delta V/V = -5\cdot10^{-4}$ [10]. At the same time, if we proceed from the compressibility of $MnAu_2$, measured at room temperature [11], $\varkappa = 1.42\cdot10^{-12}$ cm^2/dyn, and assume that it remains unchanged up to 15 kbars, the relative change in volume of the sample on transition to the ferromagnetic state due to pressure alone amounts to $\Delta V/V = -21\cdot10^{-4}$. Thus, the magnetostriction volume change is much less than the volume change due to transition from the helicoidal to the ferromagnetic state under pressure. This difference in volume change may be due to the substantial difference between the mechanisms of disruption of helicoidal order by a magnetic field and pressure.

As Fig. 4 shows, the threshold field decreases to zero with increasing pressure. Figure 4 also shows a curve of helicoid angle versus pressure, according to the data of neutron-diffraction investigations [8] at room temperature, up to 9 kbars. The helicoid angle decreases from 51° (at atmospheric pressure) to 41° (at 9 kbars), i.e., by only 10°. Since the helicoidal structure vanishes at 15 kbars, the helicoid angle should decrease abruptly to zero when the pressure is increased further by only 6 kbars.

Owing to this, one should expect the c parameter to vary anomalously with pressure above 9 kbars. Such behavior is observed at 77°K and pressures above 5.5 kbars ([8], Fig. 6).

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