	Θ_N, °K		μ_{eff}/μ_B	Θ, °K	$\left\lvert\frac{\Theta_N}{\Theta}\right\rvert$	Θ_c, °K
	calc.	exp.				
$PbFe_{2/3}W_{1/3}O_3$	406	363	4.2	—132	0.37	178
$PbFe_{1/2}Nb_{1/2}O_3$	276	143	5,4	—520	3.64	387

$|\Theta_N/\Theta| < 1$, in contrast to the majority of antiferromagnets which have $|\Theta_N/\Theta| > 1$. The small values of μ_{eff} and Θ of $PbFe_{2/3}W_{1/3}O_3$ may be due to inaccurate extrapolation of the linear part of $\chi^{-1}(T)$, which was obtained in a relatively narrow range of temperatures. Measurements could not be carried out at higher temperatures because of thermal dissociation of the crystals.

The $\chi(T)$ curves of both compounds did not obey the Curie-Weiss law at temperatures immediately above the transition points; this behavior was similar to that found for weak ferromagnets. The deviation from the Curie-Weiss law was due neither to the presence of nonmagnetic ions at octahedral sites nor to the broad phase transition regions, since the solid solutions $Mn_{1-x}Mg_xO$,[3] as well as CrSe crystals,[2] had the same properties but exhibited a $\chi(T)$ dependence typical of antiferromagnetics. It was therefore possible that the two lead compounds were weak ferromagnets which did not exhibit a residual magnetic moment because of a very large coercive force. To test this hypothesis some samples were cooled from a temperature well above the Néel point in a field of 8000 Oe. Even then no residual magnetic moment was found.

In crystals with ferroelectric and ferro- or antiferromagnetic ordering one can expect changes of magnetic or electric properties on spontaneous polarization or magnetization. For example, a transition to the ferroelectric state and a consequent change of the lattice symmetry in an antiferromagnetic may produce weak ferromagnetism, i.e., a ferroelectric phase transition may induce magnetic moment. Changes of the ferroelectric or ferromagnetic domain structure may also occur in magnetic or ferroelectric transitions. Unfortunately in both compounds the phase transitions were broad and these effects were small and spread over a range of temperatures. However, a maximum of tan δ was observed at 261°K in $PbFe_{1/2}Nb_{1/2}O_3$; this maximum was displaced when the frequency was varied. More work is necessary on this feature of tan δ.

The main conclusion of this work is that ferroelectric and antiferromagnetic properties may coexist in crystals.

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ELECTRONIC ACTIVATION OF MESIC ATOMS

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IT is known that the formation and filling of a "hole" in the inner electronic shells of atoms leads to multiple ionization, to the breaking of chemical bonds, and to release of the atom as a free ion.[1] Investigations of the charge distribution of atoms during radioactive transformations show that when one "hole" is filled, atoms lose, on the average, about seven outer electrons. Borde[2] showed that cascade transitions of muons in mesic atoms lead predominantly to ionization of the inner atomic shells. Thus, for example, about five electrons may be emitted in the bromine mesic atom as the muons go from a shell with principal quantum number n = 14 to the ground state. Consequently, in the case of mesic atoms, the average ion charge may be very large.

The existence of this phenomenon, called electronic activation of mesic atoms, may cause, for example, the probability R of muon transitions between levels of the hyperfine structure, specified by the state of the electronic shell of the mesic ion at the moment of its decay,[3] to depend on the kind of compound entered by the given atom. If the mesic ion is in a metal, the electron shell returns to the ground state in time t_0 which is small compared to the lifetime τ of the mu-meson.[1] Therefore, because of conversion on the electrons of the atom,[3] R will always be much larger than $1/\tau$. On the other hand, in dielectrics (for example, ionic crystals), the mesic ions will act as impurity centers and in that case $t_0 \gg \tau$.[1] Since a decrease in the number of electrons in an atom increases the ionization potential of the inner shells, R can be much smaller than $1/\tau$ for dielectrics.

These considerations may explain the experimental fact[4] that the values of R differ greatly in the mesic atoms of the two phosphorus modifications. Actually, recognizing that for the mesic atoms of phosphorus the interaction energy of the hyperfine structure is $\Delta W = 185$ eV while the L absorption-edge energy in silicon (mesic phosphorous) is $V_{2S} = 156$ eV, we can conclude that for the black modification (a conductor) there is agreement between the calculated and measured values of R. Calculation[5] shows that $V_{2S} \geq W$ as soon as three or four electrons are emitted in the mesic atoms of phosphorus. Therefore, for red phosphorous (a dielectric) where $t_0 \gg \tau$, even the formation of a single "hole," causes R to be less than $1/\tau$.

Experiments[6] have shown that the shell has no effect on the polarization of mu-mesons in diamagnetic metals or media. There will therefore be no such effect in black phosphorus, either.[4] In tests on red phosphorus,[4,7] the maximum asymmetry of the μ-e decay electrons, observed at a mesic-nucleus spin precession frequency half as large as the precession frequency of the spin of the free mu-meson, indicates that the electron shell likewise does not influence mu-meson polarization in red phosphorus.

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