Attention should be called here to the remarkable intensity anomalies observed in this photograph. Firstly, the relative intensities of reflections with odd values of $(h^2+k^2+l^2)$ to those with even values are anomalously large when compared with the case in the cubic phase. Secondly, we found a peculiar intensity relation among a certain line group; for example, the intensity of the $(430)(\bar{4}\bar{3}0)$ reflections is much stronger than that of the $(\bar{4}30)(4\bar{3}0)$ reflections, whereas their intensity ratio should be equal if the atoms occupied the special positions in the unit cell. These anomalies can be well understood when we assume that Zr (or Pb) ions are displaced along the [111] direction. This displacement is the most plausible one to be expected in the ferroelectric rhombohedral lattice. Such a structure is similar to that observed in $BaTiO_3$ below $-70°C$.[2] This conclusion seems to be rather unexpected, because all of the other perovskite type ferroelectrics, such as $BaTiO_3$,[2] $PbTiO_3$,[3] and $KNbO_3$,[4] show lattice changes in the following sequence for falling temperature: cubic—tetragonal —orthorhombic—rhombohedral.

The temperature change of the lattice spacing of (Pb92.5-Ba7.5)ZrO_3 was calculated from the (510) group and is shown in Fig. 1. Below 175°C the structure has a tetragonal lattice with $c/a<1$, giving superstructure lines like those observed in pure $PbZrO_3$. These superstructure lines disappear at the antiferroelectric to ferroelectric transition at 175°C.

It has been known that Pb(Zr-Ti)O_3 compositions show a similar ferroelectric phase[5] to that observed in (Pb-Ba)ZrO_3. In the previous x-ray study of Pb(Zr95-Ti5)O_3,[6] however, we were unable to determine the structure of this ferroelectric phase, though we found very small splittings of the Debye lines. A re-examination of this structure was carried out with a high purity specimen of the same composition, which is ferroelectric between 150° and 230°C. The structure of this ferroelectric phase has now turned out to be also rhombohedral, with $a=4.143$A and $\alpha=89°\ 51'$ at 200°C. We found, in this phase also, similar intensity anomalies to those observed in the corresponding phase in (Pb92.5-Ba7.5)ZrO_3.

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$\beta-\gamma$ Polarization Correlation in Sb^{124}

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It is well known that there is an angular correlation between the direction of the highest energy β-particle (2.29 Mev) and the succeeding γ-ray (0.60 Mev) in the decay of Sb^{124}.[1-3] As a consequence of the existence of this correlation, it may be shown that the γ-ray will exhibit a polarization correlation. The $\beta-\gamma$ angular correlation depends upon the spins of the nuclear states involved in the decay, and upon the matrix element of the β-decay. On the other hand, the $\beta-\gamma$ polarization correlation depends only on the observed angular correlation, and the parity change (yes or no) of the γ-transition. Thus a measurement of the polarization leads to a unique assignment for the parity of the level from which the 0.60-Mev γ-ray is emitted.

In general, if the angular correlation has the form $W(\theta)=1+\alpha\cos^2\theta$ then the γ-ray emitted at $\theta=\pi/2$ (i.e., perpendicular to the direction of the preceding β) will be polarized. The polarization is given in terms of the number of quanta polarized in the θ-direction, J_θ, and the number in the ϕ-direction, J_ϕ. Then $J_\theta/J_\phi=(1+\alpha)/(1-\alpha)$ in case the γ-radiation is dipole or quadrupole radiation with no change in parity, and the reciprocal of this if there is a change in parity.[4] Hence, to determine the parity change it is necessary to know only the angular correlation coefficient α, and whether J_θ/J_ϕ is experimentally greater or less than one.

The observation of the polarization correlation of Sb^{124} was made with an arrangement similar to that of Metzger and Deutsch,[5] with the source and β-detector in a vacuum chamber to avoid the effect of scattering of the β-particles. The source was a thin film of Sb^{124} (supplied by Oak Ridge National Laboratory) which was evaporated on an aluminum backing, then stripped off and mounted on Nylon. The detector was a thin crystal of anthracene connected by a Lucite light pipe to a photomultiplier tube outside the chamber.

The polarization detector consisted of a scintillation counter with a large anthracene crystal to scatter the radiation by Compton collision, and two sodium iodide scintillation counters to detect the scattered radiation. The polarization of the γ-ray was determined by the anisotropy of the Compton scattering from the anthracene crystal.

The measurement of the polarization correlation consisted of determining the rate of triple coincidences between the β-particle, the γ-, and the scattered γ-rays, for two scattering directions. The triple coincidence rate with the scattering direction perpendicular to the plane of the β-particle and γ-ray is N_θ. The rate with the scattering direction in the plane of the β-particle and γ-ray is N_ϕ. The angle between the β and γ was always $\pi/2$. From the anisotropy in scattering predicted by the Klein-Nishina formula it is obvious that N_θ/N_ϕ has the same significance (although not the same size, because of inefficiency in the polarization detector) as does the term J_θ/J_ϕ in determining the parity change.

Since the decay of Sb^{124} is complex, aluminum absorbers were placed directly in front of the β-detector to eliminate the low energy β-particles which do not contribute to the correlation.[2] The ratio of the observed triple coincidence rates with ~ 200 mg/cm² of aluminum was $N_\theta/N_\phi=0.93\pm0.04$ and with ~ 400 mg/cm² of aluminum was $N_\theta/N_\phi=0.89\pm0.11$. Since the angular correlation coefficient $\alpha\simeq-0.4$, these data indicate that the γ-transition must occur with no change in parity. This result is in agreement with the decay scheme proposed by Stevenson and Deutsch to explain their angular correlation results.[3] It is also in agreement with the empirical rule of Goldhaber and Sunyar[6] that the first excited state of an even-even nucleus has spin two, even parity.

Measurements of the $\beta-\gamma$ polarization correlation are now being made on other nuclei in whose decay a $\beta-\gamma$ angular correlation has been observed.

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New Technique for the Determination of Photonuclear Cross Sections*

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A NEW technique for measuring photonuclear cross sections has been developed and applied to the $Cu^{63}(\gamma, n)Cu^{62}$ and $C^{12}(\gamma, n)C^{11}$ reactions up to 60 Mev. Induced radioactivity is employed to monitor the synchrotron beam. A mechanical device, called an oscillator, slides a test sample and a similar monitor