the orbital moments are completely frozen.

An anomaly analogous to that observed by us for $CoSO_4$ was previously observed for $FeCl_2$ by Shalyt[4] in polycrystals and by Bizette et al.[5] in single crystals. However, $FeCl_2$ is a layered antiferromagnet with strong ferromagnetic interaction inside the layer and weak antiferromagnetic interaction between layers, a fact that manifests itself in the ferromagnetic sign of the constant Θ in the Curie-Weiss law. The reversal of the moments of the layer is quite natural in such a structure, even in weak fields. A similar behavior was also observed in the metallic $MnAu_2$, compound.[6] $CoSO_4$ is the first ionic crystal with such an antiferromagnetic sign of Θ that the antiferromagnetism is destroyed by a relatively weak magnetic field ($\mu H \ll kT_N$).

A detailed discussion of the observed anomaly will be made after a thorough study is completed of the phenomenon over the entire temperature range and after the structures of the crystals are established.

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COULOMB EXCITATION OF ALUMINUM

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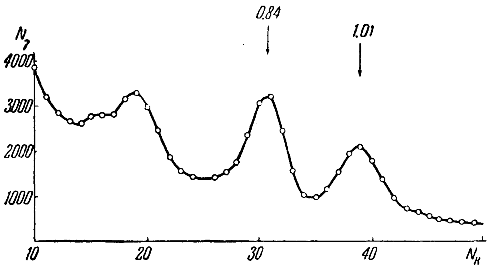
We have investigated the Coulomb excitation of Al^{27} using heavy ions accelerated in a cyclotron — 15.9-Mev triply charged nitrogen ions and 18.1-Mev triply-charged oxygen ions. The γ radiation emitted during the bombardment of aluminum was studied using a scintillation γ spectrometer having a NaI (Tl) crystal 40 mm in diameter and 40 mm high. A detailed description of the method, as well as the procedure for calculating $B(E2)\uparrow$, i.e., the reduced probability for electric quadrupole transition of the nucleus from its ground state to an excited state, was given earlier.[1,2]

The figure shows the spectrum of γ lines obtained from Coulomb excitation of aluminum by nitrogen ions. Two lines are observed, with E = 0.84 and 101 Mev. A study of the low energy region of the spectrum under the same conditions showed that the relative intensity η of the 0.84 + 0.17 Mev cascade does not exceed 4% of the direct transition to the ground state. According to reference 3, η is 2.2%.



An attempt to excite the two levels of Al^{27} using 25-Mev nitrogen ions was unsuccessful, owing to the marked increase in γ-ray background from nuclear reactions.

The results obtained using nitrogen and oxygen ions are in good agreement with one another.

In computing the values of $B(E2)\uparrow$ from the yield of γ quanta from a thick target we assumed, on the basis of reference 4, that the stopping power of aluminum for nitrogen ions is 5.9 Mev-cm^2/mg. The values of $B(E2)\uparrow$ for the levels with ΔE = 0.84 and 1.01 Mev are, respectively, 0.0019 and $0.0031\, e^2 \times 10^{-48}$ cm^4. Using the known values of the spins of the ground state and first two excited states of Al^{27},[5] we find that the partial lifetime

τ (E2) of the level at $\Delta E = 1.01$ Mev is 1.7×10^{-11} sec, while the lifetime of the level at $\Delta E = 0.84$ Mev is 1.7×10^{-11} sec. Previously only an upper limit of $\tau < 10^{-10}$ sec was known[6] for these levels in Al^{27}.

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LIFETIME OF THE FIRST EXCITED STATE OF Mg^{24}

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THE study of Coulomb excitation of nuclear levels enables us to calculate their lifetimes. For even-even nuclei the formula relating the lifetime τ of the excited state and the reduced probability $B(E2)\uparrow$ for transition from the spin 0 ground state to the first excited state (which has spin 2), has the form:

$$1/\tau = 2.46 \cdot 10^{-3} (\Delta E)^5 B(E2)\uparrow,$$

where ΔE is the energy of the level in kev, and $B(E2)$ is in units of $e^2 \times 10^{-48}$ cm^4.

Previously all attempts to excite the first level in Mg^{24} have been unsuccessful, because in this case $\Delta E = 1.37$ Mev and the energies of the α particles or protons necessary for Coulomb excitation of the level are so high that there is a marked increase in the interfering background from nuclear reactions.

In our work we used triply-charged ions of nitrogen and oxygen with energies of 15.9 and 18.1 Mev, respectively, and also quadruply-charged nitrogen ions having energies of 25.6 and 36 Mev.

The investigation of the Coulomb excitation of the first level of Mg^{24} using nitrogen and oxygen ions is made more complicated by the fact that, in the γ spectra we have investigated from Coulomb excitation of various elements, a parasitic line is always present at 1.37 Mev, i.e., a line coinciding with the one we are studying here. This line is apparently related to nuclear interaction of the nitrogen and oxygen ions with carbon deposited on the target during the operation of the cyclotron. We showed that if a target of carbon is irradiated with nitrogen or oxygen ions the intensity of the peak corresponding to a 1.37-Mev γ line increases approximately a hundredfold. We noted that, despite the spread of values of absolute yields of γ lines in the parasitic peaks, the ratio of the peak amplitude to the background changed only slightly during irradiation of targets of various materials with heavy ions.

The figure shows the γ spectrum from bombardment of natural magnesium by 15.9-Mev nitrogen ions. The dotted curve is the parasitic peak calculated on the basis of the observations mentioned above. We estimate that the maximum error in the determination of the area of the parasitic peak does not exceed $\pm 5\%$ of the area of the true peak. The average value of $B(E2)\uparrow$, determined from six different experiments, is $0.054\, e^2 \times 10^{-48}$ cm^4. This gives a value of $\tau = (1.5 \pm 0.4) \times 10^{-12}$ sec.

The lifetime of the first excited state of Mg^{24} was determined in reference 1 from data on inelastic scattering of 187 Mev electrons. According to reference 1, $\tau = 1.9 \times 10^{-12}$ sec; however the author points out that the method is not very accurate and that the result could be changed by a factor of the order of unity. At the Eighth Annual Conference on Nuclear Spectroscopy there were two reports[2,3], of measurements of τ (Mg^{24}). The lifetime of the first excited state of Mg^{24} was determined in these experiments by studying resonance scattering of γ-rays. The results of references 2 and 3 differ from one another by about a factor of 10. Our value of τ is close to the value of $\tau = (1.7 \pm 0.4) \times 10^{-12}$ sec reported in reference 2.