$f(\theta)=1+0.125\cos^2\theta+0.042\cos^4\theta(\mathrm{Ni}^{60})$ and $f(\theta)=1-1.5\cos^2\theta+2\cos^4\theta(\mathrm{Pd}^{106})$, corrected for the finite angular resolution of the instrument. The above angular correlation of the Ni^{60} gamma-rays is to be expected for a quadrupole-quadrupole transition between states of[4] angular momenta $J=4$, 2, and 0. No theoretical explanations for the angular distribution of the Pd^{106} gamma-rays has been given yet.[5, 6]

The angular correlation of the gamma-rays of A^{38} has been measured using sources of Cl^{38} produced by bombarding LiCl with 10-Mev deuterons in the Purdue cyclotron. The results are shown in Fig. 2. The measured points follow, within the experimental error, the angular correlation function $f(\theta)=1-\frac{1}{3}\cos^4\theta$. For comparison all the other known correlation functions[4] for quadrupole or dipole transitions are plotted which give smaller emission probabilities at 180° than at 90°. The deviation from the theoretical curve near 180° may be partly due to internal pair production chiefly of the 2.15-Mev gamma-transition. Nevertheless the correction applied (point P in Fig. 2) using Rose's calculations[7] of the coefficient of internal pair production assuming electric quadrupole transition (see discussion below) is not sufficient to bring the point down to the expected place. Part of this effect is probably due to positron annihilation produced by pair formation of the gamma-rays in the absorbers, which are necessary to stop the rather energetic beta-particles from Cl^{38}.

The correlation function $1-\frac{1}{3}\cos^4\theta$ is characteristic for two quadrupole quanta and angular momenta $J=3, 2, 0$ respectively of the A^{38} levels involved. The parity of the two excited states must be equal since otherwise electric dipole radiation would be possible.

Measurements of Myers and Wattenberg[2] indicating that the direct transition from the second excited level to the ground state of A^{38} occurs in less than 3×10^{-4} of the disintegrations make the assignment of the same parity of the second excited level and the ground state of A^{38} necessary. It must therefore be assumed that both transitions are by electric quadrupole radiation and that all three states of A^{38} involved have the same parity. Even if mixtures of different multipole radiations are admitted giving different correlation functions due to interference effects[8] no other assignments can be found which are compatible with selection rules and the abundance of the cross-over transitions.

According to the measurements of Langer[1] the beta-transition from Cl^{38} to the ground state of A^{38} having zero spin is once-forbidden involving a spin change of two units and change of parity suggesting a spin of 2 for Cl^{38} and odd parity if we assume an even parity of the ground state of A^{38}. The intermediate group of electrons has a ft-value of $\sim10^7$ indicating a once-forbidden transition having a spin change of 0 or 1. This indicates an angular momentum of 1, 2, or 3 and even parity in agreement with the results of our correlation measurements ($J_1=2$). The low energy beta-spectrum is allowed according to its ft-value of 1.2×10^5. The selection rules for allowed beta-transitions ($\Delta J=0$, 1, no) give an angular momentum $J_2=2$, 3, or 4 of the second excited state of A^{38} and odd parity. The angular momentum 3 is also found from our measurements, but an odd parity of this level is not compatible with our results, which indicate the same parity for all levels of A^{38}. The interpretation of the angular correlation would suggest therefore that the low energy spectrum in spite of its small ft-value of 1.2×10^5 is once-forbidden. More direct information concerning the parities of the excited levels of A^{38} will be obtained by polarization-correlations experiments which are intended to be performed in this laboratory.

We wish to thank Dr. D. J. Tendam for his help in bombarding the samples in the Purdue cyclotron.

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[*] Supported by the ONR.

[1] L. M. Langer, Phys. Rev. **77**, 50 (1950).

[2] V. Myers and A. Wattenberg, Phys. Rev. **75**, 992 (1949).

[2a] Obtained from the Isotope Division, AEC, Oak Ridge, Tennessee.

[3] E. L. Brady and M. Deutsch, Phys. Rev. **78**, 558 (1950).

[4] D. R. Hamilton, Phys. Rev. **58**, 122 (1940). D. L. Falkoff, thesis, Michigan University (1948).

[5] D. S. Ling and D. L. Falkoff, Phys. Rev. **76**, 430 (1949).

[6] A. Spiers, Phys. Rev. **78**, 75 (1950).

[7] M. E. Rose, Phys. Rev. **76**, 678 (1949).

[8] D. S. Ling and D. L. Falkoff, Phys. Rev. **74**, 1224 (1948).

Erratum: On the Primary Cosmic-Ray Spectrum

[Phys. Rev. **78**, 819 (1950)]

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In the course of publication certain errors occurred in this Letter to the Editor which requires correction. The units of geomagnetic cut-off, as given in terms of the momentum/charge ratio, pc/Ze, are properly billion volts (Bv), and not billion electron volts (Bev) as printed, and should be so understood throughout, including Tables I and II. Line 13 of the text should read "... charged component to geomagnetic latitude." The heading of column 3 of Table II should be "pc/Ze."

Apparent Error in the Measured Mass of S^{32}

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August 14, 1950

While attempting to calculate the threshold energy for the reaction $\mathrm{S}^{32}(\gamma,d)\mathrm{P}^{30}$ an apparent anomaly between the measured masses of S^{32} and Si^{30} was encountered.

Discussing mass defects in light nuclei, Rosenfeld[1] states, "In the interval $A=29\cdots34$ there is a large unexplained discrepancy between the values derived from nuclear reaction data and those based on the mass spectrograph measurement of S^{32}." The latter mass was used in Rosenfeld's table of mass defects.

This discrepancy can seemingly be attributed to an error in the measured mass of S^{32}. The following calculations are offered in support of this statement.

The reaction energies of five relevant nuclear reactions are given in the isotopic report of Mattauch and Flammersfeld[2] and in a recent paper on thresholds.[3] These values, together with the reaction energy for the reaction $\mathrm{S}^{32}(\gamma,d)\mathrm{P}^{30}$ which was measured in this laboratory, are listed in Table I.

Seaborg's tables[4] give 3.85 and 3.50 Mev for the β-decay energies of S^{31} and P^{30}. Both values were determined by magnetic spectrometer measurements.

Figure 1 illustrates the situation. The reactions considered are shown by solid arrows and the β-decays by dotted arrows.

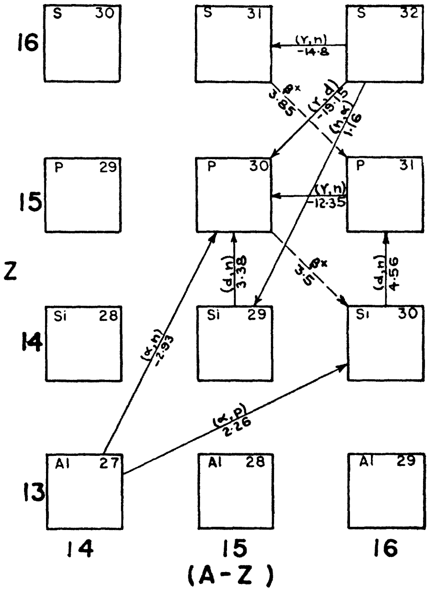

FIG. 1. Sketch showing the reactions, reaction energies, β-decays, and decay energies used in the calculations to determine the mass of S^{32}.