Harwell impurity specification and the linearity of the decay curve confirm the absence of appreciable amounts of such contaminants.

A more detailed account of this work will be published elsewhere.

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The Mass Difference $Si^{27}-Al^{27}$†

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THE $Al^{27}(p,n)Si^{27}$ threshold has been found to be 5.819±0.010 Mev using the 5.5-Mev electrostatic generator at Oak Ridge. From this the calculated value of the mass difference $Si^{27}-Al^{27}$ is 0.00519 amu and the Si^{27} disintegration energy is 3.81±0.01 Mev.

In each magnet cycle the calibration of the magnet was effected by locating in order the $F^{19}(p,\alpha\gamma)O^{16}$ levels at 1.355 Mev and 1.381 Mev[1] with mass two beam, the $Al^{27}(p,n)Si^{27}$ threshold, and the $F^{19}(p,\alpha\gamma)O^{16}$ level at 0.669 Mev[1] with mass three beam. The gamma-rays were detected with a NaI crystal counter and the neutrons with a "Bonner-Butler" type[2] counter.

Previously reported values for the $Al(p,n)$ threshold were 6.1±0.1 Mev,[3] and 5.93 Mev.[4] These measurements were done with cyclotrons using essentially a stacked-foil technique. The maximum positron energy from Si^{27} disintegration has been reported as 3.54±0.01 Mev,[5] 3.74,[6] 3.48±0.10 Mev,[7] and 3.6 Mev.[4]

† This document is based on work performed for the U. S. Atomic Energy Commission at Oak Ridge National Laboratory.

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The Ground State Hyperfine Structure and Nuclear Magnetic Moment of Praseodymium

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THE hyperfine structure of the ground state of praseodymium has been studied by the atomic beam magnetic resonance method. Transitions between magnetic levels belonging to the same total quantum number F and between magnetic levels belonging to different F have been observed. From the former transitions and the previously known nuclear spin value of 5/2, the total electronic angular momentum of the atom in the ground state has been found to be 9/2 and the g_J value of this state to be 0.727±0.005. Since this value of the Landé g factor is exactly that of a $^4I_{9/2}$ state in Russell-Saunders coupling, it seems most likely that the atomic ground state of Pr is a $^4I_{9/2}$. This state is also, according to Hund's rules, the most probable ground state of the $4f^36s^2$ configuration which has been predicted for this element.[1]

Of the five hyperfine intervals which exist for the ground state of Pr with $I=5/2$ and $J=9/2$, only two have been observed, *viz.*, the intervals $F=4\rightarrow F=3$ and $F=3\rightarrow F=2$. Their values are 3708.10±0.05 Mc/sec and 2782.20±0.05 Mc/sec, respectively. Attempts to obtain other intervals were unsuccessful, probably because of insufficient microwave power in the transition region. If it is assumed that the hyperfine levels of the $^4I_{9/2}$ state are unperturbed by neighboring states, the observed intervals may be expressed in terms of two constants A and B which measure, respectively, the interaction between the nuclear magnetic moment and the electrons, the interaction between the nuclear electric quadrupole moment and the electrons.[2] We find

$$A=+926.11\pm0.09 \text{ Mc/sec},$$
$$B=-12.9\pm1.0 \text{ Mc/sec},$$
$$B/A=-0.014.$$

The sign of A has been found to be positive by an analysis of the trajectory of the atoms in the apparatus, following the method of Davis, Feld, Zabel, and Zacharias.[2]

A deviation from the interval rule in hyperfine structure may arise from perturbations by neighboring states as well as from a nuclear electric quadrupole moment. In the case of Pr, however, an estimate of the perturbing effect of the $^4I_{11/2}$ state lying about 1450 cm^{-1} above the ground state[3] indicates that the perturbation is not sufficient to account for the observed deviation.

From the magnetic dipole interaction constant A, the contribution a_{4f} due to a single f electron has been calculated by the method of Goudsmit.[4] We obtain

$$a_{4f}=0.7626A(f^3, {}^4I_{9/2})=706.25 \text{ Mc/sec}.$$

From a_{4f} the nuclear gyromagnetic ratio is calculated from the relation

$$a_{4f}=\frac{g_I}{1836}\frac{R\alpha^2(Z-\sigma)^3}{n^3l(l+\frac{1}{2})(l+1)},$$

using $n=4$ and $\sigma=35.5$. This value of the screening constant σ is calculated from the fine structure multiplet of the ground state of neodymium.[5] A value nearly the same as this is also obtainable from the fine structure of Pr I as deduced from Pr II.[3] We find $g_I=1.53$ and hence

$$\mu=+3.8 \text{ nm}.$$

As a check, this crude method of evaluating the magnetic moment has been applied to the configurations $3d4s^2$, $3d^34s^2$, $3d^94s^2$ of Sc I, Cu I, V I, respectively, for which the magnetic moments are accurately known, and the errors in the calculated moments have been found to be from 10 to 15 percent. Therefore the accuracy of the above value of μ is probably no better than 10 percent. It is interesting to note the close agreement between this value and that calculated by Brix[6] from Pr II. This value also lends support to the view in the independent particle picture of nuclei that the nuclear moments of Pr arise mainly from a $d_{5/2}$ proton.

A detailed report of the experiment and calculations, together with an estimate of the nuclear quadrupole moment, will be given in a later paper.

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[3] An estimate of the fine structure splitting of the $f^3s^2\,{}^4I$ multiplet of Pr I may be obtained from the known levels of the f^3s, $^{3,5}I$ multiplet of Pr II in the manner illustrated for Nd in reference 5.
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