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Magnetic Moment of Os^{189}†

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A NUCLEAR induction signal of Os^{189} with a width of 10 gauss, measured between the minima of the differentiated dispersion mode, has been detected in molten OsO_4. The liquid phase of this particular compound was chosen because the Os^{189} nucleus has a large electric quadrupole moment, $Q=(+2.0\pm0.8)\times10^{-24}$ cm^2,[1] and its is therefore necessary to place the nucleus in a symmetric molecular configuration in order to minimize interactions which broaden the resonance line. It is presumed that in our sample, the osmium nucleus is located at the centroid of a tetrahedron having oxygen atoms at its vertices.

The resonant frequency was compared to that of Cl^{35} in pure $TiCl_4$ with the result

$$\nu(Os^{189})/\nu(Cl^{35})=0.791896\pm0.000093. \quad (1)$$

With the spin of Os^{189} assumed to be 3/2,[1] and with the known values of the frequency ratios $\nu(Cl^{35})$ in $TiCl_4$/$\nu(Cl^{35})$ in RbCl,[2] $\nu(Cl^{35})$ in RbCl/$\nu(H^2)$,[3] $\nu(H^2)/\nu(H^1)$,[4] the value of the magnetic moment was found to be, with $\mu(H^1)=2.79268$,[5]

$$\mu(Os^{189})=+0.650655\pm0.000081 \text{ nm}. \quad (2)$$

The positive sign in (2) was verified by comparing the sign of the Os^{189} signal with that of O^{17} in the same compound. Sign comparisons were also made with H^2 and N^{14}. The earlier determination of $\mu(Os^{189})=+0.70$ ±0.09 nm by Murakawa and Suwa[1] is in agreement with the sign and the more precise value of Eq. (2).

In view of the fact that the single-particle shell model[6] predicts that, for the case of a positive magnetic moment, only $p_{1/2}$, $f_{5/2}$, and $h_{9/2}$ states are available between the magic numbers 82 and 126, it seemed to us of interest to check the previous spin determination by an independent method. Accordingly, the heights h and line widths ΔH of Os^{189} and Cl^{37} signals were compared. The reference Cl^{37} signal from a 7.10 molar LiCl solution containing 0.0075 molar $Mn(NO_3)_2$ was used, and care was taken to ascertain that both line shapes represented the nonsaturated slow passage case. If the frequency, the rf field intensity, the Q of the receiver coil, the filling factor, and the sweep field remain unchanged for the measurements of both signals, the application of the phenomenological equations[7] gives

$$I(\mathrm{Os})[I(\mathrm{Os})+1]=I(\mathrm{Cl})[I(\mathrm{Cl})+1] \times\frac{h(\mathrm{Os})}{h(\mathrm{Cl})}\frac{N(\mathrm{Cl})}{N(\mathrm{Os})}\frac{\gamma(\mathrm{Cl})}{\gamma(\mathrm{Os})}\left(\frac{\Delta H(\mathrm{Os})}{\Delta H(\mathrm{Cl})}\right)^2. \quad (3)$$

With the known value of 3/2 for $I(\mathrm{Cl})$,[8] the measured values of the number of nuclei N in each sample, and our experimental results for the other ratios, we find

$$I(Os^{189})=1.45\pm0.13, \quad (4)$$

thus verifying the value 3/2.

Signals were not observable in solidified OsO_4 or in powdered Os metal which has a crystal structure of hexagonal symmetry, presumably because of an unfavorable ratio T_2/T_1.

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Experimental Study of the μ^- Meson Mass and the Vacuum Polarization in Mesonic Atoms*

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STUDIES of the x-rays emitted in transitions of mesons between atomic orbits about nuclei have been extended[1] to $3D-2P$ and $4F-3D$ transitions in a variety of elements for both π^- and μ^- mesons. Particular attention has been paid to μ^- mesonic transitions having energies below 90 kev, using thin filters between the anticoincidence counter and the NaI crystal of the scintillation spectrometer.[2] Because of the large and rapid change in absorption cross section at the photoelectric "K edge" energy and the precise knowledge of