LETTERS TO THE EDITOR

Prompt publication of brief reports of important discoveries in physics may be secured by addressing them to this department. Closing dates for this department are, for the first issue of the month, the twenty-eighth of the preceding month; for the second issue, the thirteenth of the month. The Board of Editors does not hold itself responsible for the opinions expressed by the correspondents.

Hyperfine Structure in the Spectra of Neutral Manganese

A light source, designed by Schüler, operated at liquid air temperatures in conjunction with a prism spectrograph and silvered Fabry-Perot etalons is being used to study the hyperfine structures in the spectral lines of neutral manganese. At 4000A a resolving power of approximately one million is obtained. The observed fine-structure patterns although identical in appearance with those found in praseodymium (Phys. Rev. **34,** 1397, 1929) are in general a fifth to a tenth as wide. Patterns of from 2 to 6 components are found, some degrading toward the red and others toward the violet. For example, λ4030 has the fine-structure components,

Int.	10	9	8	7
$\Delta\lambda$	0	+0.0122	+0.0230	+0.0317
$\Delta\nu$	0	−0.0751	−0.1416	−0.1951
			6	5
			+0.0379	+0.0420
			−0.2333	−0.2585

degrading toward longer wave-lengths while λ4018 has the

Int.	10	9	8	7
$\Delta\lambda$	0	−0.0152	−0.0274	−0.0377
$\Delta\nu$	0	+0.0941	+0.1696	+0.2333
			6	5
			−0.0456	−0.0516
			+0.2822	+0.3193

components degrading toward the violet. Since the well-known gross structure of Mn I and II in general shows strictly *LS* coupling, an excellent opportunity for the study of the role played by *s*, *p*, and *d* electrons in producing hyperfine structure presents itself. The ${}^6S_{2\frac{1}{2}}$ $(3d^5 4s^2)$ term is apparently quite narrow. With a nucleur angular momentum $(5/2)\,(h/2\pi)$ for Mn, the ${}^8P_{4\frac{1}{2}}$, ${}^6P_{3\frac{1}{2}}(3d^5 4s4p)$ and the ${}^6D_{4\frac{1}{2}}(3d^6 4s)$ terms are each broken into six *normal* components with separations 0.116, 0.107, 0.082, 0.068, 0.052 and 0.075, 0.066, 0.054, 0.038, 0.025, and 0.099, 0.086, 0.069, 0.054, 0.040 cm^{-1} respectively. While the ${}^8P_{4\frac{1}{2},3\frac{1}{2},2\frac{1}{2}}$ terms each have six components, the ${}^6D_{4\frac{1}{2},3\frac{1}{2},2\frac{1}{2},1\frac{1}{2},\frac{1}{2}}$ and ${}^6P_{3\frac{1}{2},2\frac{1}{2},1\frac{1}{2}}$ terms have 6, 6, 6, 4, 2 and 6, 6, 4 components respectively, as would be expected with $i=2\frac{1}{2}$. The total fine-structure separation 0.348 cm^{-1} for ${}^6D_{4\frac{1}{2}}$ $(3d^6 4s)$ is due chiefly to the $4s$ electron, the $3d$ electrons contributing very little. To this the $4p$ electron contribution is (a) added to give the ${}^8P_{4\frac{1}{2}}(3d^5 4s4p)$ separation 0.414 cm^{-1} and (b) subtracted to give the ${}^6P_{3\frac{1}{2}}(3d^5 4s4p)$ separation 0.258 cm^{-1}.

The total separations of the fine structures for the three terms ${}^6D_{4\frac{1}{2},3\frac{1}{2},2\frac{1}{2}}$ are found to be proportional to the cos si, when $J \geqq i$ and cos $Ji=1$, as predicted. The fine structures that have as yet been photographed are found to be in excellent agreement with the "Theoretical Interpretation of Hyperfine Structure" given by one of the authors (H. E. W. in a Letter to the Editor, Phys. Rev **34,** 1288, (1929). The value of i for manganese appears to be $(5/2)\,(h/2\pi)$ as is also the case for lanthanum and praseodymium. The ratio between gross-structure and fine-structure is about 20,000:1 the same order of magnitude as the ratio between the mass of a manganese atom and five times the mass of an electron. This indicates that if the nuclear spin is due to negative charges, as seems to be the case from the *normal* order of the fine structure, they must carry with them the total mass of the nucleus in space quantization.

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Physikalisch-Technische
Reichsanstalt
December 7, 1929.