The Nuclear spin of N15

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The Nuclear spin of N^{15}

A sample of heavy ammonia with about 36 percent N^{15} which was furnished us by Professor H. C. Urey yielded the bands of $N^{15}-N^{15}$ with sufficient strength to determine the spin of N^{15}. Almost all the bands of $N^{15}-N^{15}$ are so confused with bands of $N^{14}-N^{15}$ and $N^{14}-N^{14}$, or are so complex, that the rotational structure is not sufficiently open for reliable intensity measurements (see R. W. Wood and G. H. Dieke,* where the analysis of the $N^{14}-N^{15}$ bands is given). A notable exception is the $1\rightarrow 0$ band of the negative band (N_2^+), the head of which is at 3582.3A for $N^{14}-N^{14}$, 3587.4 for $N^{14}-N^{15}$, and 3592.5 for $N^{15}-N^{15}$. The P branch of the latter band is completely free from overlapping with other bands and, except for the lines at the very head, is completely resolved in the second order of our 21-foot grating with 30,000 lines per inch and a dispersion of about 0.6A per mm. The alternating intensities of successive rotational lines are plainly visible. In order to determine the spin a detailed measurement of the intensities is superfluous, as it is only necessary to distinguish between a few definite ratios (3 to 1 for $i=\frac{1}{2}$, 2 to 1 for $i=1$, 5 to 3 for $i=3/2$, etc.) and therefore a simplified method of intensity comparison can be used. We placed a rotating sector directly in front of the plate so that it would cut down the intensity of the lower half of the lines to one-third its original value. The microphotometer then showed that the intensities of the strong lines, when reduced to a third of their original intensity, fell on the same smooth curve as the unreduced weak lines. This proves that the intensity ratio is 3 : 1 and this was confirmed by trying other ratios of the rotating sector. Lines in other bands which are free from other lines can also be used for this purpose.

The nuclear spin of N^{15} is therefore $\frac{1}{2}$. This agrees with what should be expected, as ${}_7N^{15}$ can be obtained from ${}_8O^{16}$ (which has no spin) by taking away one proton. And whereas in $N^{14}-N^{14}$ the even numbered lines are the strong ones, it is just the reverse for $N^{15}-N^{15}$, which shows that, in agreement with expectation, the N^{15} nuclei obey Fermi-Dirac statistics.

A detailed analysis of the whole band system will appear later.

We wish to express our most sincere thanks to Professor Urey for the heavy nitrogen which made this investigation possible.

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* R. W. Wood and G. H. Dieke, J. Chem. Phys. **6**, 734 (1938).

Addendum: Primary Processes in Photodecomposition

(J. Chem. Phys. **6**, 416 (1938))

It should have been mentioned in our discussion of the formaldehyde decomposition that, since 1932, Norrish has on several occasions expressed the opinion that the predissociation in the discrete region is spontaneous.[1]

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[1] Norrish, Acta Physicochimica **3**, 173 (1935); Trans. Faraday Soc. **30**, 105 (1934); Proc. Roy. Soc. London **A146**, 257 (1934).