continuous studies during illumination were possible.

The principal effect was a reversible transfer of absorption amplitude between the two bands, fig. 1, with concomittant ESR changes. "Blue" light, meaning here any light of $h\nu > 2.5$ eV, increased the F-center ESR and optical peaks, and reduced the 3.1 eV peak. "Red" light, meaning $h\nu < 2.5$ eV, had the converse effect. Tests with a series of filters (a monochromator was not used) indicated that "blue" irradiation was most effective in the 3.1 eV band, specifically. The "red" transformation did not correlate with any absorption band; the samples have only a weak, broad absorbance in the visible region $h\nu < 2.5$ eV. Quantitative aspects of these studies will be reported separately; but the following points are of interest:

(1) At 77°K, relaxation time between the "B" and "R" conditions (after blue or red light respectively) was $\gg 1$ min; we could not locate the precise thermal equilibrium level. (2) at 300°K the same B-R transformations were detectable, by ESR, with a relaxation time ~ 1 min; equilibrium was near the "R" level. (3) At 4.2°K the process appeared "frozen out"; no light-induced changes were seen.

What is observed is almost surely the reaction $F \leftrightarrow F'$. The only alternative charge transfer process that can involve the F center is ionization of the F electron. But theoretical and other considerations [3] argue that the lifetime of a "bare" O^{2-}-vacancy must be far too short to account for the metastable "B" and "R" states.

The relative thermal equilibrium densities of F and F' centers in the CaO:Ca samples are probably governed by impurities. The stable number of F centers must be limited to the number of other electron traps which have greater affinity for the "second" electron of an F' center, than has an F center. Such "other" traps could be for example substitutional Fe^{2+} or Mn^{2+}, acting as acceptors; Fe and Mn densities [4] in our samples are both, in fact, of the order of the saturation F-center densities. O^{2-}-vacancies in excess of these densities must give rise to F' centers. We can account for $F \leftrightarrow F'$ conversion by metastable charge exchange of a "second" electron between an impurity and an F center. The locations of traps, and the dynamics of the photoreaction, are scarcely understood. We feel the "blue" process, $F' \rightarrow F$, goes by exciting the $^1S \rightarrow {}^1P$ transition of the F' center, this being presumably the 3.1 eV band, whence an electron is thermally ionized to the conduction band and becomes trapped elsewhere.

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MAGNETIC RESONANCE IN A ROTATING MAGNETIC FIELD

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The electron paramagnetic resonance of DPPH has been observed in a magnetic field rotating relative to the laboratory at a frequency of 1 kHz.

Magnetic resonance experiments are conventionally carried out on specimens which are subjected to an external magnetic field which is constant in both magnitude and direction. In this letter we report the observation of magnetic resonance in an external magnetic field which is constant in magnitude but which is rotating uniformly relative to the labratory. The observation of nuclear magnetic resonance in a rotating magnetic field was proposed several years ago by one of us

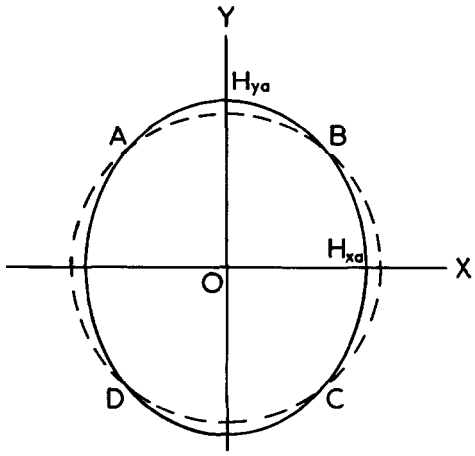

Fig. 1. Diagram illustrating resonance in a rotating magnetic field. OX, OY are the axes of the two Helmholtz coil systems. The full line is traced out by the extremity of the magnetic field vector rotating about O if the two alternating component fields are nearly equal and are in phase quadrature. The dashed circle has a radius equal to the resonance field. Resonances occur four times per cycle at the intersections A,B,C,D.

[1] as one method of removing spectral broadening by anisotropic nuclear interactions. The present experiment has had the somewhat simpler objective of observing electron paramagnetic resonance in a rotating magnetic field. Nuclear magnetic resonance has been previously observed in a linearly oscillating magnetic field [2] and in a very eccentric elliptically-polarized field [3].

A magnetic field of magnitude 18.5 oersted rotating at a frequency ν_r of 1 kHz about an axis normal to the field direction, has been generated by feeding alternating current in phase quadrature into two pairs of Helmholtz-type coils mounted with their axes orthogonal. The electron paramagnetic resonance signal from a specimen of crystalline DPPH has been observed using a marginal oscillator spectrometer working at a frequency ν_0 of 51.4 MHz.

The method of detection is illustrated in fig. 1. If the amplitudes of the alternating fields generated by the two pairs of coils are not quite equal, but are H_{xa} and H_{ya}, the extremity of the magnetic field vector rotating in the XY plane about O describes the ellipse shown by the full line in fig. 1, if the phase difference between the two alternating fields is $\frac{1}{2}\pi$. Thus we have a magnetic field of amplitude $\frac{1}{2}(H_{xa} + H_{ya})$ rotating with frequency ν_r and modulated with small amplitude $\frac{1}{2}(H_{ya} - H_{xa})$ at frequency $2\nu_r$. The dashed line in fig. 1 is a circle whose radius is the resonance field H_0 for the specimen at frequency ν_0. If H_0 is arranged to be between H_{xa} and H_{ya}, as illustrated, the specimen passes through the resonance condition four times during each rotating period, at A,B,C,D. The four resonances per rotation cycle are illustrated in the oscillogram in fig. 2 in which the timebase runs in phase with the field generated by the Y coils. As the difference $(H_{ya} - H_{xa})$ is reduced the resonance signals broaden and eventually occupy the whole trace. The resonances have also been observed for a wide variety of conditions in which H_{xa}, H_{ya} and the phase difference between the X and Y fields are varied.

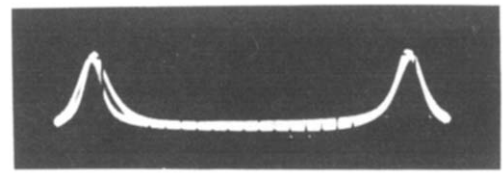

Fig. 2. Oscillosgram showing four resonances per rotation cycle.

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