For the Lamb shift ($\delta E_{2S\frac{1}{2}}-\delta E_{2P\frac{1}{2}}$) for He^+, Eq. (1) gives approximately 16 900 Mc/sec, and Eq. (3) gives about 13 880 Mc/sec, while the experimental value for this quantity as found by Lamb and Skinner[3] is around 14 020 Mc/sec. This shows the correctness of the quantum-electrodynamical formula (3) in the approximation used and the nonvalidity of Eq. (1).

Some time ago, I proposed a phenomenologic theory of the Lamb shift,[2] in which self-interactions were completely "forbidden," and in which the Lamb shift was due to some assumed direct interaction between electron and proton and between the spins and the electromagnetic field. This theory led to Eq. (1) with Eq. (2) substituted. It is hard to see how this theory could ever be made to yield the additional term with $-2(\ln Z)\delta_{l,0}$ by any simple modification of the interactions proposed. Therefore the experimental evidence on He^+ rules out the explanation of the Lamb shift by such direct interactions, and thus yields new evidence for the reality of the finite part of the quantum-electrodynamical self-interaction of the electron.

As regards the attempts to postulate the nonexistence of self-interactions, this evidence shows that such a postulate would have to be modified in such a way as to leave at least such part of the self-interaction as corresponds to the finite part of the self-energy leading to the Lamb shift, thus removing the necessity of *ad hoc* assumed direct interactions. Other restrictions to be imposed on this postulate of nonexistence of part of the self-interactions have been discussed by me earlier.[4]

[1] Bethe, Brown, and Stehn, Phys. Rev. **77**, 370 (1950).
[2] F. J. Belinfante, Phys. Rev. **84**, 949 (1951).
[3] W. E. Lamb and M. Skinner, Phys. Rev. **78**, 539 (1950).
[4] F. J. Belinfante, Phys. Rev. **85**, 468 (1952).

The Nuclear Magnetic Moment of Cr^{53} and Sr^{87}

C. D. Jeffries and P. B. Sogo
Physics Department, University of California, Berkeley, California

(Received July 15, 1953)

FROM the hyperfine structure of the paramagnetic resonance absorption of a magnetically dilute single crystal, Bleany and Bowers[1] have observed the spin of Cr^{53} to be $\frac{3}{2}$ and the magnetic moment to be $|\mu|=(0.5\pm0.1)$ nm, the sign being undetermined. Using a nuclear induction spectrometer, we have observed the nuclear magnetic resonance of Cr^{53} at a frequency of 2.40 Mc/sec in a field of 10 000 gauss. The nuclear induction signals have been observed in a 1.1-molar aqueous solution of Na_2CrO_4 in which the Cr has been isotopically enriched to 90 percent Cr^{53}. The signals have also been observed, with reduced amplitude, in a saturated solution of natural abundance Na_2CrO_4. The polarity of the Cr^{53} nuclear induction signal is opposite to that of Na^{23}, indicating that Cr^{53} has a negative magnetic moment. In the same magnetic field the ratio of the nuclear resonance frequency of Cr^{53} to that of D^2 in a sample of D_2O containing 1 molar of $MnCl_2$ has been observed to be $\nu(Cr^{53})/\nu(D^2)=0.36820\pm0.00003$. From this we find for the magnetic moment of Cr^{53}, without diamagnetic correction, $\mu(Cr^{53})=-(0.47351\pm0.00007)$ nm, where we have used in this calculation the spin $\frac{3}{2}$ of Cr^{53} as observed by Bleany and Bowers,[1] the ratio $\mu(D^2)/\mu(H)=0.307015$ as given by Mack,[2] and $\mu(H)=2.7925$ nm as determined by Bloch and Jeffries.[3]

From optical hyperfine structure measurements Heyden and Kopfermann[4] have determined the spin of Sr^{87} to be 9/2 and the magnetic moment to be $\mu=-1.1$ nm. Using a saturated aqueous solution of $SrBr_2$, we have observed a nuclear induction signal at a frequency of 1.84 Mc/sec in a field of 10 000 gauss. We have enhanced the signal amplitude and also verified that this is indeed the magnetic resonance of Sr^{87} by using a 3.1-molar aqueous solution of $SrBr_2$ in which the Sr had been enriched to 60-percent Sr^{87}. The polarity of the Sr^{87} signal was observed to be opposite to that of Br^{79}, verifying that the magnetic moment of Sr^{87} is negative. We have detected no "chemical shift"[5] between the resonance frequencies of Sr^{87} in $SrBr_2$ and SrI_2. Using the enriched sample, we have observed that, in the same magnetic field, the ratio of the nuclear resonance frequency of Sr^{87} to that of D^2 in D_2O containing 1-molar $MnCl_2$ is $\nu(Sr^{87})/\nu(D^2)=0.28232\pm0.00003$. From this we find for the magnetic moment of Sr^{87}, without diamagnetic correction, $\nu(Sr^{87})=-(1.0892\pm0.00015)$ nm, where we have used a spin of 9/2 for Sr^{87} as measured by Heyden and Kopfermann[4] and the values of $\mu(D^2)/\mu(H)$ and $\mu(H)$ as quoted above.

The authors gratefully acknowledge the assistance of Mr. Charles Cook in the preparation of the enriched Cr sample and the loan of the enriched isotopes by the Stable Isotopes Division of the U. S. Atomic Energy Commission.

[1] B. Bleaney and K. D. Bowers, Proc. Phys. Soc. (London) **A64**, 1135 (1951). K. D. Bowers, Proc. Phys. Soc. **A65**, 860 (1952).
[2] J. E. Mack, Revs. Modern Physics. **22**, 64 (1950).
[3] F. Bloch and C. D. Jeffries, Phys. Rev. **80**, 305 (1950).
[4] M. Heyden and H. Kopfermann, Z. Physik **108**, 232 (1938).
[5] W. C. Dickinson, Phys. Rev. **81**, 717 (1951).

Lower Limit for the Lifetime of the 665-kev Excited State of Mo^{97}†

F. R. Metzger and W. B. Todd
Bartol Research Foundation, of the Franklin Institute, Swarthmore, Pennsylvania

(Received July 15, 1953)

ACCORDING to Goldhaber and Hill[1] the 665-kev gamma ray emitted in the decay of Nb^{97} is probably a magnetic dipole transition between states with orbitals $g_{7/2}$ and $d_{5/2}$. As the Nb^{97} decay involves a rather energetic beta ray which can compensate for the gamma-ray recoil, Nb^{97} seemed to be a favorable case for a lifetime measurement using resonance scattering.[2]

A measurement of the nuclear resonance scattering of a gamma ray is a determination of the width of the initial nuclear level involved in the transition. The resonance scattering technique is especially well suited for lifetimes of the order of 10^{-13} second and shorter (widths$\geq 6\times10^{-3}$ ev). This is just the region into which, according to Weisskopf's lifetime formula,[3] the magnetic dipole transitions of $\approx mc^2$ energy should fall. The only $M1$ transition in this energy range whose lifetime is known is the 478-kev transition in Li^7. From an observation of the Doppler broadening due to the motion of the Li^{7*} nucleus in the $B(n,\alpha)$ reaction, Elliott and Bell[4] deduced a lifetime of 7×10^{-14} second, which is even somewhat shorter than expected from Weisskopf's formula. On the other hand, the lifetimes of several low-energy $M1$ transitions have been measured by Graham and Bell[5] using delayed coincidence techniques. Most of these lifetimes were found to be $\sim$100 times longer than predicted from Weisskopf's formula. If the 665-kev Mo^{97} gamma ray belonged to this "slow" group, resonance scattering would not be observable with our present means; if, however, the 665-kev gamma ray followed Weisskopf's formula, a large nuclear resonance scattering effect could be expected.

Ten milligrams of ZrO_2 enriched[6] in Zr^{96} were bombarded in the Brookhaven pile and yielded a 0.3-millicurie source of Zr^{97} and its daughter Nb^{97}. The gamma rays from this source were scattered alternately from Mo and Zr scatterers. The scattered radiation was observed with a scintillation spectrometer which accepted only pulses corresponding to the 665-kev photoelectron line. As the difference in atomic number between Zr and Mo is small, Rayleigh scattering from the two scatterers was almost the same. The small difference in Rayleigh scattering was determined in a separate experiment using the 663-kev gamma ray from Cs^{137}.

After correcting for the difference in Rayleigh scattering the counting rates for the Nb^{97} source with the Mo and Zr scatterers were identical, the experimental uncertainty being two percent.

If one assumes the contribution of the resonance scattering from the Mo scatterer to be two percent of the counting rate (i.e., equal to the uncertainty), and if one takes into account that only a small percentage of the gamma rays is emitted while the nucleus still has the momentum imparted to it by the beta ray,