Nucleus	Sr^{90}	Sr^{91}	Y^{90}	Y^{91}	Sb^{125}	Cs^{137}
$(W_0^2-1)ft\times 10^{10}$	0.4	0.7	0.3	0.8	1.1	1.8

The criterion fits Sr^{89} and K^{42}; in both cases shell model considerations support the assignment $\Delta I=\pm 2$ and change in parity. An excellent measurement of K^{42} has already been made by Siegbahn.[9] It disintegrates (Fig. 1) by negatron emission to the ground state of Ca^{42} and also to an excited state followed by a gamma-ray. We have analyzed Siegbahn's data for the high energy component with results shown in Fig. 2 both for an allowed FK plot and again as a forbidden FK plot wherein the factor G is included. The bulging curvature of the one and the near-straightness of the other confirm the above-stated criterion as well as those aspects of the shell model and of the Fermi theory of beta-decay which are involved in this example.

The shell model associates the odd configuration $(3d)^{-1}(4f)^3$ with the ground state of K^{42}. Similarly the even configuration $(4f)^2$ may be associated with the ground state of Ca^{42} (probably $I=0$) and with low excited states ($I=2$, 4, and 6). We suggest $I=2$ and even parity for the excited state of Ca^{42} observed in the K^{42} decay. The low energy transition is thus interpreted as first-forbidden with $\Delta I=0$.

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The Magnetic Moment of Be^9 *

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The ratio of the frequency of the nuclear magnetic resonance of Be^9 to that of the proton has been measured at 7000 gauss by the magnetic-resonance-absorption method of Pound, Purcell, and Torrey.[1] The magnet and radiofrequency bridges employed were those used by both Bitter[2] and Poss[3] in their recent nuclear-magnetic-moment determinations. However, the accuracy of the present measurement exceeds that of previous measurements with this equipment by about a factor of ten. This was accomplished by taking advantage of the almost integral ratio of the two frequencies and heterodyning the seventh harmonic of the Be^9 frequency with the fundamental of the proton frequency.

Both the proton and Be^9 resonances were obtained from a single sample consisting of an aqueous solution of beryllium fluoride. The sample container was a cylindrical section $\frac{1}{2}$-in. long and $\frac{1}{2}$ in. in diameter. The coil for the 4.2-Mc (Be^9 resonant frequency) bridge was wound around the cylinder, and the coil for the 30-Mc (proton resonant frequency) bridge was wound at right angles over the first. This technique has previously been used by F. Bitter and assures that the external magnetic field seen by the two types of nuclei is the same. The two resonances were traced on separate recording milliammeters as the magnetic field was slowly varied. The frequencies were adjusted so that the resonances occurred nearly simultaneously. From a calibration of the rate of change of magnetic field, a correction was made, when necessary, to take into account the small field differences separating the two resonances. This correction never exceeded 0.003 percent of the observed frequency ratio.

A total of ten determinations was made. From these the following value for the ratio of the resonant frequencies in the same magnetic field was obtained:

$$\nu(Be^9)/\nu(H^1)=0.1405187\pm 0.000002.$$

All ten values fall well within the above limits which were determined entirely by the uncertainty in locating the exact centers of the resonance curves.

Applying the Lamb[4] diamagnetic correction, and using the Millman and Kusch[5] value of the proton moment (2.7896 ± 0.0008) μ_N, the Be^9 magnetic moment is found to be

$$\mu(Be^9)=(-)(1.17619\pm 0.00034)\mu_N.$$

If, in agreement with more recent experiments, the more accurate value[6] of $(2.7926\pm 0.0006)\mu_N$, is taken for the proton moment, the following value is obtained:

$$\mu(Be^9)=(-)(1.17747\pm 0.00027)\mu_N.$$

It is to be noted that the uncertainties indicated for the Be^9 magnetic moment are determined by the uncertainty in the proton moment and not by that of the above frequency ratio.

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Paramagnetic Resonance Absorption in Crystals Colored by Irradiation

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Paramagnetic resonance absorption at 9350 mc produced by the irradiation of LiF with neutrons has been observed. Single crystals of LiF, which showed no resonance, were irradiated in a flux of approximately 10^{12} neutrons cm^{-2} for periods of time varying from 1 to 24 hrs. After irradiation, these crystals showed the resonance absorption described in Fig. 1, when placed at the midpoint of a resonant section of

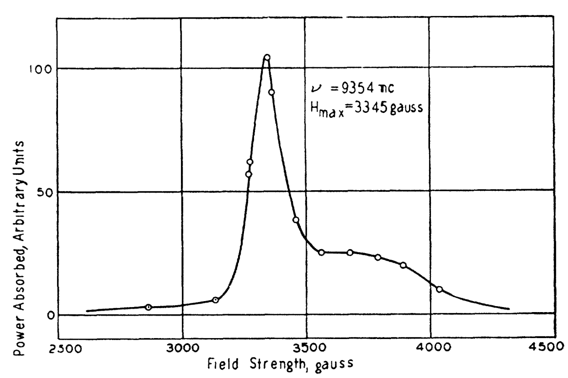

Fig. 1. Resonance absorption of LiF crystals after irradiation with neutrons.

rectangular wave guide oscillating in the $TE_{0,1,2}$ mode and the external field applied perpendicular to the wider dimension of the guide. The intensity of the effect observed after 24-hr. irradiation was less than that observed in an equal weight and volume of $CuSO_4 \cdot 5H_2O$ [1] by a factor of approximately 10. After 1-hr. irradiation, the effect was just slightly above the limits of observability. The width at half maximum absorption is approximately 160 gauss, and the absorption is asymmetric about the maximum. The maximum absorption occurred at a ratio of frequency to field strength identical with that for $MnSO_4 \cdot 2H_2O$ [1] within the error of measurement which is approximately 0.5 percent. Independent calibrations of the magnetic field and wave meter give the value, 2.00, for the ratio $h\nu/\beta H_{max} = g$. When the colored crystals were bleached by heating at 500°C, the paramagnetic resonance absorption disappeared completely. The effect has also been observed in KCl; the intensity is much less than in the LiF.

Attempts to correlate the growth and decay of the paramagnetic resonance absorption on irradiating and heating with the corresponding effects on the optical spectra encounter difficulties due to the intense colorations. E.g., the optical F band[2,3] at 2750A, supposedly due to trapped electrons, is so intense after irradiation times required for observation of the resonance that it cannot be measured in the thinnest crystals so far obtained.

The observed resonance is consistent with prevalent theories[4] of the trapping of electrons in negative ion vacancies to produce F centers. Other possible sources of such resonance are electrons trapped in other types of structure defects, free Li atoms, and free F atoms, all of which are quite probable consequences of the release of 4.6 Mev[5] per disintegration produced in the crystal. The problem of radiation-produced paramagnetic resonance is being investigated in some detail and a more complete account will be presented in the future.

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Neutron Capture γ-Rays from Cd*

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The neutron capture γ-rays from Cd^{113} have been studied by the cloud-chamber method in an attempt to determine the γ-ray energy distribution. A Cd target was placed in a neutron beam from the Oak Ridge National Laboratory pile; some of the resulting γ-rays entered a cloud chamber placed in a 1400-gauss magnetic field, where they struck a 0.0083 cm Pb foil and produced positron-electron pairs. Stereoscopic photographs were taken of the tracks and energy measurements were made by reconstructing the helical tracks through the optical system used in taking the pictures. For each pair of tracks measured an estimate was made of the various errors involved, namely: (1) multiple scattering error, (2) magnetic field error, (3) error due to electron energy loss in the Pb foil, and (4) errors of measurement due to finite track width, etc.

Each γ-ray measurement was then plotted as an appropriate error function of unit area so that when all measurements were completed the best estimate of the number of γ-rays found in any energy interval could be obtained by adding up all the area found in the interval. The energy interval widths were adjusted to give a constant probable counting error of 13 percent except at the ends of the distribution where the interval width was allowed to shrink to zero at $E_{max}+\Delta E_{max}$ and $E_{min}-\Delta E_{min}$ where the ΔE's are the resolution half-widths. This method of plotting, which allows both the counting errors and the resolution errors to dictate the amount of detail one is justified in seeing in the final distribution, will be described in more detail later.

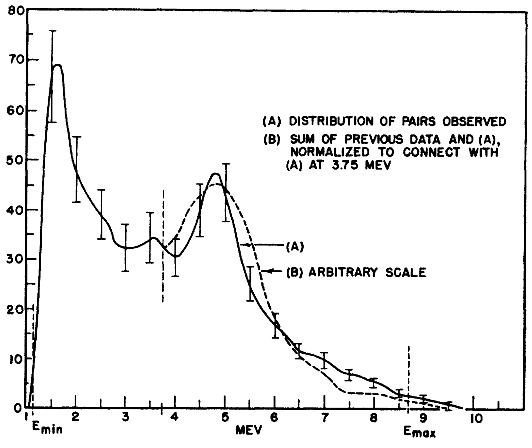

Fig. 1. (a) Distribution of pairs observed. (b) Sum of previous data and (a), normalized to connect with (a) at 3.75 Mev.

The first run** of pictures was taken under unfavorable background conditions which introduced many extraneous γ-rays from sources other than the Cd; a study of these background data showed that no reliable information could be obtained from the pictures for energies below 3.75 Mev. It was suspected that fast neutron effects were affecting the upper end of the distribution. For the second run the shielding against spurious γ-rays was improved and a set of background pictures was obtained in which every fifth picture was taken with a boron shutter placed in front of the neutron beam. This shutter allowed fast neutrons and pile γ-rays to pass through but stopped the slow neutrons. Thus every fifth picture showed the effect of all but slow neutron capture γ-rays from Cd. In this run No. 2, 8000 run-pictures and 2000 background-pictures were taken; 208 pairs were found in the run-pictures and no pairs were found in the background pictures. The energy distribution of the 208 pairs found is shown in Fig. 1(a) with the vertical lines shown in a few places to give a picture of the counting uncertainties. The highest energy measured in this run is noted on the curve as E_{max}. Run No. 1 in which background difficulties made the distribution uncertain below 3.75 Mev has been added to the part of 1(a) which lies above that energy. The result has been area-normalized and connected with the lower section of 1(a) and is shown as the dotted line of Fig. 1(b). Probable counting errors for 1(b) are $9\frac{1}{2}$ percent. An analysis of the average asymmetry in the division of the γ-ray energy between positrons and electrons has shown that in all energy intervals except 1–2 Mev the average splitting is roughly equal. Below 2 Mev the data are probably not as reliable since at these energies the probability may be appreciable that a low energy Compton electron ejected from the foil will curve back into the foil and be back-scattered into the chamber giving a spurious "pair." If this occurs frequently the average splitting of the energy of the γ-rays will be toward the positron side. This asymmetry was observed below 2 Mev.