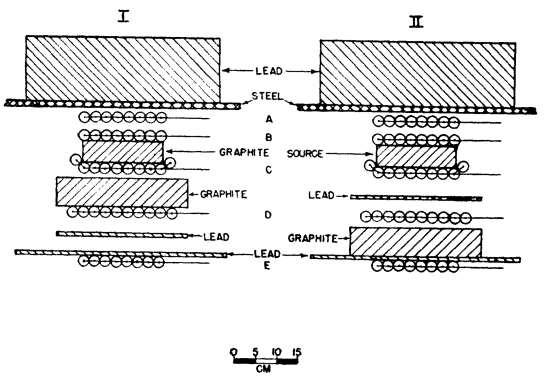

FIG. 2. Two arrangements which were alternated to compare production of bremsstrahlung in carbon (I) and lead (II). For the circuits see Fig. 1.

(3) The presence of bremsstrahlung adds to the difficulties of determining the *maximum* electron energy from absorption measurements;[1] it is clear, however, that to interpret our absorption curves, as well as Steinberger's, there is no need to invoke the presence of electrons of energy >50 Mev.

* The events $(BC)_{del}$ are also recorded and used to cancel some of the *chance* delayed events. Thus if $(CD)_{del}$, $(CE)_{del}$, etc., are accompanied by a discharge of B, they are disregarded: hence the appearance of $-B$ in all the significant rates.

** See also the rates $(CE-D-B)_{del}$ and $(CED-B)_{del}$ in the next experiment (Table I).

*** We have computed the total energy loss by radiation of electrons in the lead and carbon absorbers, as well as the "background" value (constant in both arrangements) of the energy radiated in the brass counter walls of tray C and in the carbon source itself. Assuming that the efficiency of tray E (together with the lead above it) for detecting a photon is proportional to the energy of the photon, the ratio of the $(CE-D-B)_{del}$ rates will be approximately equal to the ratio of the total energies radiated in the two cases.

[1] E. P. Hincks and B. Pontecorvo, Phys. Rev. **74**, 697 (1948); for a similar experiment see J. Steinberger, Phys. Rev. **74**, 500 (1948).

Nuclear Gyromagnetic Ratios of Be^9, Rb^{85}, Rb^{87}, and Cs^{133}

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December 24, 1948

USING the super-regenerative oscillator techniques described in recent notes,[1] we have observed magnetic resonance absorption by the nuclei Be^9, Rb^{85}, Rb^{87}, and Cs^{133} in aqueous solutions of salts. Preliminary results for the gyromagnetic ratios and magnetic moments of these nuclei are listed in Table I and within our present limits of accuracy are in fair agreement with previous results obtained by molecular beam methods.[2-4] It should be pointed out that our preliminary values are based on flux meter measurements of the magnetic fields; the flux meter was calibrated in terms of the proton resonance and we believe the values listed in Table I are accurate to one part in 300. In every case the observed resonance peak was considerably narrower than the corresponding peak obtained in molecular beam experiments. We plan to attempt to improve the accuracy of our results by making simultaneous measurements of the resonance frequency for each nuclear species and the resonance frequency for the proton in the same magnetic field.

One or two remarks about the observed resonance peaks may be in order. The Be^9 peak as observed for a solution of $BeCl_2$ is quite strong, and no difficulties are anticipated in making the proposed direct comparison with the proton peak. An interesting result of our studies of rubidium is that the intensity of the peak observed for the less abundant isotope Rb^{87} is greater than that of the peak observed for the more abundant isotope Rb^{85}. The peak observed for Cs^{133} was weak, and considerable difficulty is anticipated in making the direct comparison with the proton peak.

TABLE I. Preliminary results for gyromagnetic ratios and magnetic moments.

Nucleus	Gyromagnetic ratio g	Spin	Magnetic moment μ
Be^9	0.783	—	—
Rb^{85}	0.536	5/2	1.34
Rb^{87}	1.83	3/2	2.74
Cs^{133}	0.734	7/2	2.57

The work reported here was made possible by research grants from the Ohio State University Development Fund and from the Graduate School.

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[1] J. R. Zimmerman and D. Williams, Phys. Rev. **74**, 1885 (1948), and **75**, 198 (1949).
[2] P. Kusch, S. Millman, and I. I. Rabi, Phys. Rev. **55**, 666 (1939).
[3] P. Kusch and S. Millman, Phys. Rev. **56**, 527 (1939).
[4] P. Kusch, S. Millman, and I. I. Rabi, Phys. Rev. **55**, 1176 (1939).

The Chain $_{56}Ba^{130}(n,\gamma)_{56}Ba^{131}\rightarrow_{55}Cs^{131}\rightarrow_{54}Xe^{131}$

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THE above chain was studied by Katcoff[1] who made the mass assignment of the chain, determined the half-lives, and studied some of the radiation characteristics of the members. Fu-Chun Yu, Gideon, and Kurbatov[2] examined the disintegration schemes of the members of the decay chain. Katcoff gives the decay of Cs^{131} (10.2-day half-life) as occurring by orbital capture, without γ-ray emission. Kurbatov *et al.* find a half-life of 10 ± 0.3 days in fundamental agreement with that of Katcoff. However, they also find an intense radiation of electrons of 112 kev which were identified as conversion electrons of a 145-kev γ-ray emitted by Cs^{131} and estimate its conversion to be about 97 percent. Finkle[3] found that neither Ba^{131} nor Cs^{131} emits positrons.

During the course of irradiation of natural barium we had occasion to examine the above chain. The barium was removed from the cesium by five carbonate precipitations

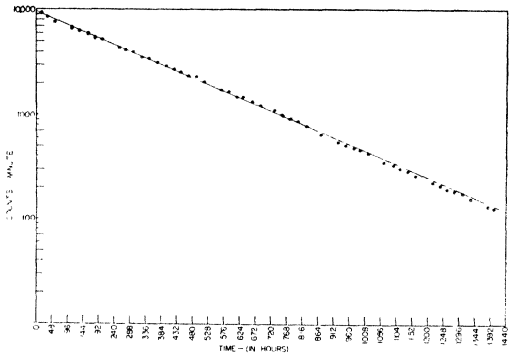

FIG. 1. Decay curve Cs^{131}.

using cesium and barium carriers. The cesium was then separated as the perchlorate and exhaustively purified.

The half-life was measured over a period of six half-lives and found to be 9.6±0.1 days by the method of least squares. The decay curve is shown in Fig. 1. We find, in great abundance, a soft radiation which may be ascribed to the conversion electrons found by Kurbatov *et al.* An absorption curve in aluminum is shown in Fig. 2. This consists of two components, the softer of which is replotted on a larger scale. Assuming that the softer radiation may be treated as though it were similar to a continuous spectrum of β^--radiation, the energy has been determined by back-scattering[4] and found to be 115 kev. The harder component has a half-thickness of 700 mg/cm² and is identical with the 31-kev x-ray found by Katcoff.

If P = the number Ba^{130} atoms irradiated, Q = the number Ba^{131} atoms formed, R = the number Cs^{131} atoms formed, σ = the cross section of Ba^{130} for capture, ρv = neutron flux, t = duration of irradiation, and λ and λ' are the disintegration constants for Ba^{131} and Cs^{131}, respectively, then

$$\sigma = \frac{R}{\rho v P[[(1-e^{-\lambda' t})/\lambda'] - [(e^{-\lambda t} - e^{-\lambda' t})/(\lambda' - \lambda)]]}.$$

The Cs^{131} activity obtained was corrected for decay elapsing between removal of the sample from the pile and chemical separation, time elapsing between chemical separation and measurement, chemical recovery, counter efficiency, absorption in sample, in counter window and in air gap between counter window and sample, and back-scattering from tray. The flux was experimentally determined using La^{139}. Its cross section has been taken to be 8.4 barns.[5]

Assuming that the Cs^{131} γ-ray is 97 percent converted, the cross section for neutron capture of Ba^{130} has been found to be 24±8 millibarns.

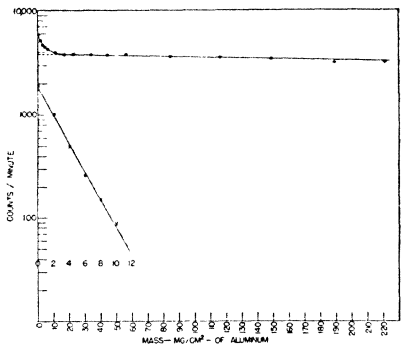

FIG. 2. Cs^{131} absorption curve using aluminum.

[1] Seymour Katcoff, Phys. Rev. **72**, 1160 (1947).
[2] Fu-Chen Yu, D. Gideon, and J. D. Kurbatov, Phys. Rev. **71**, 382 (1947).
[3] Bernard Finkle, Phys. Rev. **72**, 1260 (1947).
[4] L. Yaffe and K. M. Justus, Phys. Rev. **73**, 1400 (1948).
[5] L. Seren, H. N. Friedlander, and S. H. Turkel, Phys. Rev. **72**, 888 (1947).

Table of Interplanar Spacings for Different Target Materials for the Back Reflection Region

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January 3, 1949

A TABLE has been computed to expedite the reduction of diffraction patterns obtained in the back reflection region and may be considered a continuation of Research Report R-94602-10-C.

The table gives d values for Mo, Cu, Co, Fe, and Cr targets for every tenth of a degree in 2θ, or five hundredths of θ, to four and five significant figures. The values of the interplanar spacings, d, are computed from the Bragg equation: $n\lambda = 2d \sin\theta$ where θ is the glancing angle, λ the wave-length of the diffracted target radiation, and n is taken as unity. The table is computed in angstrom units for the $K\alpha_1$ radiation and factors are given for converting these spacings to those for $K\alpha_2$ and $K\alpha$. Conversion curves from $K\alpha_1$ to kx units are also given for all five target materials over the angular range.

The tables may be obtained directly from the author.

On Mesons π and μ

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December 23, 1948

SEVERAL papers have recently appeared[1-3] which raise certain doubts about the two-meson hypothesis proposed by the author[4] in order to explain the contradictory behavior of high altitude and sea-level mesons. It seems worth while to clarify the fundamental ideas of the two-meson theory and to discuss briefly its status in the light of the latest experimental results.

The two-meson hypothesis stated: (1) the mesons produced with large cross section at high altitudes are different from the majority of weakly interacting sea-level mesons, (2) the high altitude mesons are strongly coupled to