gamma-ray is strongly internally converted, and the conversion electron and following x-ray or Auger electrons are detected, simultaneously, with the beta-ray, and produce a pulse 80 kev larger than the beta-ray. If 80 kev is subtracted from the apparent energy of the spectrum points, and a new Kurie plot is made, curve B results with an end point at 255±10 kev. For confirmation, the gamma-spectrometer was set to 675 kev and the beta-coincidence spectrum run. The remaining number of counts was small, but the Fermi-Kurie plot of the results is shown in curve C. The endpoint is 255±15 kev. This seems to confirm the lower beta-ray energy and establishes the position of the 720-kev transition in the decay scheme.

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[1] Zeldes, Brosi, and Ketelle, Phys. Rev. **81**, 642 (1951).

[2] K. Way *et al.*, Nuclear Data, Nat. Bur. Standards (U. S.), Circ. 499 (1950).

[3] Kern, Mitchell, and Zaffarano, Phys. Rev. **76**, 94 (1949).

[4] B. H. Ketelle, Phys. Rev. **80**, 758 (1950).

On the Magnetic Moments of Mg^{25}, Re^{185}, Re^{187}, and Be^9

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Using the nuclear induction spectrometer,[1] the magnetic moments of Mg^{25}, Re^{185}, and Re^{187} have been determined. The values of the magnetic moments listed in Table I were computed directly from the measured frequency ratios, and the values of the magnetic moments of N^{14} and Na^{23} were used for the comparison without corrections of any kind.

Table I. Magnetic moments.

Nucleus	Magnetic moment in nuclear magnetons
Mg^{25}	-0.85466 ± 0.00015
Re^{185}	3.1433 ± 0.0006
Re^{187}	3.1755 ± 0.0006
$\mu(Re^{187})/\mu(Re^{185})=1.01026\pm0.00008$	

From the optical hfs method the nucleus Mg^{25} was known to have a spin value 5/2 and its magnetic moment was determined to be[2] -0.96 ± 0.07 nm. Using a magnetic field of 11,000 gauss and a sample of 4.6-molar solution of $MgCl_2$ in water, the resonance of Mg^{25} was located near a frequency of 3.9 Mc. Comparing the resonance frequency of Mg^{25} with that of N^{14} from a sample of concentrated HNO_3, we found

$$\nu(Mg^{25})/\nu(N^{14})=0.84714\pm0.00008. \tag{1}$$

The sign was verified to be negative. Taking the value 5/2 for the spin of Mg^{25}, the frequency ratio (1) leads to

$$\mu(Mg^{25})=-0.85446\pm0.00015 \text{ nm} \tag{2}$$

for the magnetic moment of Mg^{25} which is in good agreement with the spectroscopically determined value. In computing the value (2), we have made use of the value 0.40355 ± 0.00005 nm for the magnetic moment of N^{14}, which is different from the value 0.40369 ± 0.00006 nm reported by Proctor and Yu.[3] This is due to the fact that the newly determined value[4]

$$\mu(P)=2.79245\pm0.00020 \text{ nm} \tag{3}$$

for the proton moment was used instead of the value 2.79348 ± 0.00034 nm obtained by Taub and Kusch.[5]

The two isotopes Re^{185} and Re^{187} of rhenium were investigated by Schüler and Korsching.[6] From the hfs of the line λ4889 in the ReI spectrum, they obtained the ratio

$$\mu(Re^{187})/\mu(Re^{185})=1.02069\pm0.00043 \tag{4}$$

for the magnetic moments of Re^{185} and Re^{187}. In the present investigation, we have used a sample of an aqueous solution of the compound $NaReO_4$. As in the case of MnO_4^-, the ReO_4^- ion was presumed to be only feebly paramagnetic. The perturbation caused by a strong magnetic field at the position of the rhenium nucleus due to strong paramagnetism could thus be avoided. On the other hand, no resonance could be found with a water solution of the paramagnetic compound K_2ReCl_6. The two resonances of Re^{185} and Re^{187} were located near a frequency of 6.4 Mc in an external field of 6700 gauss. Their resonance frequencies were compared with that of Na^{23} from a 0.25-molar aqueous solution of NaCl with 1 molar of $MnSO_4$. We obtained

$$\nu(Re^{187})/\nu(Na^{23})=0.85987\pm0.00009, \tag{5a}$$

$$\nu(Re^{185})/\nu(Na^{23})=0.85114\pm0.00009, \tag{5b}$$

$$\nu(Re^{187})/\nu(Re^{185})=1.01026\pm0.00008. \tag{5c}$$

The sign of the magnetic moment was verified to be positive for both isotopes. Since both Re^{185} and Re^{187} are known[7] to have a spin 5/2, the ratio (5c) is equal to the ratio of their magnetic moments, which agrees very well with the hfs value (4). Taking the spin value 5/2 and the value 2.2158 ± 0.0003 nm for the magnetic moment of Na^{23}, we obtained the values of the two magnetic moments of rhenium listed in Table I. The value of the magnetic moment of Na^{23} was computed from the proton moment (3) and the frequency ratio $\nu(Na^{23})/\nu(P)$ given by Bitter.[8] Both rhenium isotopes possess a large quadrupole moment. The interaction of this quadrupole moment with the molecular electric fields gave a line width of about 10 gauss for both rhenium signals. The magnitude of these signals was very much enhanced by using an rf field of about 3 gauss.

In the course of these measurements, we have also investigated the sign of the magnetic moment of Be^9 with the use of an aqueous solution of $Be(NO_3)_2$. An earlier and, as it seems to us, unambiguous determination by Rabi and his co-workers[9] gave the sign to be negative; nevertheless, it is listed in the table compiled by Mack[10] with a question mark. Our result fully confirms the correctness of the above-mentioned earlier assignment.

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[1] W. G. Proctor, Phys. Rev. **79**, 35 (1950).

[2] Crawford, Kelly, Schawlow, and Gray, Phys. Rev. **76**, 1527 (1949).

[3] W. G. Proctor and F. C. Yu, Phys. Rev. **81**, 20 (1951).

[4] F. Bloch and C. D. Jeffries, Phys. Rev. **80**, 305 (1950).

[5] H. Taub and P. Kusch, Phys. Rev. **75**, 1481 (1949).

[6] H. Schüler and H. Korsching, Z. Physik **105**, 168 (1937).

[7] Zeeman, Gisolf, and de Bruin, Nature **128**, 637 (1931).

[8] F. Bitter, Phys. Rev. **75**, 1326 (1949).

[9] Kusch, Millman, and Rabi, Phys. Rev. **55**, 666 (1939).

[10] J. E. Mack, Revs. Modern Phys. **22**, 64 (1950).

On the Nuclear Interaction of π^- Mesons in Nuclear Emulsions*

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The preliminary analysis of the nuclear interactions produced by π^- mesons in nuclear emulsions has been extended to the kinetic energy range of 70–90 Mev. Results are here presented on the nuclear stars, scatterings, and stoppings in flight observed in this energy range.

The experimental arrangement was similar to that already used for mesons of kinetic energy of 30–50 Mev.[1] The G-5 plates were exposed directly to the external meson beam (KE=95±5 Mev) of the Nevis cyclotron. Because of ionization losses suffered in traversing the glass and emulsion, the corresponding energies of mesons studied ranged between 70 and 90 Mev. Only those tracks entering the emulsion from the proper direction and longer than 500 microns were accepted in the analysis. The average grain density of the allowed tracks as compared to the minimum was found to be 1.18±0.07, in agreement with that expected for