Letters to the Editor

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Nuclear Magnetic Moment of Sc^{45}

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RESONANCE in Sc^{45} has been found in a saturated (~0.1 molar) acid solution of $ScCl_3$, and the magnetic moment measured as 4.7560±0.0002 nuclear magnetons. The search was conducted by slow, automatic variation of the magnetic field, which was stabilized to about one part in 100,000. A twin-T bridge with lock-in amplifier and recording meter having a 2-sec. response time was used; the signal-to-noise ratio was about 20.

The proton signal for comparison was produced by a regenerative detector; the two samples were adjacent in the magnetic field, and allowance was made for the small difference between the fields at the two samples, amounting to about 0.006 percent.

The frequency ratio so obtained is $Sc/H = 0.242939 \pm 0.000003$. Using the value 5.58494±0.00016 of Hipple, Sommer, and Thomas[1] for the gyromagnetic ratio of the proton, and including a diamagnetic correction of 0.151 percent, the gyromagnetic ratio of Sc^{45} is found to be $g(Sc^{45}) = 1.35885 \pm 0.00005$.

Since the spin[2,3] is 7/2, the magnetic moment is as quoted above. The spectroscopic value +4.8 obtained by Kopfermann and Wittke[4] is in very good agreement with this.

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Search for Nuclear Energy Levels in C^{13} *

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IN 1935 Paton[1] determined the energies of four groups of protons produced by the bombardment of boron with alpha-particles. Two of these groups were believed to correspond to levels of the residual nucleus in the $B^{10}(\alpha,p)C^{13}$ reaction at 4.9 and 6.0 Mev excitation energies.[2] Investigating the same reaction using enriched B^{10} samples, Creagen[3] reported possible evidence for a level in C^{13} at 5.6 Mev. One might expect that these levels would also appear as resonances in the total cross section of carbon for fast neutrons. Earlier measurements of this cross section[4-6] did not show resonances corresponding to these levels, but there was a possibility that narrow resonances had been missed because of the wide spacing of the experimental points.

In the present investigation the total cross section of carbon for fast neutrons was determined for neutron energies between 20 kev and 1360 kev. By means of a transmission experiment of the type previously described,[7] the cross section was measured with neutrons produced by the $Li^7(p,n)Be^7$ reaction. The neutron energy spread was about 13 kev below 900 kev neutron energy and 20 kev above this energy. Experimental points were taken at intervals of 10 kev below 900 kev and 22 kev above this energy. A smooth monotonic decrease in the total cross section from 4.8 barns at 20 kev neutron energy to 2.4 barns at 1360 kev neutron energy was obtained. Throughout this energy region the standard statistical error in the cross section was less than five percent. The observed total cross section agrees with the results of the Minnesota group[5,8] and of Wattenberg[4] to within three percent, except for one point obtained by Lampi *et al.*,[5] at 1340 kev which is nine percent lower than the present measurement.

If resonances were to be observed corresponding to possible levels in C^{13} listed by Hornyak and Lauritsen[9] at 5.0 and 6.0 Mev excitation energies, they should appear at neutron energies of 130 kev and 1210 kev. On the basis of Breit-Wigner resonance theory, the variation in cross section for such resonances should be at least 24 barns and 2.5 barns respectively. No resonances were observed; the maximum deviation of the experimental points from the smooth curve was about 0.5 barn for neutrons below 400 kev and about 0.2 barn above this energy. On the basis of the resolution used, it may be estimated that the natural width of such levels if they exist is less than five kev.

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Detection of Magnetic Resonance by Ion Resonance Absorption

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BY combining the techniques of nuclear resonance absorption[1] and the omegatron,[2] the cyclotron resonance of H_2^+ ions has been observed dynamically with an oscillating detector[3] coupled directly to an oscilloscope.

If an r-f voltage satisfying the cyclotron relationship $\omega = eH/Mc$ is applied to two parallel plates between which ions are produced and trapped as in the omegatron,[2] the ions will absorb energy from the r-f field. If these parallel plates are made part of the capacitance of a parallel resonant circuit, the energy absorbed by the ions can be detected in exactly the same manner as nuclear resonance absorption. Whereas nuclear resonance absorption is detected by the power absorbed in the inductance, the cyclotron resonance here described produces a power loss in the capacitance.

While no effort was made to obtain maximum sensitivity, it can be shown that this method of detection is considerably more sensitive than detection of a resonance directly by collecting the resonant ions. Assuming that the least ion current that can be detected with an electrometer is 10^{-15} amp. and that the H_2^+ ions have a final energy corresponding to 500 v, calculations show that the increase in signal-to-noise ratio using ion resonance absorption should at least be of the order of 50. This could be improved by increasing the size of the tube or the magnetic field intensity.

The sensitivity, simplicity, and speed of response of this method of detection should make it highly desirable for any application where the principle of the omegatron might be used, such as high resolution mass analyzers, analytical mass spectrometers, and mass spectrometer type leak detectors. Furthermore, the ion resonance absorption method of detection makes possible the use of the omegatron for measuring and regulating weak magnetic fields by applying the same techniques used with nuclear resonance absorption.

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