breaks in ionization efficiency curves; however, there is no doubt that sizable N^+ currents have been found[10] below 40 eV. Probably these ions result from secondary reactions rather than from primary electron-molecule interactions. The pressures are higher (10^{-5}-10^{-4} Torr), and ion removal times are longer in mass spectrometers than in our apparatus, but it is likely that the secondary reactions leading to the N^+ currents involve molecules adsorbed on surfaces near the ion production region. Marmet and Morrison[11] have recently adduced striking evidence of the importance of wall effects to the ion currents in mass spectrometers. Moore[12] has observed similar effects. It is known that during molecular collisions a number of the selection rules do not rigorously hold, and forbidden predissociations can occur.[13] An adsorbed gas layer can play the same role as a gas at a pressure much higher than that existing in the interaction volume; secondary interactions can occur very rapidly at the wall and thus compete with the short radiative lifetimes of excited N_2^+ states to induce the (forbidden) predissociations.

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NUCLEAR MAGNETIC DIPOLE MOMENT OF Ca^{41} †

E. Brun,* J. J. Kraushaar, and W. L. Pierce‡
Physics Department, University of Colorado, Boulder, Colorado

and

Wm. J. Veigele
The Martin Company, Denver, Colorado

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The properties of the nuclide Ca^{41} are of particular interest because it is one of relatively few nuclides consisting of just one nucleon outside closed shells of neutrons and protons, and should, therefore, be more amenable to theoretical treatment than is the usual case. Although the spin and parity of the ground state have been assigned[1] as $\frac{7}{2}-$ on the basis of the decay by electron capture and various reaction studies and are in agreement with the shell model prediction of $f_{7/2}$, the absence in nature of this radioisotope ($T_{1/2} = 1.1 \times 10^5$ years) has hindered studies of its magnetic properties.

We have observed the nuclear magnetic dipole spin resonance of Ca^{41} in a saturated $Ca(NO_3)_2$ aqueous solution. The calcium used in the preparation of the sample had been enriched to 99.98% Ca^{40} and then exposed to a total time-integrated flux of 2.39×10^{21} thermal neutrons/cm^2 in the ETR at Idaho Falls, Idaho. Using a value of 0.22 barn for the (n_{th}, γ) cross section of Ca^{40}, the relative isotopic abundance of Ca^{41} in the irradiated calcium was calculated to be 5.3×10^{-4}. A small amount of cobalt acetate was added to the calcium nitrate solution to relax the nuclear spins, and a Varian, crossed-coil, c.w. spectrometer with a twelve-inch magnet was used to search for the Ca^{41} resonance, in the absorption mode.

The values of modulation field and rotating H_1 field were set at 0.5 gauss (at 80 cycles/second) and about 1 gauss, respectively, these values having been empirically determined as approximately optimum for the Ca^{43} resonance in a similar, saturated, natural calcium nitrate plus cobalt solution. (The relative isotopic abundance of Ca^{43} in natural calcium is 13×10^{-4}.) Using a transmitter frequency of four megacycles/second and a scanning rate of about 16 gauss/hour, the Ca^{41} resonance was found at a field of approximately 11.5 kilogauss after only ten hours of searching. The signal to noise ratio was about four, and the sign of the signal, relative to a Cl^{37} reference resonance, which was only a few gauss away, indicated a negative moment. The magnetic field was continuously monitored with a Varian F-8 fluxmeter using a deuteron probe. All frequencies were measured with a Hewlett-Packard 524C counter.

The amplitude of the Ca^{41} nuclear induction signal, relative to a Ca^{43} signal in a similar environment, is consistent with a nuclear spin quantum number of $\frac{7}{2}$, and cannot easily be reconciled with any other spin differing by as much as one unit from this value. The ratio of the Ca^{41} resonance frequency to that of the deuteron in the same field was $\nu(Ca^{41})/\nu(D^2) = 0.530631 \pm 0.000003$, implying an uncorrected nuclear magnetic dipole moment of -1.59235 ± 0.00002 nm for Ca^{41}, using the values $\mu(H^1)/\mu(D^2) = 3.2571999 \pm 0.0000012$[2] and $\mu(H_1) = 2.79268 \pm 0.00003$ nm.[3] If one takes into account the diamagnetic shielding of the nucleus by the orbital electrons,[4] one obtains a value $\mu(Ca^{41}) = -1.5946$ nm.

The extreme single-particle model (Schmidt model), which seems to work well for some other nuclei analogous to Ca^{41}, notably O^{17}, predicts a magnetic moment of -1.913 nm for Ca^{41}, a value whose magnitude is 20% too large. In order to explain similar deviations from the Schmidt values, de-Shalit[5] and others assumed a quenching mechanism for bound nucleons which reduces the magnetic moments of both protons and neutrons from their free-nucleon values. If the effective moments for the various single-particle states can be determined, the magnetic moments of nuclei whose configuration mixing due to residual proton-proton or neutron-neutron interactions is absent can be calculated. Using empirical data for K^{40}, de-Shalit predicted a magnetic dipole moment of -1.65 ± 0.03 nm for Ca^{41}, a value fairly close to the actual moment. Following the ideas of de-Shalit, the magnetic moments of Ca^{41}, K^{39}, K^{40} can be compared, and they yield a good consistency test. We assume that Ca^{41} and K^{39} have pure single-particle ground states, $\nu(f_{7/2})$ and $\pi(d_{3/2})$, respectively. The effective moments of the odd nucleons are equal to the measured magnetic moments of Ca^{41} and K^{39}. Hence, $\mu_{\text{eff}} = 0.3914$ nm for a $d_{3/2}$ proton, and $\mu_{\text{eff}} = -1.5946$ nm for an $f_{7/2}$ neutron. If we furthermore assume that in K^{40} a $\pi(d_{3/2})$ and a $\nu(f_{7/2})$ state are coupled to form a state with total angular momentum $I = 4$, the above effective moments yield $\mu_{\text{calc}} = -1.2492$ nm for K^{40}, a value in reasonable agreement with the actual moment of $\mu_{\text{exp}} = -1.2981$ nm.

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*On leave from Physics Department, University of Zürich, Zürich, Switzerland.

‡Presently at Physics Department, Oregon State University, Corvallis, Oregon.

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