sult in sign and approximately in magnitude. The difference may be attributed to film preparation or to the fact that our measurement is localized to the Fermi surface (±0.001 eV) whereas theirs is an average over an energy region of 0.4 or 0.8 eV.

It is certainly premature to take completely seriously the numerical value for the polarization of the carriers of Ni obtained by this simple analysis. Tunneling into strongly interacting *s* and *d* bands is unlikely to fit such a simple model. However, it appears that this method of spin-dependent tunneling should develop into a useful tool for studying spin-dependent energy states in magnetic materials.

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Magnetic Monopole Transitions in Electron Scattering

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The electroexcitation cross section for the second-order magnetic monopole transition $0^+ \rightarrow 0^-$ has been calculated in ^{16}O. It is assumed that the spectrum of intermediate excited states is complete and that energy loss may be neglected. If these approximations are valid, it should be possible to observe this transition.

The subject of dispersion corrections in electron scattering has recently been treated in several theoretical and experimental papers,[1-14] mainly for elastic scattering. Such effects are described by diagrams in which two or more virtual photons are exchanged between the electron and the nucleus, with the intermediate nucleus virtually excited. Due to the increased accuracy possible in electron-scattering experiments, such effects are, in principle, observable, possibly showing up as an energy dependence in the charge-density parameters. However, the calculations have indicated that at least for the case of high-energy electrons the dispersion effects are predominantly a function of momentum transfer.[6] This makes it possible to describe the dispersion effect as a small, complex, energy-independent correction to the scattering potential.[7] The situation is not so clear at lower electron energies where the calculations are strongly model dependent. Furthermore, it is difficult to justify neglecting the nuclear excitation energy, which has been done in most of the previous work.

An attempt has been made to interpret the results obtained at low and high energies in terms of dispersion corrections.[10,12-14] However, because of the extremely crude approximations made in the theoretical analysis it is not entirely clear at the present time whether such an interpretation is valid. For this reason it would be of interest to have an experiment the results of which could be unambiguously interpreted as due to dispersive effects. Such an experiment would be the observation of a magnetic monopole transition in electron scattering, which is strictly forbidden in first-order Born approximation and can proceed only through the virtual excitation of intermediate nuclear states.

For this reason we have estimated the cross section for the electroexcitation of the 10.9-MeV 0^- level in ^{16}O. Considerations of angular momentum and parity forbid this transition by one-photon exchange. However, it can proceed by a two-step process in which the nucleus is first excited by an $E\lambda$ transition and then deexcited by an $M\lambda$ transition or vice versa. The state under consideration is given in the shell model[15] by the relatively pure configuration $(1p_{1/2})^{-1}2s_{1/2}$.

As a first approximation we have calculated the cross section in second-order Born approximation using plane waves for the electron wave functions and assuming that the excitation spectrum of the nucleus is described by quasielastic scattering.[16] In this model a particle in the $1p_{1/2}$ state is lifted into the continuum, described by plane waves, and then drops into the $2s_{1/2}$ state. The dominant contribution can be described by an interaction with the charge density plus an interaction with the magnetization density (angular-momentum arguments can be used to show that the convection current does not contribute). Terms involving two interactions with the current density are expected to be of relative order q/M, where q is the momentum transfer and M the nucleon mass. If the energy loss is neglected, it is possible to use closure and to obtain an extremely simply analytic expression for the cross section, namely,

$$d\sigma/d\Omega=\sigma_M 4\alpha^2(E^2/M^2)\mu_p^2\sin^4(\tfrac{1}{2}\theta)[\pi^2+4\sin^2(\tfrac{1}{2}\theta)][\int R_{2s}(r)j_1(qr)R_{1p}(r)r^2dr]^2, \quad (1)$$

where σ_M is the Mott cross section, θ is the scattering angle, E is the energy of the electron, and $\mu_p=2.79$ is the magnetic moment of the proton.[17] The radial integral describes the transition between the $1p_{1/2}$ and the $2s_{1/2}$ states and may be evaluated for harmonic oscillator wave functions[18] with the result

$$\int R_{2s}(r)j_1(qr)R_{1p}(r)r^2dr=-\tfrac{2}{3}x^{1/2}(1-x)e^{-x}, \quad (2)$$

where $x=(qr_0/2)^2$. The oscillator parameter r_0 for ^{16}O has been obtained from elastic electron scattering[19] and is equal to 1.76 fm. Values of the cross section are given in Table I for several energies and angles. We note at this point that exactly the same cross section is obtained for electroexcitation of the $T=1$ state at 12.8 MeV. It is probably more difficult to observe this level, because it is higher in the continuum and has a considerably larger width.

The cross section given in Eq. (1) has been derived under numerous approximations, which, however, are often made in the calculation of dispersive effects. In particular, use of the closure approximation is not expected to be good below 100 MeV.[20]

Table I. The differential cross section $d\sigma/d\Omega$ for electroexcitation of the 10.9-MeV 0^- level in ^{16}O as a function of electron energy E and scattering angle θ. The cross section is given in units of 10^{-36} cm^2.

E (MeV) \ θ	30°	60°	90°
50	0.51	1.42	1.71
100	1.63	3.02	1.69
150	2.97	1.99	0.03
200	3.49	0.29	0.50

The value of the cross section is determined mainly by the behavior of the radial integral, which has a maximum value for momentum transfer $q\approx 0.54$ fm^{-1}. The additional angular dependence is given approximately by $\cos^2(\tfrac{1}{2}\theta)$. With the newer linear accelerators it is possible to measure cross sections of the order of magnitude given in Table I. Since the width of the 0^- level is small[21] (it decays by γ emission), it should be possible to observe this level with a high-resolution experiment. Although such an experiment is extremely difficult, it would be of interest, because it sheds further light on the magnitude of the dispersive effects and perhaps also on the validity of the various approximations usually made in the calculations.

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Upper Cutoff in the Spectrum of Solar Particles

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Arguments are advanced in favor of the existence of an upper cutoff in the spectrum of solar protons. In the case of the event of 28 January 1967, on the basis of the recordings made by the worldwide network of neutron monitors, this cutoff is found to be 4.3 ±0.5 GeV.

The purpose of this Letter is to show that an upper cutoff exists in the spectrum of solar protons. By upper cutoff is meant an energy level beyond which there are no accelerated particles. The extensive work done in the last fifteen years on solar proton events has seldom mentioned the existence of this cutoff notwithstanding the fact that this quantity is a useful parameter for studying the mechanisms of particle acceleration.

The method resorted to consists in using the worldwide network of neutron monitors as an energy spectrometer while adding the presence of a maximum energy in the proton spectrum. Mountain stations were ignored. The percentage increases were related to a pressure of 760 mm Hg by a double correction of the barometric effect. The method of Palmeira, Bukata, and Gronstal[1] was applied with the following attenuation lengths: $\lambda g = 140$ g/cm^2 for galactic particles; $\lambda f = 103$ g/cm^2 for solar particles.[2] With this correction made, the percentage increase F_2 for a neutron monitor may be formulated as follows[1]:

$$F_2 = \frac{A_1}{N_g}\int_{P_c}^{\infty}\left(\frac{dj}{dP}\right)_f S(P)dP, \qquad (1)$$

where A_1 is a constant, N_g the counting rate due to galactic cosmic rays with a standard neutron monitor located in a place of magnetic rigidity P_c, P the magnetic rigidity of the protons, $(dj/dP)_f$ the differential spectrum of the solar protons, and $S(P)$ the proton specific-yield function. Here we use for N_g the values obtained by Carmichael et al.[3] during their latitude survey in North America in 1965, and for P_c the values calculated by Shea et al.[4] Use is made of Lockwood and Webber's specific-yield function.[5] In order to simplify numerical calculations, this function is represented by power laws in different rigidity bands. Lastly, when considering the existence of a cutoff P_m in the differential spectrum under the power law, we may write

$$F_2 = (A_2/N_g)\int_{P_c}^{P_m} P^{-\mu} S(P)dP. \qquad (2)$$