gularities very closely. Apparently the coupling to the acoustical branches is stronger than that to the optical ones, for there is no structure resolved in the optical region. Also, there is very little structure in the two and more phonon parts of the spectrum. This is to be expected since widths of bands arising from dispersion of frequencies would be increased proportionally to the number of phonons involved. For other crystals no neutron-diffraction data are available, but a comparison with calculated phonon spectra[5] shows that the maxima correspond to the acoustical region.

Figure 3 shows the phonon spectra for KI:KNO_2 and NaBr:NO_2. The sharp line at 70 cm^{-1} in KI:KNO_2^- differs from the other phonon structure in sharpness; even the corresponding three-phonon line is resolved at 206 cm^{-1}. We estimate that any width arising from dispersion for this line is less than 2 cm^{-1}. Its position is in the energy gap between the acoustical and optical branches of KI, as suggested by the calculations of Karo and Hardy.[5] It is possible that this line is due to a local mode in the gap. Such modes have been discussed in the literature[6] and, for our case of a light mass substituted for the normally heavier mass, the local mode would be possible in the gap, provided the force constants are not too small. There is a similar sharp line at 138 cm^{-1} in NaBr:$NaNO_2$.

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ANALYSIS AND INTERPRETATION OF H^3 AND He^3 FORM FACTORS*

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Recently the electric and magnetic-moment form factors of H^3 and He^3 have been measured by Collard and Hofstadter[1] and Collard et al.[2] The form factors have then been analyzed by Schiff et al.[3] and Levinger[4,5] under various assumptions to obtain independent determinations of the charge form factor of neutron and other quantities such as the exchange magnetic-moment form factors and F_0 and F_L. The charge form factor given by Schiff et al.[3] is consistently smaller than that obtained from the electron-scattering experiments with deuteron,[6,7] while that given by Levinger is larger (Fig. 1). Further, Schiff et al.[3] introduced the S' state of mixed spatial symmetry in the nuclear wave function, giving large difference in F_0 and F_L, which is in contradiction with other observations.[8,9] In both above analyses the contributions from meson-exchange currents to the charge form factors of H^3 and He^3 have been neglected.

The aim of this Letter is to report an analysis of the form factors of H^3 and He^3, assuming that the contributions of the meson-exchange currents to the charge form factors of H^3 and He^3 is not negligible. It follows from Siegert's theorem[10] that the static electric multipole moments of nuclei are independent of any exchange currents. We shall therefore normalize the exchange charge form factors of H^3 and He^3 to zero momentum transfer.

Following Schiff[11] we write down the following general expressions for the three-dimensional Fourier transforms of the charge and moment distributions of H^3 and He^3:

$$2F_{\rm ch}^{\rm H}(q^2) = 2F_{\rm L}(q^2)F_{\rm ch}^{p}(q^2) + F_0(q^2)F_{\rm ch}^{n}(q^2) + F_{0,\rm ch}^{S}(q^2) - F_{\rm ch}^{V}(q^2); \quad (1)$$

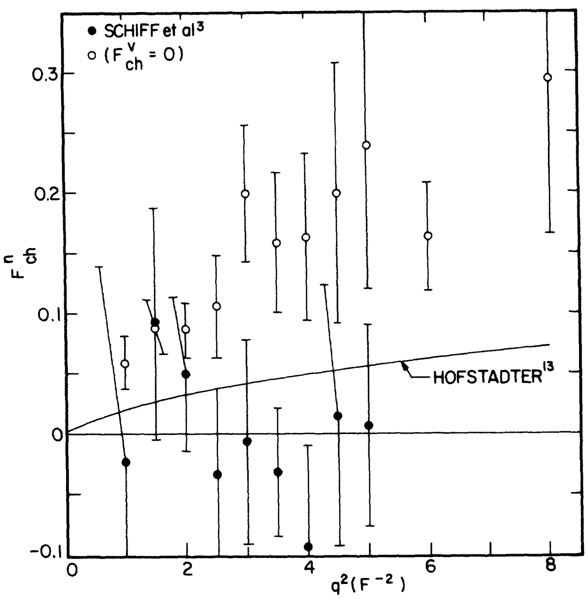

FIG. 1. Charge form factor for the neutron.

$$F_{ch}^{T}(q^2) = 2F_L(q^2)F_{ch}^{n}(q^2) + F_0(q^2)F_{ch}^{p}(q^2) + F_{0,ch}^{S}(q^2) + F_{ch}^{V}(q^2); \qquad (2)$$

$$\mu(\mathrm{He}^3)F_{mag}^{H}(q^2) = \mu(n)F_0(q^2)F_{mag}^{n}(q^2) + \tfrac{2}{3}\mu(p)[F_0(q^2) - F_L(q^2)]F_{mag}^{p}(q^2) - 0.2F_{mag}^{V}(q^2) + F_{mag}^{S}(q^2) + F_{mag}^{D}(q^2); \qquad (3)$$

$$\mu(\mathrm{H}^3)F_{mag}^{T}(q^2) = \mu(p)F_0(q^2)F_{mag}^{p}(q^2) + \tfrac{2}{3}\mu(n)[F_0(q^2) - F_L(q^2)]F_{mag}^{n}(q^2) + 0.2F_{mag}^{V}(q^2) + F_{mag}^{S}(q^2) + F_{mag}^{D}(q^2). \qquad (4)$$

F_{ch}^H, F_{ch}^T, F_{mag}^H, and F_{mag}^T are the charge and magnetic-moment form factors of He^3 and H^3 (denoted by the superscript T) and are normalized to unity at $q^2 = 0$. μ's are the static magnetic moments in units of nuclear magneton. F_{ch}^S and F_{ch}^V are the scalar and vector contributions from meson-exchange currents to the charge form factors of He^3 and H^3. We shall assume F_{ch}^S to be equal to zero all along. $F_{ch}^V(0) = 0$. F_{mag}^S and F_{mag}^V are the scalar and vector parts of exchange magnetic moments. $F_1 = (2F_L + F_0)/3$, $F_2 = (F_0 - F_L)$, and F_{mag}^D are the contributions from S, SS', and SD states of nuclear wave function, respectively. We have normalized F_{mag}^V at $q^2 = 0$ to unity.[12] Nothing is known about the respective normalization of F_{mag}^S and F_{mag}^D, but their sum is −0.014 nm at $q^2 = 0$. With the charge form factors, F_{ch}^p, of proton, and the magnetic-moment form factors, F_{mag}^p and F_{mag}^n, of proton and neutron being well-known from experiment, we are left with seven quantities F_{ch}^n, F_0, F_L, F_{ch}^V, F_{mag}^V, F_{mag}^S, and F_{mag}^D to be determined from four equations. We then assume $F_0 = F_L$ and F_{ch}^n known and write $F_x = F_{mag}^S + F_{mag}^D$. The quantities F_0, F_{ch}^V, F_{mag}^V, and F_x so determined from expressions (1-4) at each value of q^2 are shown in Table I. We use analytic ex-

Table I. Form factors.

q^2 (F^{-2})	F_{ch}^V	F_0	F_{mag}^V	F_x
1.0	0.025 ±0.013	0.665 ±0.011	1.433 ±0.954	0.047 ±0.189
1.5	0.030 ±0.010	0.523 ±0.009	2.450 ±0.382	−0.038 ±0.074
2.0	0.022 ±0.009	0.426 ±0.008	1.933 ±0.209	−0.007 ±0.040
2.5	0.021 ±0.012	0.343 ±0.010	1.186 ±0.255	0.040 ±0.048
3.0	0.038 ±0.011	0.303 ±0.010	0.194 ±0.184	0.051 ±0.034
3.5	0.023 ±0.010	0.248 ±0.009	0.309 ±0.144	0.047 ±0.024
4.0	0.018 ±0.010	0.200 ±0.009	0.314 ±0.208	0.062 ±0.039
4.5	0.018 ±0.011	0.162 ±0.011	0.635 ±0.159	0.021 ±0.028
5.0	0.019 ±0.010	0.142 ±0.010	0.355 ±0.140	0.024 ±0.025
6.0	0.008 ±0.003	0.100 ±0.003	0.063 ±0.044	0.038 ±0.014
8.0	0.005 ±0.003	0.039 ±0.003	0.185 ±0.027	0.022 ±0.012

pressions for the nucleon form factors given by Hofstadter.[13]

The existence of a reasonable set of values of F_0, $F_{ch}{}^V$, $F_{mag}{}^V$, and F_x (Table I) itself indicates that the inclusion of a term containing the meson-exchange contributions to the charge form factors of H^3 and He^3 is consistent and is probably correct. It is seen from Table I that the magnitude of $F_{ch}{}^V$ is of the order 0.02-0.03 at all available values of q^2. $F_{ch}{}^V$ remains positive and almost constant, while $F_{mag}{}^V$ falls off quickly as q^2 increases. No direct comparison of the above results is made with those given by Levinger,[5] as different normalizations have been used. The influence of various different assumptions on quantities determined from the form factors of He^3 and H^3 is being analyzed at present and detailed results will be published shortly. The comparison of these and other results with the theory of exchange meson currents given by the author[14] will be made in another publication.

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FLUX OF PRIMARY COSMIC-RAY ELECTRONS OF RIGIDITY ABOVE 4.5 BV

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Previous experiments[1,2] on the intensity of primary electrons in the cosmic radiation have been made at high latitudes (cutoff rigidity 0.7 and 0.1 BV, respectively), and at a period of still active sun (June and November 1960, respectively). Since one of the objects of these measurements is to determine the density of electrons which can emit the synchrotron radiation which is assumed to be responsible for the nonthermal component of galactic radio noise,[3] it is of interest to obtain a value of the electron flux as free as possible from the effect of solar modulation, which is known to be least effective at minimum solar activity and on high-energy particles.

A first balloon flight was therefore carried out on 5 November 1963 at Air-sur-Adour (southern France, cutoff rigidity 4.5 BV). The apparatus employed[4] consists of a cylindrical spark chamber, 26-cm diameter and 17-cm height, containing nine aluminum plates 10×10 cm square. On each of the central five plates is laid one radiation length of lead. The chamber is triggered by a fast (30-nsec) coincidence between two plastic scintillators, corresponding to the passage of one or more singly charged fast particles in the upper scintillator and four or more in the lower scintillator. When the pulse height in the upper scintillator exceeds that corresponding to one singly charged fast particle, an indicator lamp is lit. The apparatus had been previously calibrated in momen-