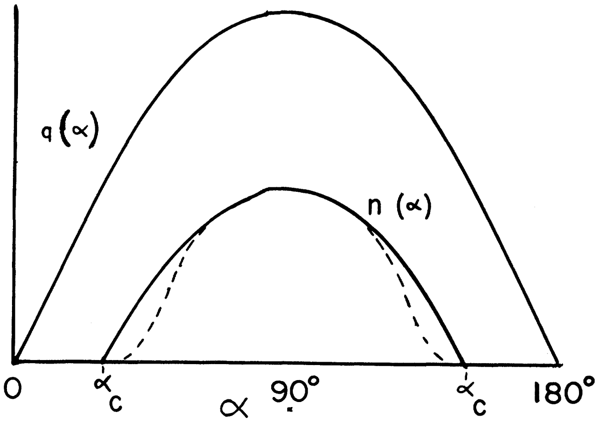

FIG. 1. The assumed isotropic source function $q(\alpha_0)$ and the resultant angular distribution of trapped particles $n(\alpha_0)$ plotted against the particles' pitch angle when they cross the plane of the magnetic equator. Note the absence of particles with $\alpha_0 < \alpha_C$ due to escape from the trapping field. The dashed curve indicates the effect on $n(\alpha_0)$ of the variation of atmospheric density with altitude.

The diffusion coefficient D used above has been evaluated for the mixture of atoms and ions present in the exosphere, using the theory for scattering of relativistic particles under screened and unscreened conditions.[7] Appropriate mean values for the inner exosphere and outer exosphere (where hydrogen predominates) are

$$D_{in} = 20\, cd/\gamma^2; \quad D_{out} = 10\, cd/\gamma^2, \qquad (13)$$

where d is the density in g/cm^3, and $\gamma^2 = (1 - \beta^2)^{-1}$. The transition altitude (~1000 km) should therefore show itself as a sharp increase in N, assuming other quantities in (11) to be constant. If Q is independent of d (or if its dependence is known), then the increase of N with altitude can be used to derive the variation of density with altitude, thereby the scale height, and hence the kinetic temperature of the base of the exosphere.

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*Supported by the Air Force Office of Scientific Research.

[1] Van Allen, Ludwig, Ray, and McIlwain, preliminary experimental results from US-IGY Satellites 1958-alpha and -gamma presented at the National Academy of Sciences, May 1, 1958 (unpublished).

[2] A. J. Dessler, Phys. Rev. Lett. 1, 68 (1958).

[3] S. F. Singer, Bull. Am. Phys. Soc. Ser. II, 3, 40 (1958).

[4] S. F. Singer, Trans. Am. Geophys. Union 38, 175 (1957); a more detailed paper has been submitted to J. Geophys. Research.

[5] See S. F. Singer, in Progress in Elementary Particle and Cosmic-Ray Physics (Interscience Publishers, New York, 1958), Vol. 4, pp. 263-8; as well as earlier work by H. Griem and S. F. Singer, Phys. Rev. 99, 608, (1955).

[6] H. Alfvén, Cosmical Electrodynamics (Oxford University Press, Oxford, 1950).

[7] A more detailed account of this work is being submitted to the Journal of Geophysical Research.

CORRELATION OF COSMIC-RAY INTENSITY AND SOLAR ACTIVITY

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(Received August 4, 1958)

The present International Geophysical Year was chosen to include the most likely period of maximum activity of the sun. It is probably too early to tell whether or not the maximum of the current cycle has yet been reached, but it is already certain that the yearly average of the Zurich sunspot numbers for 1957 is much higher than ever before observed.[1] It is therefore of interest to see what has been the effect on cosmic rays.

In analyzing the data for long periods of time from the Carnegie Institution ionization chambers, Forbush[2] in 1954 found an inverse relationship between solar activity, as measured by Zurich sunspot numbers, and cosmic-ray intensity. Also Neher and Forbush[3] showed in 1952 that there was a good correlation for at least a few weeks between the ionization due to cosmic rays at balloon altitudes at geomagnetic latitude 56°N, the ionization at ground level at Cheltenham and Huancayo, and the neutron intensity at Sacramento Peak, New Mexico, and Climax, Colorado.

It is the purpose of this letter to point out the following relations: (a) The yearly averages of the ionization data at Huancayo correlate very well with the average value of the ionization measured at 90 000 ft, or 15 g cm^{-2} at Thule, Greenland. These latter values were made over about a 2-3 week period during the month of August of the particular year.[4] (b) There is also a very good anti-correlation with solar activity as measured by the yearly average of Zurich sunspot numbers for the same period. These relationships are shown in Fig. 1.

The large ratio of 19 to 1 for the percentage change near the north geomagnetic pole to that at the equator is due primarily to the large numbers of low-energy particles in the primary radiation which can get through the earth's magnetic field at Thule and penetrate 15 $g\,cm^{-2}$ of air and which were present in some numbers during the solar minimum of 1954.

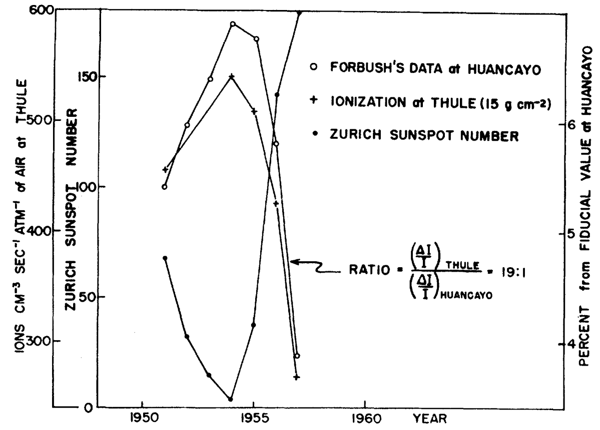

FIG. 1. Long-term correlation between ionization due to cosmic rays at high altitudes (15 $g\,cm^{-2}$ pressure) near the north geomagnetic pole, the ionization at Huancayo, Peru, and the Zurich sunspot numbers.

The above therefore constitutes further evidence that for these long-time effects, (a) the changes are world wide, (b) the low energy particles are affected more than those of higher energy, (c) the average, yearly Zurich sunspot numbers are a good index of the long-term effect of the sun on the intensity of cosmic rays as measured on the earth.

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[1] W. Waldmeier, J. Geophys. Research 63, 411 (1958).

[2] S. E. Forbush, J. Geophys. Research 59, 534 (1954).

[3] H. V. Neher and S. E. Forbush, Phys. Rev. 87, 889 (1952).

[4] See Neher, Peterson, and Stern, Phys. Rev. 90, 655 (1953); H. V. Neher, Phys. Rev. 103, 228 (1956); 107, 588 (1957); H. V. Neher and H. Anderson, Phys. Rev. 109, 608 (1958).

PHOTOPION CROSS SECTIONS AND A SECOND RESONANCE*

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In a recent letter[1] Wilson has suggested that the rise in the photopion cross sections above 500 Mev may be interpreted as being due to another resonance in the pion nucleon system. Since the π^+ cross section is the larger, the resonance must presumably be in a $T = 1/2$ state. If we examine the observed angular distributions, it is also possible to determine the probable angular momentum and parity of such a state.

We consider a scheme indicated roughly in Fig. 1. There are three important contributions to the photopion cross section up to about 900 Mev: (A) the $J = 3/2$, $T = 3/2$, p-wave resonance at about 300 Mev; (B) the proposed $T = 1/2$ resonance at about 700 Mev; (C) the "direct photoelectric" production (s-wave, electric dipole), occurring only for π^+. If A, B, C are the three corresponding complex amplitudes, then for the total cross sections we have

$$\sigma(\pi^+) \propto \frac{2}{3}\,|A|^2 + \frac{4}{3}\,|B|^2 + |C|^2,$$
$$\sigma(\pi^0) \propto \frac{4}{3}\,|A|^2 + \frac{2}{3}\,|B|^2\,. \tag{1}$$

At the peak, ~ 700 Mev, one has $\sigma(\pi^+) \cong 2\,\sigma(\pi^0)$ whence

$$|C|^2 \cong 2\,|A|^2 \tag{2}$$

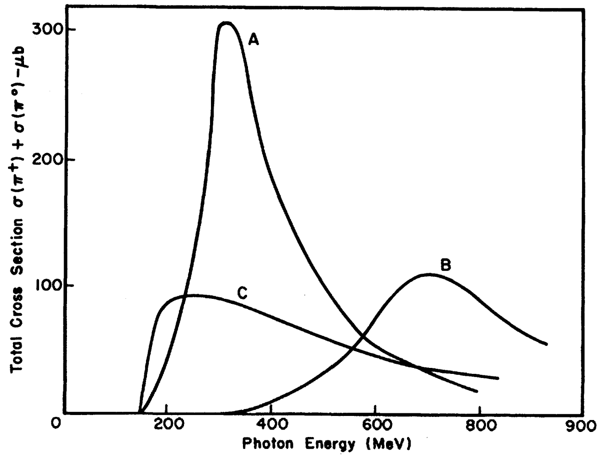

FIG. 1. Major contributions to photoproduction of pions below 900 Mev.