Results to date, while still of a preliminary nature, indicate that $0.10<R<0.13$. Final results will be reported in more detail at a later date.

This paper is based on work performed under the auspices of the AEC.

[1] Rumbaugh, Roberts, and Hafstad, Phys. Rev. **54**, 657 (1938).

Exchange Phenomena of the Nucleons That Generate Penetrating Showers

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RECENTLY G. Cocconi performed measurements on the absorption of ionizing PSPR* (which are believed to be protons) in Pb, Fe, C, and air.[1] He finds that this absorption is not exponential in the condensed absorbers and that the mean range of ionizing PSPR in the atmosphere increases with the lead thickness above the penetrating shower detector. These results are not compatible with an exponential absorption of the PSPR which was verified by Tinlot and Gregory[2] in Pb and Fe and by Wataghin[3] and Tinlot[4] in the atmosphere.

The fundamental difference between the experimental arrangement of Cocconi and those of the other authors, is that a proton of the PSPR appears as absorbed in any material situated in position Σ (Fig. 1 of Cocconi's paper[1]), not only when it generates a penetrating shower, but also when it emerges from Σ in the form of a neutron.

Let us discuss Cocconi's results by taking into account the phenomenon described above. We shall make the following hypothesis: (1) The absorption of nucleons through production of penetrating showers is exponential in all materials and is independent of their charge as well as of the altitude of the point of observation. (2) The probability of a transformation of a proton into a neutron is equal to that of the reverse process. (3) At Echo Lake (708 g/cm^{-2}) the number of protons is already equal to the number of neutrons in the PSPR. Indeed, if this were not so, Cocconi should have found a mean range for the ionizing PSPR in the atmosphere (without any absorber above the detector) smaller than the mean range of the total PSPR determined by Wataghin and Tinlot. Thus varying the absorber thickness at position Σ' in Cocconi's experiments[1] and the absorber thickness in the arrangement of Tinlot and Gregory,[2] it is only necessary to consider the exponential absorption due to the production of penetrating showers.

Following this interpretation one deduces easily from Cocconi's measurements the values of the mean range λ for the production of penetrating showers in different absorbers:

$$\lambda_{\mathrm{Pb}}=345\pm37\ \mathrm{g/cm^{-2}},$$
$$\lambda_{\mathrm{Fe}}=240\pm27\ \mathrm{g/cm^{-2}},$$
$$\lambda_{\mathrm{C}}=100\pm12\ \mathrm{g/cm^{-2}},$$
$$\lambda_{\mathrm{Air}}=113\pm7\ \mathrm{g/cm^{-2}},$$

in good agreement with the values given by other workers.[2-4] A short calculation yields for the mean range μ for charge exchange the values

$$\mu_{\mathrm{Pb}}=247\pm61\ \mathrm{g/cm^{-2}},$$
$$\mu_{\mathrm{Fe}}=300\pm121\ \mathrm{g/cm^{-2}},$$

at Echo Lake (708 g/cm^{-2}). For μ_{C} we obtain a larger value than the preceding ones, but the statistical errors are too important to allow a precise determination. However this result is not surprising since charge exchange and shower production are competititive processes. It is then reasonable to expect that μ should increase if λ decreases. At Ithaca (1007 g/cm^{-2}) μ is found to be several times larger, but a precise determination is impossible.

We see that the exchange properties of the PSPR explain Cocconi's results consistently with the results of other authors. On the other hand we wish to point out that the energy loss of the protons by ionization has been neglected, and this might not be very accurate in the case of the rather low energy events recorded by Cocconi[1] and by Tinlot and Gregory.[2] However, we think that this factor could at most alter somewhat the numerical values of the mean ranges.[5]

* We use the abbreviation PSPR for Penetrating Shower Producing Radiation.
[1] G. Cocconi, Phys. Rev. **75**, 1074 (1949). We are indebted to Professor Cocconi for having communicated to us his results before publication.
[2] J. Tinlot and B. Gregory, Phys. Rev. **75**, 519 (1949).
[3] G. Wataghin, Phys. Rev. **71**, 453 (1947).
[4] J. Tinlot, Phys. Rev. **74**, 1197 (1948).
[5] A more complete account will appear in the Anais da Acad. Bras. de Cienc.

The Nuclear Spin and Quadrupole Moment of I^{129}

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THE nuclear spin and quadrupole moment of I^{129} have been determined from measurements on the $J=2\rightarrow3$ rotational transition of CH_3I^{129}, which occurs in the 6.75 millimeter wave region. As is apparent from observation of Fig. 1, the spin of I^{129} is unquestionably 7/2. The very large number of absorption lines which are found in the hyperfine structure make it impossible to fit the theoretical pattern of any other spin to the observed data. The theoretical plots shown include only first order theory.

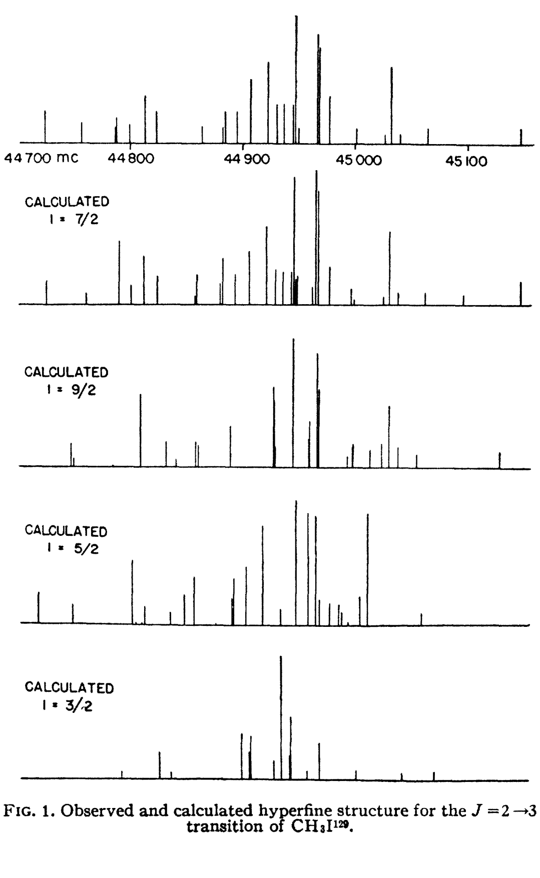

FIG. 1. Observed and calculated hyperfine structure for the $J=2\rightarrow3$ transition of CH_3I^{129}.