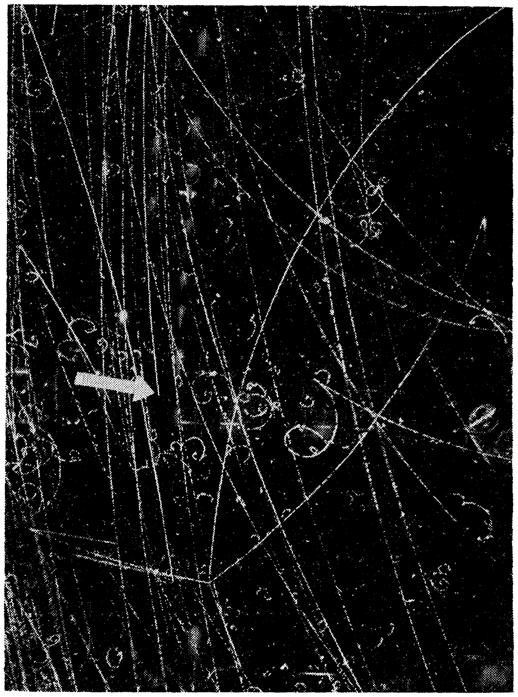

FIG. 3. An antiproton charge exchange. The antiproton is incident from the top and to the left of center, and the antiproton ending is indicated by an arrow. The antineutron from the charge-exchange process annihilates in the lower center of the picture. Five pions are produced in the annihilation with an energy release >1500 Mev.

butions differ markedly from the n-p which is also plotted for comparison. The total $\bar{p}$-p elastic cross section for scattering between 15° and 165° (center of mass) is 41_{-7}^{+10} mb. This should be compared to Fulco's value of 68 mb for the same angular interval.

The charge-exchange process $\bar{p}+p\rightarrow\bar{n}+n$ can be observed in the bubble chamber. One event has been identified and it is shown in Fig. 3 because of its inherent interest. The angle between the antiproton direction and the line connecting the antiproton ending with the vertex of the star is 30° in the lab system. The visible energy release in the star is >1500 Mev with the tentative identification of the annihilation products as $3\pi^+$ and $2\pi^-$. Thus the star is consistent with the process $\bar{n}+p\rightarrow 3\pi^+ + 2\pi^-$. The energy of the antiproton at the point of disappearance is estimated as 50 ± 30 Mev.

Other results such as the carbon annihilation and scattering cross sections and details of the annihilation process must await completion of the analysis.

[1] Five additional $\bar{p}$-p scattering events have been observed in nuclear emulsions by Chamberlain, Goldhaber, Jauneau, Kalogeropoulos, Segrè, and Silberberg. These are reported in the *Proceedings of the Padua-Venice Conference on Fundamental Particles, 1957* (Suppl. Nuovo cimento, to be published).

[2] Jose Fulco, Phys. Rev. **110**, 784 (1958) and University of California Radiation Laboratory Report UCRL-8183 (unpublished).

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9.51-Mev Level in N^{14}

D. M. ZIPOY
Laboratory of Nuclear Studies, Cornell University, Ithaca, New York
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IT was pointed out recently[1] that the radiative decay angular distributions from the 9.51-Mev state in N^{14} were inconsistent with the spin assignment of $J=3$ reported in a paper on a $C^{13}(p,p)C^{13}$ experiment done previously,[2] but were consistent with a $J=2$ assignment. Because of this discrepancy, the analysis of the elastic scattering data was redone with the result that the assignment of $J^{\pi}=2^-$ does give a better fit than $J^{\pi}=3^-$. The resonance is fit well with a mixture of forty percent $S=1$ and sixty percent $S=0$ states and a level width of 40 kev. It is interesting to note that this mixture corresponds to $j=\frac{5}{2}$ with essentially no contribution from $j=\frac{3}{2}$, where j is the sum of the orbital angular momentum and one of the spins; j is then combined with the other spin to give J. An assignment of $J^{\pi}=1^-$ for the level gives a very poor fit, as do any other assignments with the possible exception of $J^{\pi}=3^-$ mentioned previously.

Because of the interference between the 9.39- and 9.51-Mev levels, the width of the 9.39-Mev level changed to about 20 kev; the assignment is still 1^-.

[1] E. Warburton (private communication).

[2] Zipoy, Freier, and Famularo, Phys. Rev. **106**, 93 (1957).

Hyperfine Structure of Deuterium and Nucleon-Nucleon Spin-Orbit Potentials*

A. M. SESSLER, *The Ohio State University, Columbus, Ohio*
AND
H. M. FOLEY, *Columbia University, New York, New York*
(Received March 24, 1958)

THE original suggestion[1] that nucleon-nucleon forces include a spin-orbit term has recently been reconsidered by a number of authors.[2] The inclusion of such forces leads to a modification of the magnetic properties of the deuteron[3] and in particular modifies the magnetic moment, as has been emphasized in a recent paper by Feshbach.[4] It is the purpose of this note to point out that the hyperfine structure (hfs) of deuterium is a very sensitive indicator of the amount of spin-orbit forces in the deuteron; and that even with the present theoretical uncertainty in the interpretation of the hfs, it affords a limitation on the amount of magnetic moment arising from spin-orbit forces which proves to be more severe than that afforded by mere examination of the magnetic moment of the deuteron.[4]