LETTERS TO THE EDITOR

Prompt publication of brief reports of important discoveries in physics may be secured by addressing them to this department. Closing dates for this department are, for the first issue of the month, the eighteenth of the preceding month, for the second issue, the third of the month. Because of the late closing dates for the section no proof can be shown to authors. The Board of Editors does not hold itself responsible for the opinions expressed by the correspondents.

Communications should not in general exceed 600 words in length.

Gamma-Radiation from Fluorine Bombarded with Protons

In our recent work[1] on the gamma-radiation from Li^7+H^1 we have shown that the pairs ejected from thin lead foils in a Wilson cloud chamber gave a more accurate determination of the energy of very high energy gamma-radiation than do the recoil electrons. The observed distribution in energy of the pairs showed considerable asymmetry and we concluded from this that the radiation consisted of more than one line since a single line would be expected to give rise to a nearly symmetrical distribution in energy of the pairs.

We have verified this observation in the case of $F^{19}+H^1$. The distributions in energy of pairs and single electrons and positrons are shown in Fig. 1. It is seen that the pairs are very nearly symmetrically distributed and they indicate a single line at 6.0±0.2 Mev. The distribution of recoil electrons is consistent with this and considerably broader as is to be expected from the angular distribution of Compton electrons as given by the Klein-Nishina formula and from the greater uncertainties in the measurement of tracks of large radius of curvature. The energy losses in the scatterers although approximately twice as great for pairs as for single particles are small compared to the uncertainty in measurement.

Some of the data were obtained with lead foil as scatterer and the remainder with aluminum foil. Alternate pictures were taken with 1 cm lead absorber in and out of the beam. Table I gives the number of pairs and single electrons observed in each case.

From this we find

$$\mu_{Pb}=0.4\pm0.1\ \text{cm}^{-1},$$
$$(\sigma/\pi)_{Pb}\approx0.8 \quad \text{and} \quad (\sigma/\pi)_{Al}\approx3.0.$$

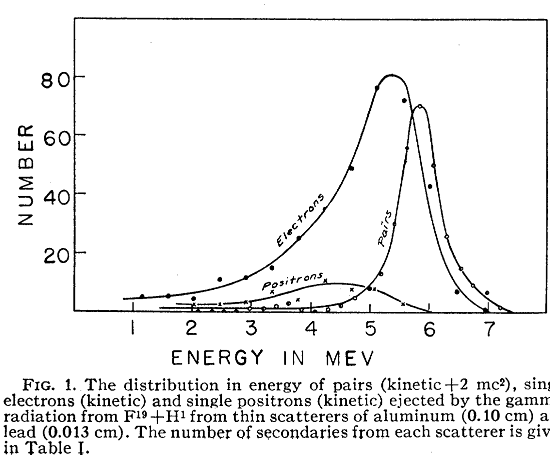

FIG. 1. The distribution in energy of pairs (kinetic+2 mc^2), single electrons (kinetic) and single positrons (kinetic) ejected by the gamma-radiation from $F^{19}+H^1$ from thin scatterers of aluminum (0.10 cm) and lead (0.013 cm). The number of secondaries from each scatterer is given in Table I.

TABLE I. *Number of pairs and single electrons observed.*

	Pairs >4.5 Mev	Pairs <4.5 Mev	Single Electrons	Single Positrons	Recoil Electrons (Electrons-Positrons)
Scatterer					
0.10 cm Al (350 kv)	45	0	197	12	185
.013 cm Pb (160 kv)	98	10	167	38	129
Absorber					
None	87	4	221	28	193
1 cm Pb	56	6	143	22	121

The corresponding theoretical values for 6 Mev radiation are

$$\mu_{Pb}=0.5\ \text{cm}^{-1},$$
$$(\sigma/\pi)_{Pb}=0.72,$$
$$(\sigma/\pi)_{Al}=4.5.$$

The differences are probably not significant since the accuracy is not very great.

The gamma-radiation from $F^{19}+H^1$ was first observed by McMillan[2] by means of an ionization chamber. Tuve[3] and his collaborators have shown that the radiation is produced at several resonance energies, namely; 0.328, 0.892 and 0.942 Mev. The measurements here presented were made with a thick target bombarded with 0.75 Mev protons and we are therefore concerned only with the resonance level at 0.328 Mev. The reaction $F^{19}+H^1\rightarrow Ne^{20}$ is exothermic by 13.3 Mev but no gamma-radiation corresponding to this energy has been observed and we must assume therefore that this transition is forbidden by some rigid selection rule. Because of the sharpness of the resonance level, it seems unlikely that it can disintegrate with appreciable probability to $O^{16}+He^4$, and we should like to ascribe the gamma-radiation not to O^{16}, but to Ne^{20}:

$$F^{19}+H^1\rightarrow(Ne^{20})'\xrightarrow{\gamma}(Ne^{20})''\rightarrow O^{16}+He^4.$$

Alpha-particles with approximately 2 Mev energy should be produced but these have not yet been observed. Perhaps the total energy of the reaction $F^{19}+H^1\rightarrow Ne^{20}$ may be emitted as gamma-radiation from one of the higher resonance levels.

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February 12, 1937.

[1] L. A. Delsasso, W. A. Fowler and C. C. Lauritsen, Phys. Rev. **51**, 391 (1937).
[2] E. McMillan, Phys. Rev. **46**, 325 (1934).
[3] L. R. Hafstad, N. P. Heydenburg and M. A. Tuve, Phys. Rev. **50**, 504 (1936).