Most probable values of $\bar{v}/c$

f, kc	1.5—2.5	3—3.5	4—4.5	5—6	7—9	10—14	16—20
v/c, exptl.	1.09	1.05	1.024	1.014	1.006	1.004	1.002
f, kc	2	3		5	7	10	20
$\bar{v}/c$, theoret.	1.014	1.0456		1.017	1.0085	1.0041	1.0015

vals. The distribution curves obtained had pronounced maxima; they give the values of $\bar{v}/c$ shown in Fig. 2 (points) and in the table.

Comparison of the experimental and theoretical[3] values (Fig. 2, curve b) shows that they begin to deviate significantly at $f < 3$ kcs. This deviation is perhaps due to the fact that at such low frequencies the model of the ionosphere chosen in the calculations becomes inappropriate, since the wavelengths are comparable with the thickness of the ionospheric layers.

It should be pointed out that since, at the distances r considered, only the zero-order mode of the spectrum of the received wave plays an important part, therefore the values of $\left(1 + \frac{\psi}{\omega}\frac{c}{r}\right)$ immediately determine the imaginary values S_{01} of the wave numbers; and a comparison of them with the corresponding theoretical values of S_{01} may permit determination of the effective conductivity of the ionosphere with respect to transmission of electromagnetic waves in the range of frequencies investigated.

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SCATTERING OF 333 MEV NEGATIVE π MESONS BY HYDROGEN

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THE elastic and exchange scattering of π^- mesons by hydrogen has been studied by us. The beam of π^- mesons was obtained with the use of the synchrocyclotron of the Joint Institute for Nuclear Research. The energy of the beam was found to be 333 ± 9 Mev. Measurements were made with the use of scintillation counters. Liquid hydrogen was used as the target and was contained in a foamed plystyrene container.

Table I presents the measured differential elastic scattering cross-section for π^- mesons after the inclusion of all corrections. Table II presents the corrected differential cross-section for gamma ray emission from the decay of π^0 mesons.

TABLE I

ϑ°_{cms}	$\frac{d\sigma}{d\omega}$, 10^{-27} cm²/sterad
41.9	1.28±0.14
61.3	0.90±0.10
79.2	0.69±0.09
100.8	0.51±0.03
119.7	0.52±0.07
140.6	0.96±0.10
159.2	0.93±0.13

TABLE II

ϑ°_{cms}	$\frac{d\sigma}{d\omega}$, 10^{-27} cm²/sterad
20.8	6.52±1.37
41.0	6.31±1.30
60.0	3.72±0.77
77.7	2.36±0.50
99.0	1.55±0.34
128.8	0.95±0.23
146.9	1.29±0.31
159.7	1.10±0.24

By performing a least squares fit of the function $d\sigma/d\omega = a + b\cos\vartheta + c\cos^2\vartheta$ to the cross-section data (ϑ measured in the center of mass system), one obtains the following results (in units of 10^{-27} cm²/sterad):

a) Elastic scattering of π^-

mesons: $a_- = 0.54 \pm 0.024$, $b_- = 0.34 \pm 0.058$, $c_- = 0.90 \pm 0.098$.

b) Gamma emission from π^0 meson decay; $a_\gamma = 1.87 \pm 0.24$, $b_\gamma = 2.89 \pm 0.44$, $c_\gamma = 2.32 \pm 0.59$.

The angular distribution of the π^0 mesons can be easily obtained from a_γ, b_γ, and c_γ. One obtains $a_0 = 0.68 \pm 0.20$, $b_0 = 1.80 \pm 0.27$, $c_0 = 1.90 \pm 0.50$.

The total elastic cross-section as determined by the above angular representation is $(10.7 \pm 0.6) \times 10^{-27}$ cm^2; the total exchange cross-section is $(16.6 \pm 1.4) \times 10^{-27}$ cm^2. The total cross-section for π^- meson interaction with hydrogen is $(28.8 \pm 1.8) \times 10^{-27}$ cm^2 where we have included the production of mesons by mesons[1] to the elastic and exchange contributions. For comparison one may cite the meson attenuation measurements in hydrogen[2] which gave a total cross-section of $(25.7 \pm 1.0) \times 10^{-27}$ cm^2.

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SCATTERING OF 307 MEV NEGATIVE π MESONS BY HYDROGEN WITH CHARGE EXCHANGE

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We have measured the angular distribution of γ rays emitted in the decay of π^0 mesons which were formed by exchange scattering of π^- mesons by hydrogen ($\pi^- + p \rightarrow \pi^0 + n$). The π^- meson beam was obtained by the use of the synchrocyclotron of the Joint Institute for Nuclear Research. The energy of the π^- mesons was measured at 307 ± 9 Mev as obtained from range measurements in copper. Scintillation counters were used to obtain the data. Liquid hydrogen which was contained in a foamed polystyrene container was used as the target.

ϑ°_{cms}	$\frac{d\sigma}{d\omega}$, 10^{-27} cm^2/sterad
20.5	9.80±2.02
40.5	8.46±1.74
59.2	4.05±0.83
76.8	2.24±0.46
98.0	1.50±0.31
128.1	1.40±0.31
146.4	1.32±0.30
159.4	1.32±0.29

The measured differential cross-section for gamma ray emission in the center of mass system is presented in the table. These cross-sections include all necessary corrections.

A least squares fit of the function $d\sigma/d\omega = a + b\cos\vartheta + c\cos^2\vartheta$ (ϑ measured in center of mass system) to the data results in the following values for the coefficients (in units of 10^{-27} cm^2/sterad): $a_\gamma = 1.87 \pm 0.24$, $b_\gamma = 3.30 \pm 0.53$, $c_\gamma = 3.14 \pm 0.71$. From these coefficients one can easily obtain the angular distribution of π^0 mesons and one finds $a_0 = 0.57 \pm 0.23$, $b_0 = 2.10 \pm 0.34$, $c_0 = 2.67 \pm 0.60$.

The total cross-section for charge exchange scattering as determined by the above angular distribution is $(18.4 \pm 1.6) \times 10^{-27}$ cm^2. Adding this cross-section to the elastic scattering cross-section[1] and including meson production by mesons[2] one obtains a total interaction cross-section for π^- meson in hydrogen of $(30.2 \pm 1.8) \times 10^{-27}$ cm^2. Meson attentuation measurements in hydrogen[3] yield a total interaction cross-section of $(3.16 \pm 1.6) \times 10^{-27}$ cm^2 (interpolated to 307 Mev).

In the accompanying figure the four dashed curves represent calculations based on four sets of phase shifts. These were obtained[1] from a preliminary phase analysis of elastic scattering of π^- mesons by hydrogen where one assumed that only the S and P states participate in the scattering. The measurements of the present work are indicated in the figure.