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SUMMARY OF THE RESEARCH PROGRESS MEETING OF JANUARY 3, 1952

Sergey Shewchuck

February 12, 1952

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Berkeley, California

SUMMARY OF THE RESEARCH PROGRESS MEETING OF JANUARY 3, 1952

Sergey Shewchuck

Radiation Laboratory, Department of Physics,
University of California, Berkeley, California

February 12, 1952

I. Study of Isotopes of Promethium - Vera K. Fischer.

The work which was discussed in this talk has been submitted to the University as a thesis and issued in report UCRL-1629. Following is an abstract of the report:

"Bombardments of isotopically enriched neodymium samples have been performed with 8.9 Mev protons from the 60-inch cyclotron of the Crocker Radiation Laboratory and with protons at higher energies from the linear accelerator of the Radiation Laboratory of the University of California. Praseodymium has been bombarded at various energies with alpha particles from the 60-inch cyclotron. The half-lives and radiation characteristics of the promethium isotopes produced from these bombardments have been measured. The isotopes were identified chemically and their mass allocations were determined on the basis of their relative yields.

Nuclear shell theory was applied to explain ambiguities and to estimate the decay characteristics of unobserved promethium isotopes. Indirect confirmation of the theory was obtained in the coherence of the results.

The following nuclides were characterized for the first time: Pm^{141}, Pm^{146}, and Pm^{150}. In addition, work on promethium isotopes previously described gave results indicating errors in the assignments of Pm^{143} and Pm^{144} and in the half-life of Pm^{149}. The previous characterizations of

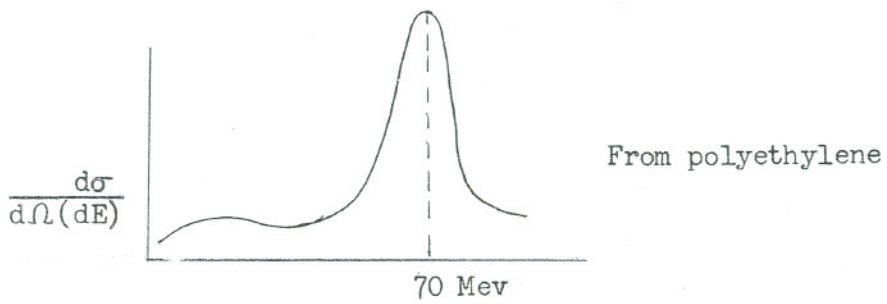
Pm^{146}, Pm^{147}, and Pm^{148} were checked. A 42 day negatron emitting nuclide was observed to be an isomer of either Pm^{147} or Pm^{148}. Limits were set on the half-life of Pm^{142}."

II. Excitation Functions for Meson Production by Protons on Protons - A. Schulz.

This talk concerned progress on work which was first mentioned by Hamlin, Jakobson, Merritt and Schulz in a report UCRL-1433, August 29, 1951. The reactions under investigation are:

$$p + p \longrightarrow \pi^+ + D$$
$$\longrightarrow \pi^+ + p + n.$$

The first was studied by C. Richman et al, who got a spectrum for the H contribution as follows:



The peak resonance at 70 Mev was later confirmed as being due to deuterons. At present smaller proton energies are being tried to see how production varies with E.

The experimental arrangement used is shown in Fig. 1. The detection scheme was a $\pi - \mu$ delay coincidence. The proton beam was degraded by using Pb degraders. This was different in that others used low Z material in the D tube so as not to scatter the beam. But, it was found that the stopping power of Pb was relatively high in regard to the mesons produced. Hence, Pb was the best compromise between background mesons and stopping power.

To date the experiments include about 14,000 π^+ mesons counted with an average counting rate over all run of 6.5/min. As the proton beam is degraded down the production cross section decreases for all materials except Pb, which is low anyway. Curves showing the cross section versus energy for π^+ meson production and carbon are given in Figs. 2, 3, and 4 for proton energies of 336 Mev, 326 Mev and 315 Mev, respectively. All corrections were applied except those for multiple scattering of mesons in Cu absorbers and for protons in the degrader, both of which were expected to be small. Fig. 5 gives the excitation function curve for π^+, p reaction starting with a cross section of zero for the proton energy of 290 Mev and extending to 340 Mev. This curve appears to be fairly consistent with that obtained by Steinberger, who used the inverse reaction

$$\pi^+ + D \rightarrow p + p$$

His data are for higher energies and have a slightly steeper slope. This would be compatible with the idea that there is an excited nucleon resonance state which increases the slope for meson energies above 30 to 40 Mev in the center of mass frame of reference.

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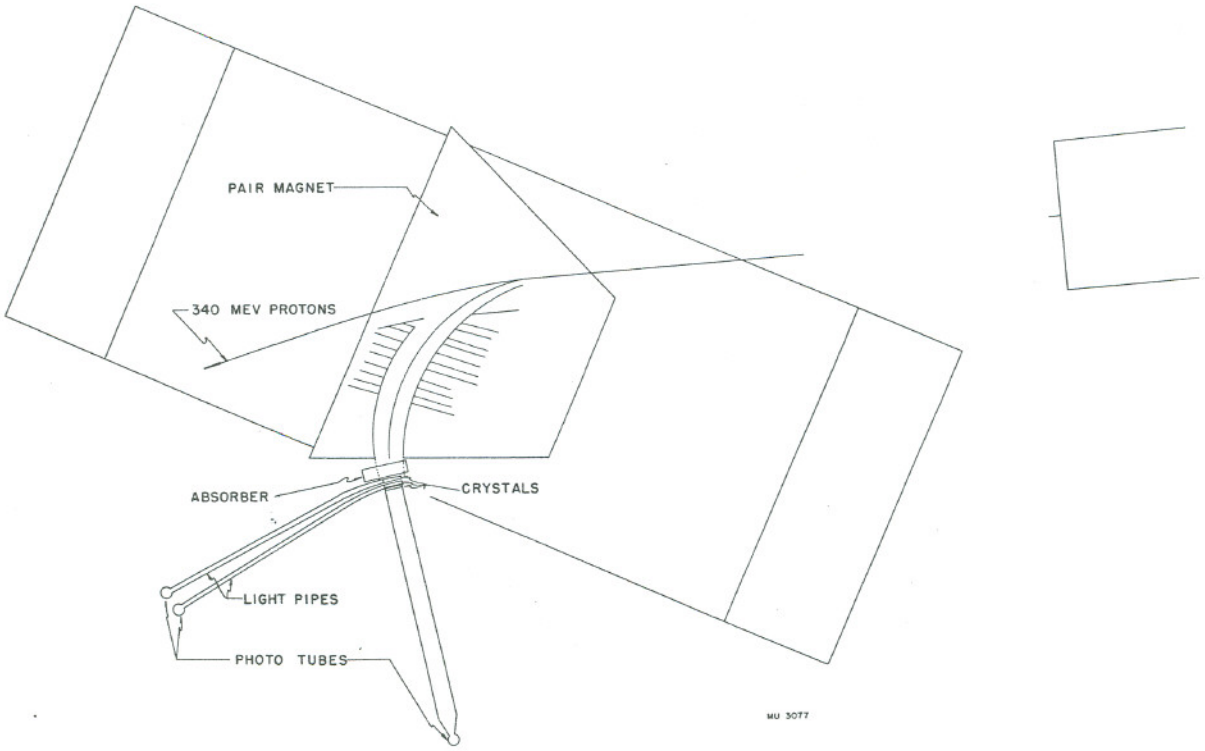
PAIR MAGNET
340 MEV PROTONS
ABSORBER
CRYSTALS
LIGHT PIPES
PHOTO TUBES
MU 3077

Fig. 1

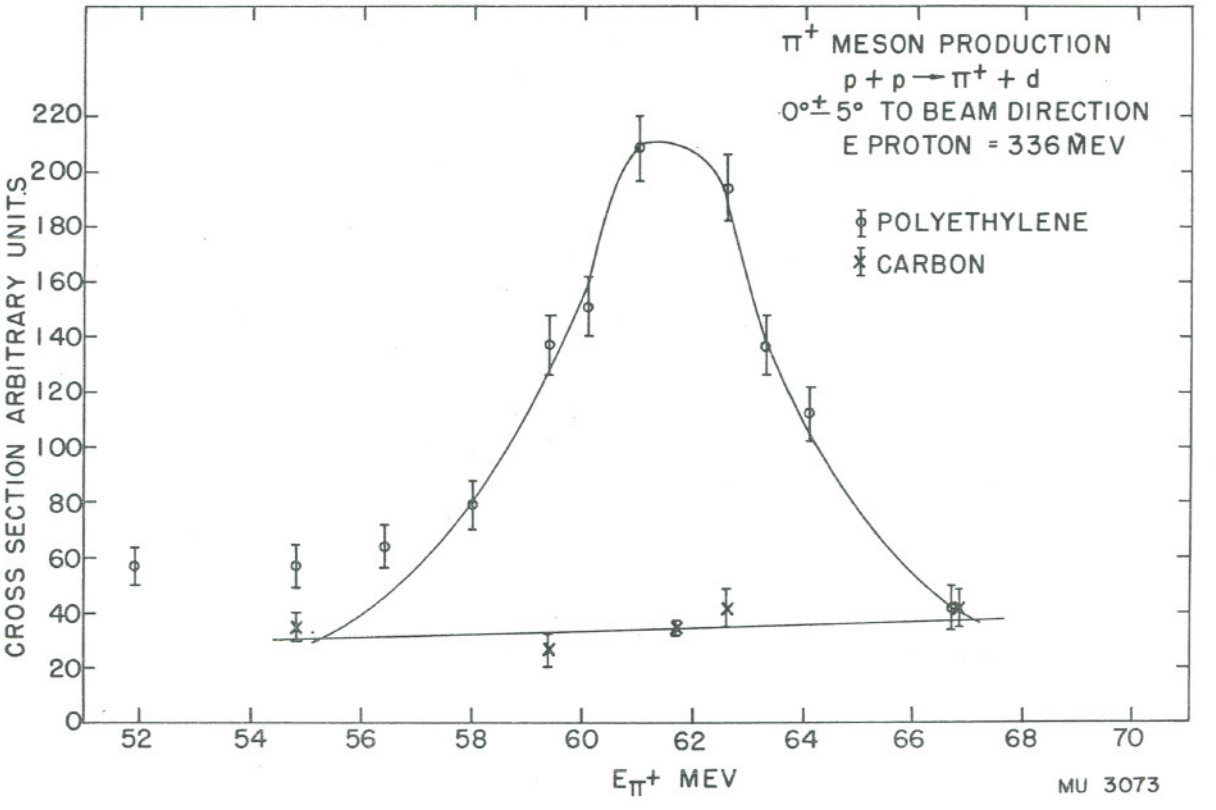
π+ MESON PRODUCTION
p + p → π+ + d
0° ± 5° TO BEAM DIRECTION
E PROTON = 336 MEV
POLYETHYLENE
CARBON
CROSS SECTION ARBITRARY UNITS
0
20
40
60
80
100
120
140
160
180
200
220
52
54
56
58
60
62
64
66
68
70
Eπ+ MEV
MU 3073

Fig. 2

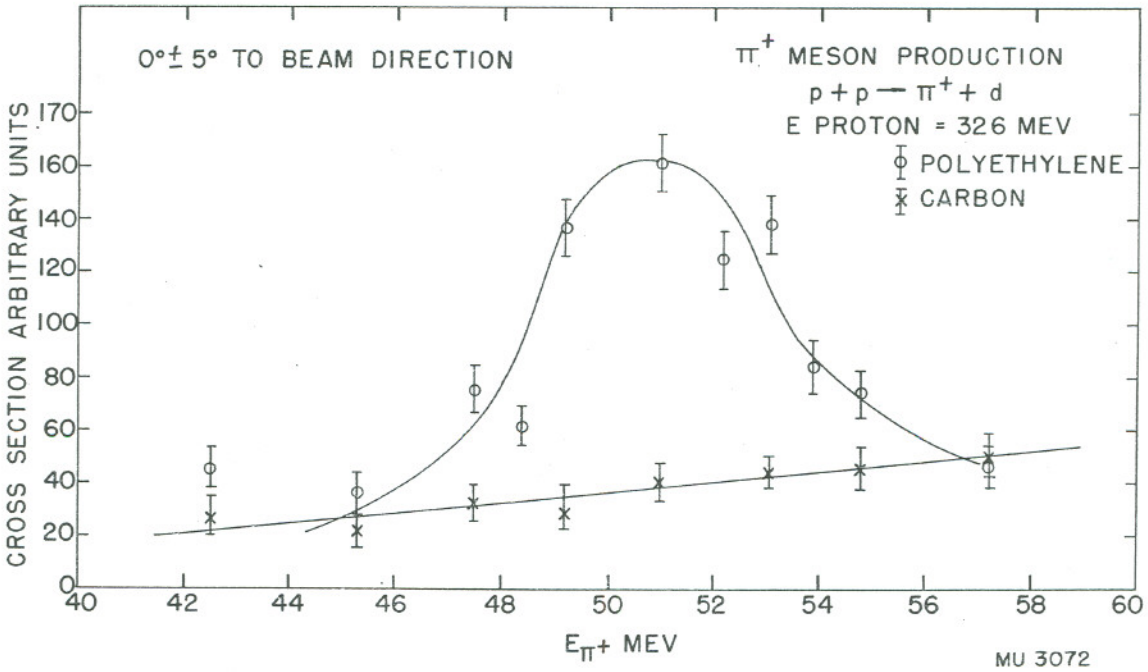
0° ± 5° TO BEAM DIRECTION
π+ MESON PRODUCTION
p + p → π+ + d
E PROTON = 326 MEV
POLYETHYLENE
CARBON
CROSS SECTION ARBITRARY UNITS
0
20
40
60
80
100
120
140
160
170
40
42
44
46
48
50
52
54
56
58
60
Eπ+ MEV
MU 3072

Fig. 3

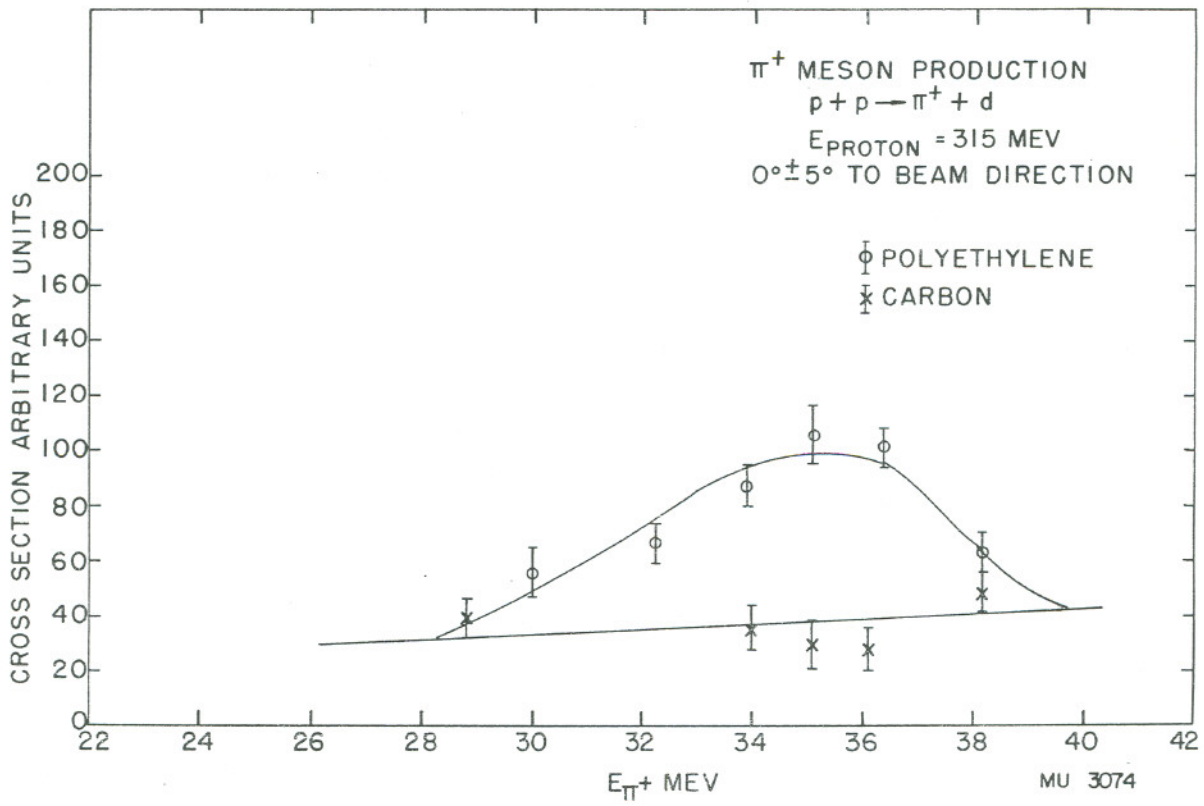
π+ MESON PRODUCTION
p + p → π+ + d
E PROTON = 315 MEV
0° ± 5° TO BEAM DIRECTION
POLYETHYLENE
CARBON
CROSS SECTION ARBITRARY UNITS
0
20
40
60
80
100
120
140
160
180
200
22
24
26
28
30
32
34
36
38
40
42
Eπ+ MEV
MU 3074

Fig. 4

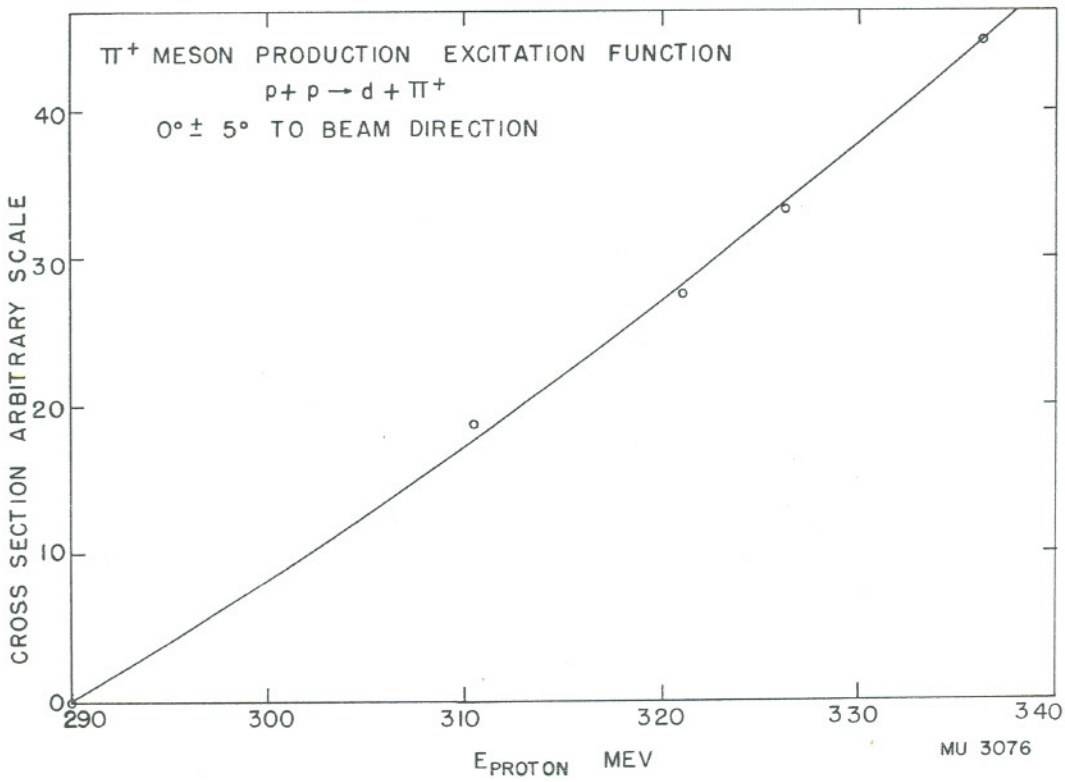
π+ MESON PRODUCTION EXCITATION FUNCTION
p + p → d + π+
0° ± 5° TO BEAM DIRECTION
CROSS SECTION ARBITRARY SCALE
0
10
20
30
40
290
300
310
320
330
340
E PROTON MEV
MU 3076

Fig. 5