UCRL-10222

University of California

Ernest O. Lawrence Radiation Laboratory

TWO-WEEK LOAN COPY

This is a Library Circulating Copy which may be borrowed for two weeks. For a personal retention copy, call Tech. Info. Division, Ext. 5545

Berkeley, California

DISCLAIMER

This document was prepared as an account of work sponsored by the United States Government. While this document is believed to contain correct information, neither the United States Government nor any agency thereof, nor the Regents of the University of California, nor any of their employees, makes any warranty, express or implied, or assumes any legal responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by its trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof, or the Regents of the University of California. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof or the Regents of the University of California.

To be presented by D. Keefe at the Conference on High Energy Physics, CERN.

UCRL-10222

ELASTIC K^--p SCATTERING BETWEEN 700 AND 1400 MeV/c*

E. F. Beall, W. Holley, D. Keefe, L. T. Kerth, J. J. Thresher, C. L. Wang, and W. A. Wenzel
Lawrence Radiation Laboratory
University of California
Berkeley, California

May 24, 1962

The K^--p total cross section is known to have a peak in the T = 0 state at about 1.05 BeV/c incident K^- momentum.[1,2] Two possible interpretations of this peak are:

(a) The peak is a global symmetry analogue (in the π-hyperon system) of the third π-nucleon resonance.[3] If the KZN parity is odd, as seems likely,[4] then the resonance should be $F_{5/2}$.

(b) The peak is caused by a rapid rise in the cross section for $K^- + p \rightarrow K^{*-} + p$, via the Ball-Frazer mechanism.[5] If the K^* has spin 1, then Ball and Frazer show how a large peak in the $D_{3/2}$ contribution to the K^--p elastic cross section could arise.

Our experiment consisted of a study of K^--p interactions in the neighborhood of the 1.05 BeV/c resonance, using spark chambers. A variable-momentum K^- beam was selected using gas Cerenkov counters in a secondary beam from the Bevatron. A thin-foil cylindrical spark chamber surrounding a liquid hydrogen target was used to record the angles of the incident K^- and of the outgoing reaction products. A semicylindrical chamber placed downstream, containing carbon and steel absorbers, was used to obtain range and polarization information. Segmented tilted mirrors placed behind the chambers provided depth information on the tracks. The incident momentum could be determined for each event to better than 1% by means of spark chambers and a bending magnet.

* Work done under the auspices of the U. S. Atomic Energy Commission.

Of the 360 000 pictures taken during this experiment, about 5% have been scanned for elastic scatters only, by using conventional bubble chamber scanning tables. Only the angles of the three tracks and their stereo images in the small cylindrical chamber were measured for each potential elastic event. Each measured event was fitted to coplanarity and opening-angle requirements, by using a stereographic projection and kinematics tables. About 120 events each at ten different momenta were accepted as elastic scatters in this preliminary sample.

The results of this analysis are shown as center-of-mass differential cross sections in Fig. 2 a-d. These curves have been corrected for the loss of solid angle caused by the ends of the cylinder (approximately a factor of 2). No other corrections have been made. For each curve, the left-hand edge of the horizontal bar on the second point from the left corresponds to the minimum K^- scattering angle accepted. The right-hand edge of the horizontal bar on each right-hand point corresponds to the minimum proton laboratory angle accepted. The points at $\cos\theta = +1$ were computed from:

$$\frac{d\sigma}{d\Omega}(0\ \text{deg}) = [\text{Im}\ F(0\ \text{deg})]^2 + [\text{Re}\ F(0\ \text{deg})]^2 \quad .$$

The imaginary parts were computed from known total cross sections by the optical theorem, and the real parts from forward dispersion relations. The magnitudes of the $\frac{d\sigma}{d\Omega}(0\ \text{deg})$ and the errors are in general dominated by the $\text{Im}\ F(0\ \text{deg})$. The errors shown on all points are purely statistical. Corrections up to 20%

on some points may have to be made eventually. Recent data from the Lawrence Radiation Laboratory 15-inch bubble chamber are shown for comparison at 1150 MeV/c.[6]

The smooth curves in Fig. 2 a-d are drawn to guide the eye. The points in the intervals $+0.8 < \cos\theta < +1.0$ have been neglected in drawing the curves, since there is reason to believe that severe corrections are required in these intervals. Note that there is a backward peak in this energy region. Also, the cross section near 90 deg seems to have a minimum near the resonance, and the forward peak has a maximum at the resonance (as expected from the total cross sections).

The total elastic cross section, obtained by integrating the curves in Fig. 2 a-d, is shown in Fig. 3 as a function of momentum. The total cross sections from references 1, 2, and 6 are shown for comparison. It can be seen that the elastic cross section follows the behavior of the total cross section. The energy behavior of the integral of $\frac{d\sigma}{d\Omega}$ backward of $\cos\theta = +0.8$ parallels closely the behavior of the total cross sections, as well. The total elastic peak in Fig. 3 is about 8 mb above a background of about 12 mb. However, the momentum resolution of ± 5% has not been unfolded from our results; hence, the total elastic peak may be slightly more pronounced than is shown in Fig. 3.

REFERENCES

1. O. Chamberlain, K. M. Crowe, D. Keefe, L. T. Kerth, A. Lemonick, Tin Maung, and T. F. Zipf, Phys. Rev. 125, 1696 (1962).

2. V. Cook, B. Cork, T. F. Hoang, D. Keefe, L. T. Kerth, W. A. Wenzel, and T. F. Zipf, Phys. Rev. 123, 320 (1961).

3. L. T. Kerth, and A. Pais, Lawrence Radiation Laboratory Report UCRL-9706, May, 1961 (unpublished).

4. R. D. Tripp, M. B. Watson, and M. Ferro-Luzzi, Phys. Rev. Letters 8, 175 (1962); also, Phys. Rev. Letters (to be published).

5. J. S. Ball and W. R. Frazer, Phys. Rev. Letters 7, 204 (1961).

6. W. Graziano and S. Wojcicki, Lawrence Radiation Laboratory Report UCRL-10177, April 1962 (unpublished).

FIGURE CAPTIONS

Fig. 1. General orientation of the equipment, and photograph of an event.

Fig. 2.(a-d). Differential cross sections for different momenta.

Fig. 3. Total elastic and total cross sections as a function of momentum. The solid circles refer to the present experiment.

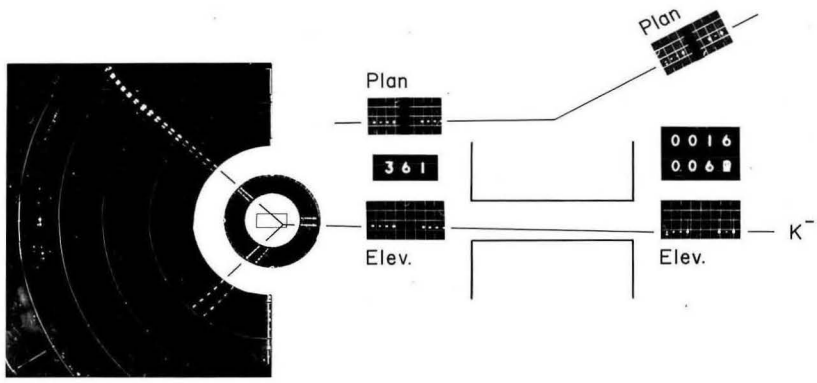


Fig. 1

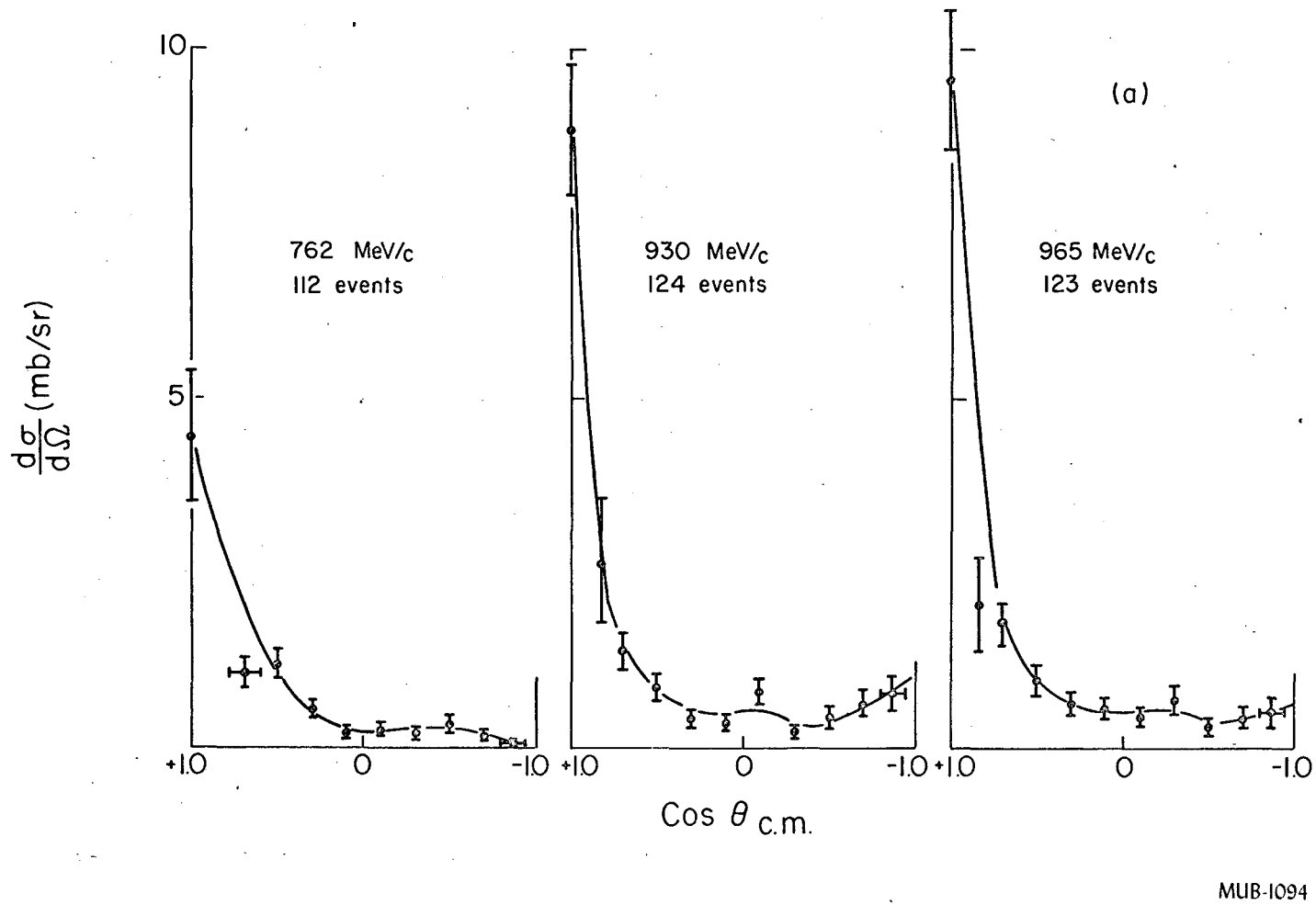

10
5
$\frac{d\sigma}{d\Omega}$ (mb/sr)
762 MeV/c
112 events
930 MeV/c
124 events
965 MeV/c
123 events
(a)
+1.0
0
-1.0
Cos θ c.m.
MUB-1094

Fig. 2a

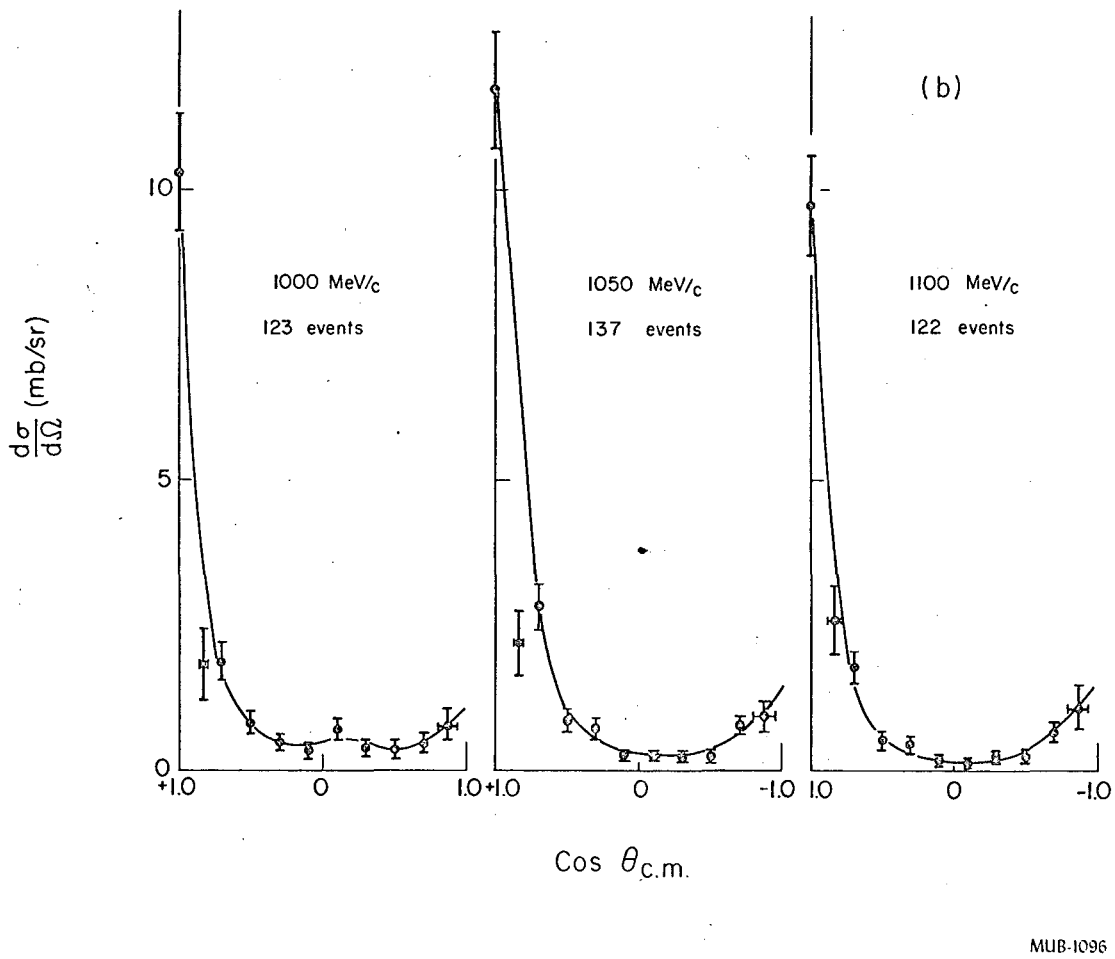
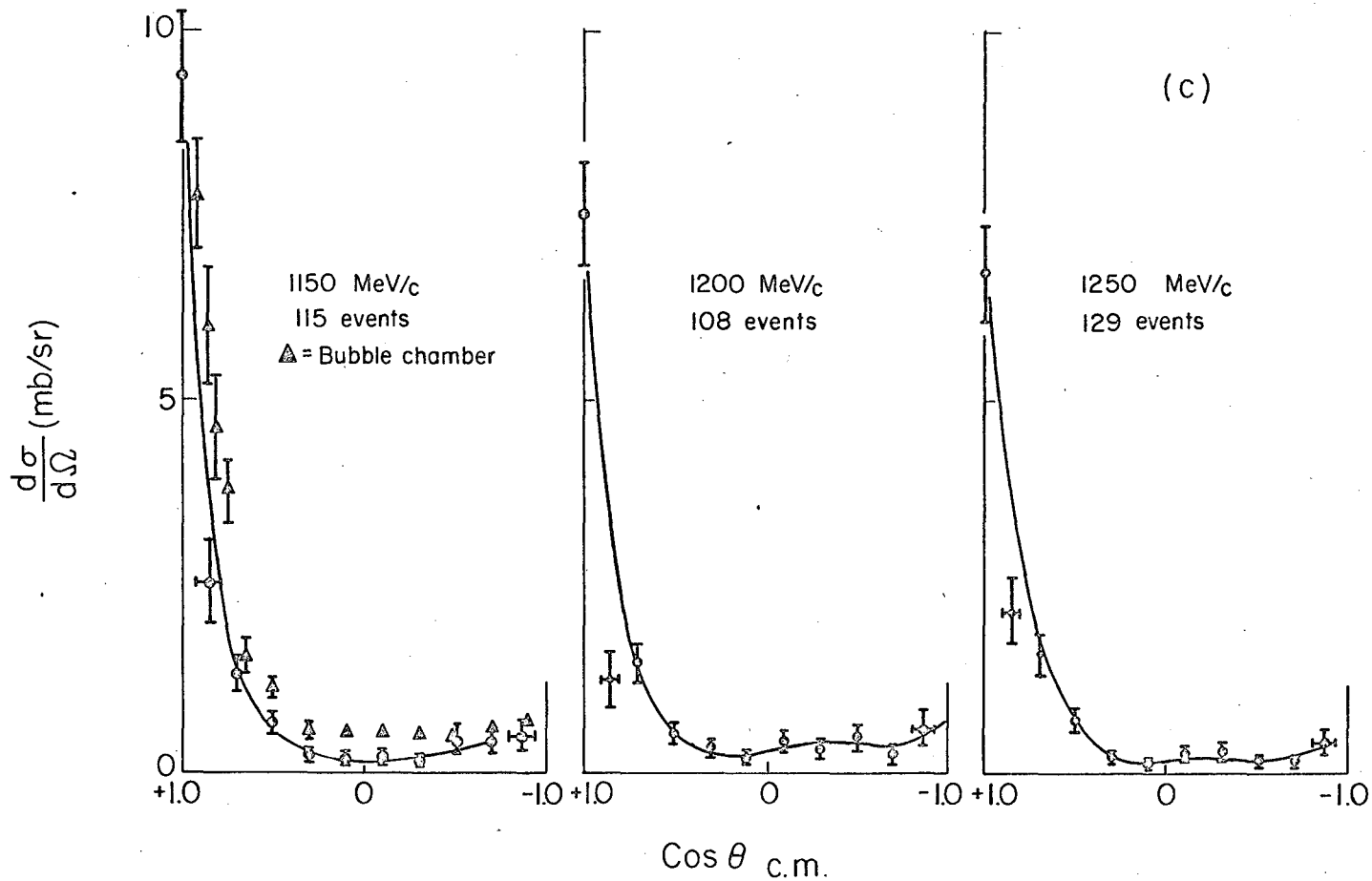
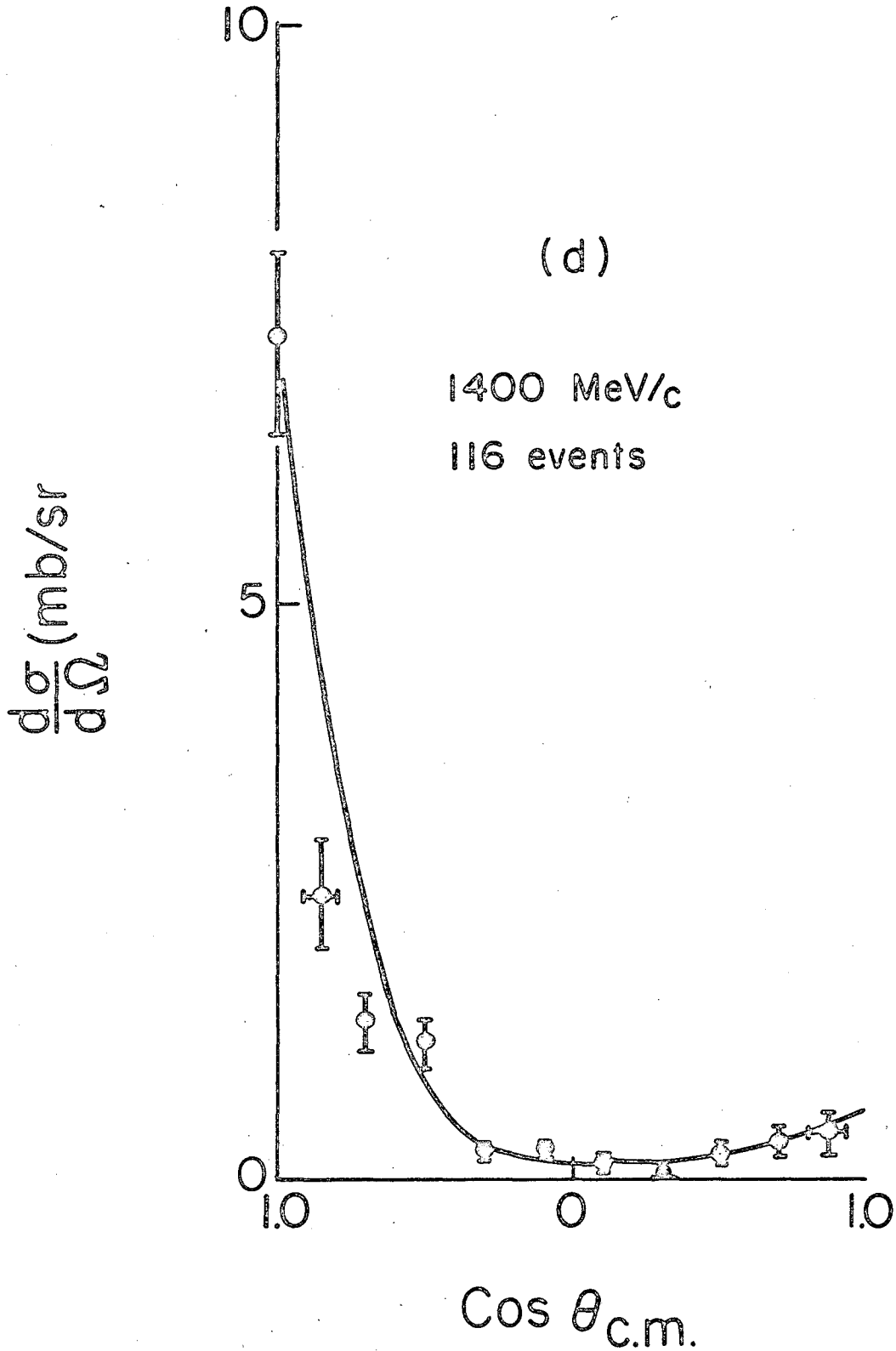

(b)
1000 MeV/c
123 events
1050 MeV/c
137 events
1100 MeV/c
122 events
dσ/dΩ (mb/sr)
10
5
0
+1.0
0
1.0
+1.0
0
-1.0
1.0
0
-1.0
Cos θc.m.
MUB-1096

Fig. 2b



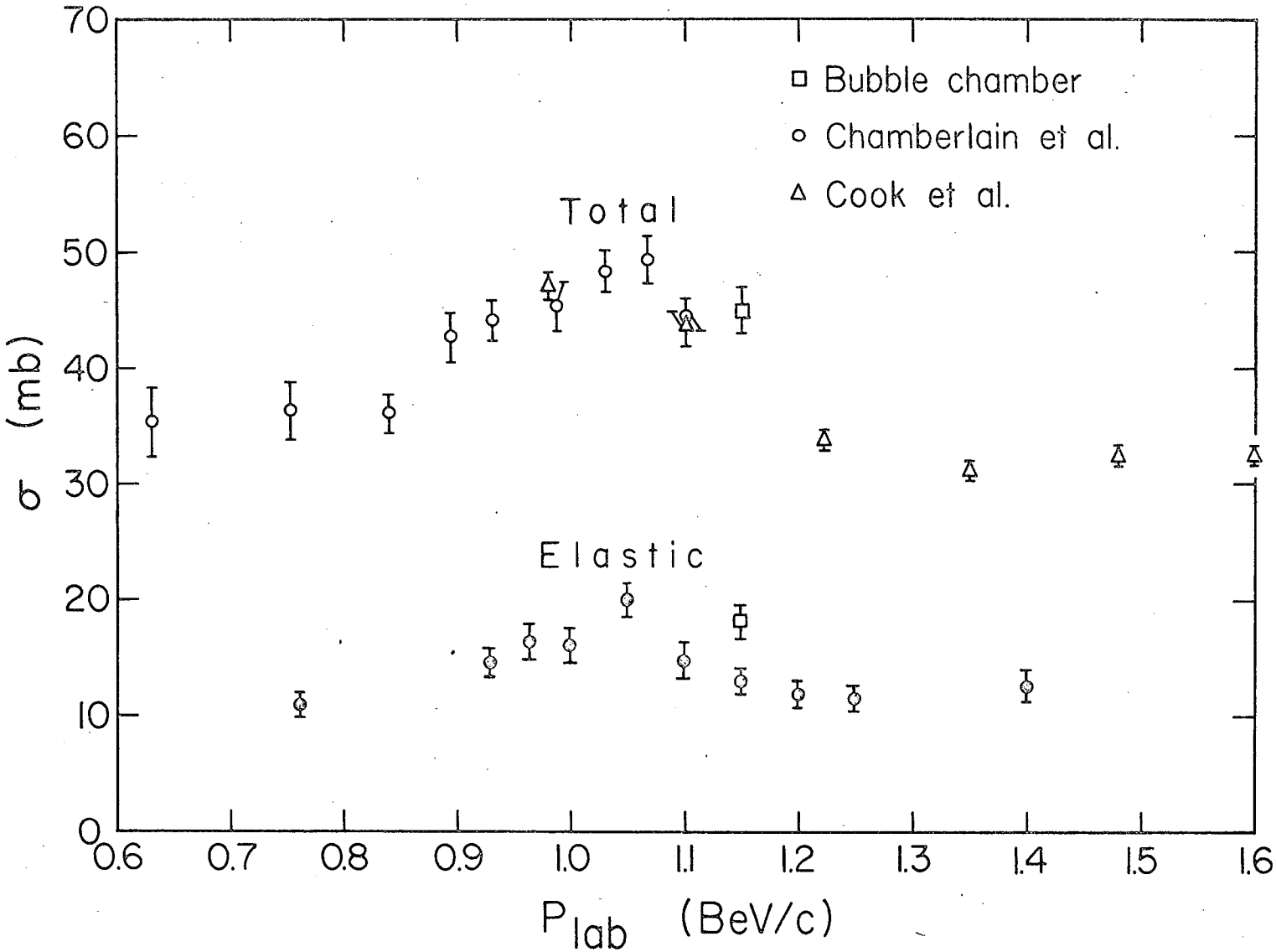
MUB-1095

Fig. 2c



MU-26873

Fig. 2d



MU-25874

Fig. 3