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A REVIEW OF PION MINUS PRODUCTION CROSS SECTIONS AND YIELDS IN
PROTON-NUCLEUS COLLISIONS FROM THRESHOLD TO $E_p = 70$ GEV

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Nuclear Data Section

International Atomic Energy Agency

September 1986

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FOREWORD

This report reviews most of the experimental works dealing with the pion minus production cross sections and yields in the $A(p, \pi^-)A+1$ reaction at proton incident energies $E_p \leq 70$ GeV and for $A \geq 2$ already discussed in a recent paper at $0.5 \text{ GeV} < E_p < 1 \text{ GeV}$ (BR85); the $p(p, \pi^-)d$ reaction has not been included because of regularly updated cross section data compiled elsewhere, e.g. by Flaminio et al. (FL84). Furthermore, very early measurements already reported in (LI62) have been voluntarily omitted. The table emphasizes and updates one of the topics previously covered in (FE80).

For each reported work, indicated by the reference given in the last column, the table gives the target nucleus, the kinetic energy E_p (in GeV) and the momentum P_p (in GeV/c) of the incident protons, the angular range Θ (in degrees), the kinetic energy E (in GeV) or the momentum P (in GeV/c) of the emitted π^- ; the measured quantities and the corresponding units are reported in the last but one column. The target nuclei are listed with increasing Z and the different works with increasing E_p .

The author would be very grateful to everyone pointing out errors or omissions in the table.

A Review of Pion Minus Production Cross Sections and Yields in

Proton-Nucleus Collisions from Threshold to $E_p = 70$ GeV

Abbreviations:

| | | |
|---------------------|----|--|
| A | = | Mass number of the target nucleus |
| E_p | = | Proton kinetic energy |
| P_p | = | Proton momentum |
| E^π | = | π^- total energy |
| E | = | π^- kinetic energy |
| P | = | π^- momentum except, for the labelled values that correspond to: |
| | a) | π^- transverse momentum P_\perp |
| | b) | momentum transfer in the centre of mass frame $ \vec{q}_{c.m.} = \vec{P}_p - \vec{P} _{c.m.}$ |
| | c) | the ratio x of the pion momentum to the maximum pion momentum in the centre of mass frame $x = (P/P_{max})_{c.m.}$ |
| θ | = | π^- detection angle (in the laboratory or in the center of mass frame, as given by the authors) |
| Ω | = | Solid angle |
| G.S. | = | Ground state of the residual nucleus |
| E_x | = | Excitation energy of the residual nucleus |
| $N(E)$ | = | π^- yield = dN/dE |
| $N(\theta, p)$ | = | π^- differential yield = $d^2N/(dp d\Omega)$ |
| $\sigma(\theta)$ | = | Differential cross section $d\sigma/d\Omega$ |
| $\sigma(E)$ | = | Differential cross section $d\sigma/dE$ |
| $\sigma(\theta, E)$ | = | Double differential cross section $d^2\sigma/(dE d\Omega)$ |
| $\sigma(\theta, p)$ | = | Double differential cross section $d^2\sigma/(dp d\Omega)$ |
| $\sigma(\vec{p})$ | = | Invariant cross section = $E^\pi d\sigma/d\vec{p}$ |
| σ_T | = | Total cross section for π^- production |

| Target | E_p (GeV) | P_p (GeV/c) | Θ (degrees) | E (GeV) | P (GeV/c) | Measured Quantities: Units | References | |
|----------|-------------|---------------|--------------------|---------------------------|---|---|--|--------------|
| D | 0.538-0.978 | 1.140-1.671 | | | | σ_T : mb | DA82 | |
| | 0.585 | 1.200 | | | | σ_T : mb | CR80a | |
| | 0.585 | 1.200 | 22.5 | | 0.024-0.254 | | $\sigma(\Theta, E): \mu\text{b MeV}^{-1} \text{sr}^{-1}$ | CR80a; CR80b |
| | | | 45 | | 0.024-0.192 | | " " | " " |
| | | | 60 | | 0.024-0.151 | | " " | " " |
| | | | 90 | | 0.024-0.151 | | " " | " " |
| | | | 135 | | 0.024-0.151 | | " " | " " |
| | 0.730 | 1.380 | 15 | | 0.030-0.408 | | $\sigma(\Theta, E): \mu\text{b MeV}^{-1} \text{sr}^{-1}$ | C072 |
| | | | 20 | | 0.030-0.358 | | " " | " |
| | | | 30 | | 0.030-0.358 | | " " | " |
| | | | 45 | | 0.030-0.305 | | " " | " |
| | | | 60 | | 0.030-0.255 | | " " | " |
| | | | 75 | | 0.030-0.205 | | " " | " |
| | | | 90 | | 0.030-0.155 | | " " | " |
| | 0.730 | 1.380 | | | | σ_T : mb | C072 | |
| 0.80 | 1.46 | 180 | | 0.191-0.314 | $\sigma(\Theta, p): \text{mb GeV}^{-1} \text{c sr}^{-1}$ | CH83 | | |
| 4.89 | 5.75 | 180 | | 0.188-0.426 | " " | " | | |
| 7.7; 8.0 | 8.6; 8.9 | 180 | | 0.200-0.600 | $A^{-1}\sigma(\vec{p}): \text{mb GeV}^{-2} \text{c}^3 \text{sr}^{-1}$ | BA77; BA82 | | |
| 70 | 70.9 | 90 | | 0.480-2.210 ^{a)} | $\sigma(\vec{p}): \text{mb GeV}^{-2} \text{c}^3$ | AB80a | | |
| 70 | 70.9 | 90 | | 1.55-4.22 ^{a)} | $\sigma(\vec{p}): \text{mb GeV}^{-2}$ | AB84 | | |
| He | 8.0 | 8.9 | 90; 180 | | 0.200-0.800 | $A^{-1}\sigma(\vec{p}): \text{mb GeV}^{-2} \text{c}^3 \text{sr}^{-1}$ | BA82 | |

| Target | E_p (GeV) | P_p (GeV/c) | Θ (degrees) | E (GeV) | P (GeV/c) | Measured Quantities: Units | References |
|-----------------|-------------|---------------|--------------------|-----------|----------------|---|------------|
| ${}^6\text{Li}$ | 8.0 | 8.9 | 168;180 | 0.380 | | $A^{-1}\sigma(\vec{p})$: mb GeV $^{-2}$ c 3 sr $^{-1}$ | BA79 |
| | 8.0 | 8.9 | 162 168 | | 0.800 0.500 | $\sigma(\Theta, p)$: relative units " " | B084 " |
| ${}^7\text{Li}$ | 8.0 | 8.9 | 168;180 | 0.380 | | $A^{-1}\sigma(\vec{p})$: mb GeV $^{-2}$ c 3 sr $^{-1}$ | BA79 |
| | 8.0 | 8.9 | 168 | | 0.500 | $\sigma(\Theta, p)$: relative units | B084 |
| Be | 0.185 | 0.618 | 35-130 | | | $\sigma(\Theta)$: for the G.S. and the 3.36, 5.28 and 6.63 MeV excited states in ${}^{10}\text{C}$: nb sr $^{-1}$ | DA73 |
| | 0.185 | 0.618 | | | 0.600 b) | $\sigma(\Theta)$: nb sr $^{-1}$ | BE80 |
| | 0.200 | 0.645 | 32-150 | | | spin averaged yields for the G.S. and the 3.35 MeV excited state in ${}^{10}\text{C}$: arbitrary units | L082 |
| | 0.200 | 0.645 | 25-150 | | 0.470-0.675 b) | $\sigma(\Theta)$: nb sr $^{-1}$ | SJ80;H081 |
| | 0.200-0.800 | 0.645-1.464 | | | 0.600 b) | $\sigma(\Theta)$ for the ${}^{10}\text{C}$ G.S.: nb sr $^{-1}$ | H081 |
| | 0.225 | 0.688 | 46-135 | | | spin averaged yields for the G.S. and the 3.35 MeV excited state in ${}^{10}\text{C}$: arbitrary units | L082;H081 |
| | | | 46 | | | $N(E)$ for $E_x < 28$ MeV in ${}^{10}\text{C}$: relative scale | L082 |
| | 0.225 | 0.688 | | | 0.52-0.72 b) | $\sigma(\Theta)$ for the ${}^{10}\text{C}$ G.S.: nb sr $^{-1}$ | L081;H081 |

| Target | E_p (GeV) | P_p (GeV/c) | Θ (degrees) | E(GeV) | P(GeV/c) | Measured Quantities: Units | References |
|--------|-------------|---------------|-------------------------------|---|-----------------------------|--|---------------------------------|
| Be | 0.250 | 0.730 | 46-135 | | | Spin averaged yields for the G.S. and the 3.35 MeV excited state in ^{10}C : arbitrary units | L082 |
| | 0.450 | 1.023 | 21.5 | 0.132;0.166; 0.200 | | $\sigma(\Theta, E)$: $\mu\text{b MeV}^{-1} \text{sr}^{-1}$ | LI62 |
| | 0.580 | 1.194 | 60 90 120 135 | 0.022-0.076 0.022-0.102 0.022-0.102 0.022-0.102 | | $\sigma(\Theta, E)$: $\mu\text{b MeV}^{-1} \text{sr}^{-1}$ " " " " " " | JA75 " " " |
| | 0.580 | 1.194 | | | | σ_T : mb | JA75 |
| | 0.585 | 1.200 | 22.5 45 60 90 135 | 0.024-0.254 0.024-0.192 0.024-0.151 0.024-0.151 0.024-0.151 | | $\sigma(\Theta, E)$: $\mu\text{b MeV}^{-1} \text{sr}^{-1}$ " " " " " " " " | CR80a;CR80b " " " " |
| | 0.585 | 1.200 | | | | σ_T : mb | CR80a |
| | 0.590 | 1.207 | 22.5 90 | 0.0133-0.031 0.0109-0.035 | | $\sigma(\Theta, E)$: $\mu\text{b MeV}^{-1} \text{sr}^{-1}$ " " | CR80 " |
| | 0.600 | 1.219 | 0.8 21.5 | 0.050-0.300 0.050-0.350 | | $\sigma(\Theta, E)$: $\mu\text{b MeV}^{-1} \text{sr}^{-1}$ " " | HI69 " |
| | 0.600 | 1.219 | 0 | | 0.522-0.575 | $\sigma(\Theta, p)$: $\text{nb MeV}^{-1}\text{c sr}^{-1}$ | R072 |
| | 0.613 | 1.236 | 5; 25 | | 0.5487;0.6506 ^{b)} | $\sigma(\Theta)$ for the G.S., the 3.35 MeV and the 5.28 MeV states in ^{10}C : nb sr^{-1} | C078;C083; BR79 |
| | 0.725 | 1.374 | 0 | 0.075-0.440 | | $\sigma(\Theta, E)$: $\mu\text{b MeV}^{-1} \text{sr}^{-1}$ | HA64 |

| Target | E_p (GeV) | P_p (GeV/c) | Θ (degrees) | E (GeV) | P (GeV/c) | Measured Quantities: Units | References |
|--------|-------------|---------------|--------------------|----------------|-------------|--|------------|
| Be | 0.730 | 1.380 | 15 | 0.030-0.553 | | $\sigma(\Theta, E): \mu\text{b MeV}^{-1} \text{sr}^{-1}$ | CO72 |
| | | | 20 | 0.030-0.553 | | " " | " |
| | | | 30 | 0.030-0.486 | | " " | " |
| | | | 45 | 0.030-0.408 | | " " | " |
| | | | 60 | 0.030-0.358 | | " " | " |
| | | | 75 | 0.030-0.305 | | " " | " |
| | | | 90 | 0.030-0.255 | | " " | " |
| | | | 105 | 0.030-0.205 | | " " | " |
| | | | 120 | 0.030-0.205 | | " " | " |
| | | | 135 | 0.030-0.205 | | " " | " |
| | | | 150 | 0.030-0.205 | | " " | " |
| | 0.730 | 1.380 | | | | $\sigma_T: \text{mb}$ | CO72;JA75 |
| | 0.800 | 1.464 | 9.5 | | | $N(E)$ at $E_x < 12 \text{ MeV}$ in ^{10}C : relative scale | HO79;HO81 |
| | 0.800 | 1.464 | | 0.590-0.750 b) | | $\sigma(\Theta)$ for the G.S., the 3.35 MeV, 5.3 MeV and the 6.6 MeV states in ^{10}C : nb sr^{-1} | HO79;NA82 |
| 1 | 1.7 | | 17;32 | 0.2-0.8 | | $\sigma(\Theta, p): \text{cm}^2 \text{MeV}^{-1} \text{c sr}^{-1}$ | ED76 |
| 1.05 | 1.75 | | 2.5 | 0.5-1 | | $\sigma(\Theta, p): \text{mb GeV}^{-1} \text{c sr}^{-1}$ | PA75;PA75a |
| 1.73 | 2.50 | | 2.5 | 0.5-1.75 | | " " | " " |
| 2 | 2.8 | | 17 | 0.3-1.0 | | $\sigma(\Theta, p): \text{cm}^2 \text{MeV}^{-1} \text{c sr}^{-1}$ | ED76 |
| | | | 32 | 0.2-1.2 | | " " | " |
| 2.1 | 2.9 | | 2.5 | 0.5-2.0 | | $\sigma(\Theta, p): \text{mb GeV}^{-1} \text{c sr}^{-1}$ | PA75;PA75a |
| 2.66 | 3.47 | | 2.5 | 0.5-2.625 | | " " | " " |
| 3 | 3.8 | | 17 | 0.4-1.4 | | $\sigma(\Theta, p): \text{cm}^2 \text{MeV}^{-1} \text{c sr}^{-1}$ | ED76 |
| | | | 0 | 0.8-2.0 | | $\sigma(\Theta, p): \text{arbitrary units}$ | " |

| Target | E_p (GeV) | P_p (GeV/c) | Θ (degrees) | E (GeV) | P (GeV/c) | Measured Quantities: Units | References |
|--------|-------------|---------------|--------------------|-----------|---|---|---------------|
| Be | 3.12 | 3.95 | 3.55 | | 0.78-2.63 | $\sigma(\vec{p})$: mb GeV ⁻² c ³ sr ⁻¹ $\sigma(\Theta, p)$: mb GeV ⁻¹ c sr ⁻¹ | BA79a BA76 |
| | 3.5 | 4.3 | 2.5 | | 0.5-3.25 | $\sigma(\Theta, p)$: mb GeV ⁻¹ c sr ⁻¹ | PA75; PA75a |
| | 4.2 | 5.05 | 2.5 | | 0.5-4.0 | " " | " " |
| | 4.8 | 5.7 | 2.5 | | 0.5-4.75 | " " | " " |
| | 5.8 | 6.7 | 3.55 | | 0.810-5.10 | $\sigma(\vec{p})$: mb GeV ⁻² c ³ sr ⁻¹ $\sigma(\Theta, p)$: mb GeV ⁻¹ c sr ⁻¹ | BA79a BA76 |
| | 7.76 | 8.65 | 0 | | 4 | $\sigma(\Theta, p)$: mb GeV ⁻¹ c sr ⁻¹ | DE65 |
| | 7.9 | 8.8 | 3.55 | | 5.93-7.71 | $\sigma(\vec{p})$: mb GeV ⁻² c ³ sr ⁻¹ | BA79a |
| | 8.0 | 8.9 | 168;180 | 0.380 | | $A^{-1}\sigma(\vec{p})$: mb GeV ⁻² c ³ sr ⁻¹ | BA79 |
| | 8.0 | 8.9 | 162 168 | | 0.800 0.500 | $\sigma(\Theta, p)$: relative units " | BO84 " |
| | 8.1 | 9 | 10.77 | | 1.04-5.28 | $\sigma(p, \Theta)$: mb GeV ⁻¹ c sr ⁻¹ | BE77 |
| | 8.1 | 9 | 10.77 | | 1.59-5.28 | $\sigma(\vec{p})$: mb GeV ⁻² c ³ sr ⁻¹ | BA79a |
| | 8.8 | 9.7 | 3.55 | | 1.02-7.21 | $\sigma(\vec{p})$: mb GeV ⁻² c ³ sr ⁻¹ $\sigma(p, \Theta)$: mb GeV ⁻¹ c sr ⁻¹ | BA79a BA76 |
| | 8.8 | 9.7 | | | 5.4 | $\sigma(p, \Theta)$: arbitrary scale | GA76 |
| | 10 | 10.9 | 9 | | 1.0-6.0 | $N(p, \Theta)$: GeV ⁻¹ c sr ⁻¹ | BA61 |
| | 10.9 | 11.8 | 0 | | 4;6;7 | $\sigma(\Theta, p)$: mb GeV ⁻¹ c sr ⁻¹ | DE65 |
| | 11.4 | 12.3 | 0;5;10 | | 0.51;0.82;1.03 | $\sigma(\Theta, p)$: mb GeV ⁻¹ c sr ⁻¹ | MA69 |
| 11.4 | 12.3 | 3 | | 1.5-4.8 | $\sigma(\Theta, p)$: mb GeV ⁻¹ c sr ⁻¹ | MA71 | |

| Target | E_p (GeV) | P_p (GeV/c) | Θ (degrees) | E(GeV) | P(GeV/c) | Measured Quantities: Units | References |
|--------|-------------|---------------|--------------------|--------|-----------------|--|-------------|
| Be | 11.6 | 12.5 | 2-16 | | 1.0-11.5 | $\sigma(\Theta, p)$: mb GeV ⁻¹ c sr ⁻¹ | LU65 |
| | 12 | 12.9 | 0 | | 0.525-2.10 | $\sigma(\Theta, p)$: relative units | BO84 |
| | | | 0 | | 0.735-2.10 | $\sigma(\vec{p})$: mb GeV ⁻² c ³ | " |
| | 17.9 | 18.8 | 0;5.7 | | 4-12 | $\sigma(\Theta, p)$: mb GeV ⁻¹ c sr ⁻¹ | DE65 |
| | 18.3 | 19.2 | 0.7 | | 6;8;10;12 | $\sigma(\Theta, p)$: b GeV ⁻¹ c sr ⁻¹ | AL70 |
| | | | | | 13.5-18.14 | | |
| | | | 1.15 | | 6;8;10;12;14;16 | " " | " |
| | | | 1.72 | | 6;8;10;12;14;16 | " " | " |
| | | | 2.29 | | 6;8;10;12;14;16 | " " | " |
| | | | 2.86 | | 6;8;10;12;14;16 | " " | " |
| | | | 3.44 | | 6;8;10;12;14;16 | " " | " |
| | | | 4.01 | | 6;8;10;12;14;16 | " " | " |
| | 20 | 20.9 | 4.75;9 | | 1-13 | $N(p, \Theta)$: GeV ⁻¹ c sr ⁻¹ | BA61 |
| | 22.2 | 23.1 | 0;5.7 | | 4-12 | $\sigma(\Theta, p)$: mb GeV ⁻¹ c sr ⁻¹ | DE65 |
| | 27.6 | 28.5 | 14.6 | | 0.75-2.25 a) | $\sigma(\vec{p})$: μ b GeV ⁻² c ³ | BE76 |
| | 30 | 30.9 | 4.75;9;20 | | 0.6-14.5 | $N(p, \Theta)$: GeV ⁻¹ c sr ⁻¹ | BA61 |
| | 66.1 | 67 | 0.11 | | 3-32 | $\sigma(\Theta, p)$: b GeV ⁻¹ c sr ⁻¹ | BO79a;BO80a |
| | | | 0.23 | | 5-40 | " " | " " |
| | | | 0.34 | | 6-52 | " " | " " |
| | | | 0.46 | | 8-54 | " " | " " |
| | | | 0.57 | | 10-52 | " " | " " |
| | | | 0.69 | | 15-21 | " " | " " |
| | | | 0.80 | | 13-49 | " " | " " |
| | | | 0.92 | | 12-44 | " " | " " |
| | | | 1.03 | | 11-38 | " " | " " |
| | | | 1.15 | | 10-34 | " " | " " |
| | 70 | 70.9 | 79 | | 2.1-2.6 | $\sigma(\vec{p})$: cm ² GeV ⁻² c ³ | AB76 |

| Target | E_p (GeV) | P_p (GeV/c) | Θ (degrees) | E (GeV) | P (GeV/c) | Measured Quantities: Units | References |
|--------|-------------|---------------|--------------------|-------------|--|--|-------------|
| C | 0.450 | 1.023 | 21.5 | 0.132 | | $\sigma(\Theta, E): \mu\text{b MeV}^{-1} \text{sr}^{-1}$ | LI62 |
| | | | 60 | 0.166;0.099 | | " " | " |
| | | | | 0.200 | | | |
| | 0.580 | 1.194 | 60 | 0.022-0.076 | | $\sigma(\Theta, E): \mu\text{b MeV}^{-1} \text{sr}^{-1}$ | JA75 |
| | | | 90 | 0.022-0.102 | | " " | " |
| | | | 120 | 0.022-0.102 | | " " | " |
| | | | 135 | 0.022-0.076 | | " " | " |
| | 0.580 | 1.194 | | | | $\sigma_T: \text{mb}$ | JA75 |
| | 0.585 | 1.200 | 22.5 | 0.024-0.254 | | $\sigma(\Theta, E): \mu\text{b MeV}^{-1} \text{sr}^{-1}$ | CR80a;CR80b |
| | | | 45 | 0.024-0.192 | | " " | " " |
| | | | 60 | 0.024-0.151 | | " " | " " |
| 90 | | | 0.024-0.151 | | " " | " " | |
| 135 | | | 0.024-0.151 | | " " | " " | |
| 0.585 | 1.200 | | | | $\sigma_T: \text{mb}$ | CR80a | |
| 0.590 | 1.207 | 90 | 0.007-0.0336 | | $\sigma(\Theta, E): \mu\text{b MeV}^{-1} \text{sr}^{-1}$ | CR80 | |
| 0.600 | 1.219 | 0.8;21.5 | 0.050-0.300 | | $\sigma(\Theta, E): \mu\text{b MeV}^{-1} \text{sr}^{-1}$ | HI69 | |
| 0.660 | 1.294 | 105 | 0.010-0.070 | | $\sigma(\Theta, E): \text{mb MeV}^{-1} \text{sr}^{-1}$ | BA77a | |
| 0.725 | 1.374 | 0 | 0.075-0.440 | | $\sigma(\Theta, E): \mu\text{b MeV}^{-1} \text{sr}^{-1}$ | HA64 | |
| 0.730 | 1.380 | 15 | 0.030-0.486 | | $\sigma(\Theta, E): \mu\text{b MeV}^{-1} \text{sr}^{-1}$ | C072 | |
| | | 20 | 0.030-0.486 | | " " | " | |
| | | 30 | 0.030-0.486 | | " " | " | |
| | | 45 | 0.030-0.408 | | " " | " | |
| | | 60 | 0.030-0.358 | | " " | " | |
| | | 75 | 0.030-0.305 | | " " | " | |
| | | 90 | 0.030-0.255 | | " " | " | |
| | | 105 | 0.030-0.255 | | " " | " | |

| Target | E_p (GeV) | P_p (GeV/c) | Θ (degrees) | E (GeV) | P (GeV/c) | Measured Quantities: Units | References |
|--------|-------------|---------------|--------------------|-------------|--|---|------------|
| C | 0.730 | 1.380 | 120 | 0.030-0.205 | | $\sigma(\Theta, E): \mu\text{b MeV}^{-1} \text{sr}^{-1}$ | C072 |
| | | | 135 | 0.030-0.205 | | " " | " |
| | | | 150 | 0.030-0.205 | | " " | " |
| | 0.730 | 1.380 | | | | $\sigma_T: \text{mb}$ | C072;JA75 |
| | 0.80 | 1.46 | 180 | | 0.189-0.315 | $\sigma(\Theta, p): \text{mb GeV}^{-1} \text{c sr}^{-1}$ | CH83 |
| | 1 | 1.7 | 17;32 | | 0.2-0.8 | $\sigma(\Theta, p): \text{cm}^2 \text{MeV}^{-1} \text{c sr}^{-1}$ | ED76 |
| | 1.05 | 1.75 | 180 | | 0.187-0.418 | $\sigma(\Theta, p): \text{mb GeV}^{-1} \text{c sr}^{-1}$ | CH83 |
| | 1.05 | 1.75 | 0-12 | | 0.27-1 | $\sigma(\vec{p}): \text{mb GeV}^{-2} \text{c}^3 \text{sr}^{-1}$ | M083 |
| | 1.05 | 1.75 | 2.5 | | 0.5-1 | $\sigma(\Theta, p): \text{mb GeV}^{-1} \text{c sr}^{-1}$ | PA75;PA75a |
| | 1.73 | 2.50 | 2.5 | | 0.5-1.75 | " " | " " |
| | 2 | 2.8 | 17 | | 0.3-1.2 | $\sigma(\Theta, p): \text{cm}^2 \text{MeV}^{-1} \text{c sr}^{-1}$ | ED76 |
| | | | | 32 | 0.2-1.2 | " " | " |
| | 2.1 | 2.9 | 2.5 | | 0.5-2.0 | $\sigma(\Theta, p): \text{mb GeV}^{-1} \text{c sr}^{-1}$ | PA75;PA75a |
| | 2.10 | 2.89 | 180 | | 0.186-0.491 | $\sigma(\Theta, p): \text{mb GeV}^{-1} \text{c sr}^{-1}$ | CH83 |
| | 2.1 | 2.9 | 0-12 | | 0.27-2.06 | $\sigma(\vec{p}): \text{mb GeV}^{-2} \text{c}^3 \text{sr}^{-1}$ | M083 |
| | 2.66 | 3.47 | 2.5 | | 0.5-2.625 | $\sigma(\Theta, p): \text{mb GeV}^{-1} \text{c sr}^{-1}$ | PA75;PA75a |
| | 3 | 3.8 | 0 | | 0.8-2.0 | $\sigma(\Theta, p): \text{arbitrary units}$ | ED76 |
| | | | | 17 | 0.4-1.4 | $\sigma(\Theta, p): \text{cm}^2 \text{MeV}^{-1} \text{c sr}^{-1}$ | " |
| | 3.5 | 4.3 | 2.5 | | 0.5-3.25 | $\sigma(\Theta, p): \text{mb GeV}^{-1} \text{c sr}^{-1}$ | PA75;PA75a |
| | 4.2 | 5.05 | 2.5 | | 0.5-4.0 | " " | " " |
| 4.8 | 5.7 | 2.5 | | 0.5-4.75 | " " | " " | |
| 4.89 | 5.75 | 180 | | 0.188-0.705 | $\sigma(\Theta, p): \text{mb GeV}^{-1} \text{c sr}^{-1}$ | CH83 | |

| Target | E_p (GeV) | P_p (GeV/c) | Θ (degrees) | E (GeV) | P (GeV/c) | Measured Quantities: Units | References |
|-----------------|-------------|---------------|--------------------|----------------------|--|--|------------|
| C | 5.1 | 6 | 180 | 0.109-0.673 | | $2 \sigma(\vec{p})$: mb GeV ⁻² c ³ | BA75 |
| | 7.5 | 8.4 | 180 | 0.119-1.072 | | " " | " |
| | 8.0 | 8.9 | 168 180 | 0.079-0.770 0.380 | | $A^{-1}\sigma(\vec{p})$: mb GeV ⁻² c ³ sr ⁻¹ | BA79 |
| | 8.0 | 8.9 | 90 162 168 | | 1.100 0.800 0.500 | $\sigma(\Theta, p)$: relative units | BO84a |
| | | | | | | " " | BO84 |
| | | | | | | " " | " |
| | 10 | 10.9 | 0 | | 0.40;1.06;1.40 | $\sigma(\Theta, p)$: mb GeV ⁻¹ c sr ⁻¹ | AM82 |
| | 18 | 18.9 | 0 | | 0.40;1.06;1.40 | " " | " |
| | 24 | 24.9 | 0 | | 0.40;1.06;1.40 | " " | " |
| | 70 | 70.9 | 90 | | 0.480-2.510 a) | $\sigma(\vec{p})$: relative units | AB80 |
| 70 | 70.9 | 90 | | 0.99-4.65 a) | $\sigma(\vec{p})$: mb GeV ⁻² | AB84a | |
| ¹² C | 0.200 | 0.645 | 25-155 | | 0.5-0.66 b) | $\sigma(\Theta)$ for the ¹³ O G.S.: nb sr ⁻¹ | HO80;HO81 |
| | 0.200-0.800 | 0.645-1.464 | | | 0.600 b) | $\sigma(\Theta)$ for the ¹³ O G.S.: nb sr ⁻¹ | HO81 |
| | 0.201 | 0.646 | 30 90 | 0.020;0.033 0.020 | | $\sigma(\Theta, E)$: μ b MeV ⁻¹ sr ⁻¹ | BI85 |
| | | | | | | " " | " |
| | 0.205 | 0.653 | 31-153 | | | $\sigma(\Theta)$ for the ¹³ O G.S.: nb sr ⁻¹ | JA82;HO84 |
| | 0.330 | 0.854 | | | | σ_T : mb | DI85 |
| | 0.400 | 0.954 | | | | " " | " |
| | 0.500 | 1.090 | | | | " " | " |
| 0.613 | 1.236 | 5-35 | | 0.5868-0.7606 b) | $\sigma(\Theta)$ for the G.S. and the 2.82 MeV state of ¹³ O: nb sr ⁻¹ | CO78;CO83;BR79 | |

| Target | E_p (GeV) | P_p (GeV/c) | Θ (degrees) | E (GeV) | P (GeV/c) | Measured Quantities: Units | References |
|----------------------|-------------|---------------|--------------------|-----------|--------------|---|------------|
| ^{13}C | 0.185 | 0.618 | 35-130 | | | $\sigma(\Theta)$ for the ^{14}O G.S.: nb sr $^{-1}$ | DA73a,DI76 |
| | 0.185 | 0.618 | | | 0.6 b) | $\sigma(\Theta)$: nb sr $^{-1}$ | BE80 |
| | 0.190 | 0.627 | 31-153 | | | $\sigma(\Theta)$ for the ^{14}O G.S.: nb sr $^{-1}$ | JA82;H084 |
| | 0.191 | 0.629 | | | 0.50-0.66 b) | $\sigma(\Theta)$ for $\langle E_x \rangle = 6.5$ MeV in ^{14}O : nb sr $^{-1}$ | VI82;VI83 |
| | 0.200 | 0.645 | | | 0.6 b) | $\sigma(\Theta)$: nb sr $^{-1}$ | BE80 |
| | 0.200 | 0.645 | 25-155 | | 0.48-0.69 b) | $\sigma(\Theta)$ for the ^{14}O G.S.: nb sr $^{-1}$ | H080 |
| | 0.613 | 1.236 | 5 | | 0.5732 b) | $\sigma(\Theta)$ for the ^{14}O G.S.: nb sr $^{-1}$ | C078;C083 |
| ^{14}C | 0.183 | 0.614 | 31-153 | | | $\sigma(\Theta)$ for the ^{15}O G.S.: nb sr $^{-1}$ | JA82;H084 |
| | 0.183 | 0.614 | | | 0.50-0.65 b) | $\sigma(\Theta)$ for $E_x = 7.3$ MeV in ^{15}O : nb sr $^{-1}$ | VI82;VI83 |
| | 0.183 | 0.614 | 28 | | | $\sigma(\Theta, E)$ for $E_x < 13$ MeV in ^{15}O : nb sr $^{-1}$ MeV $^{-1}$ | VI82;VI83 |
| CH_2 | 0.80 | 1.46 | 180 | | 0.191-0.314 | $\sigma(\Theta, p)$: mb GeV $^{-1}$ c sr $^{-1}$ | CH83 |
| | 4.89 | 5.75 | 180 | | 0.188-0.426 | " " | " |
| CD_2 | 4.89 | 5.75 | 180 | | 0.188-0.425 | $\sigma(\Theta, p)$: mb GeV $^{-1}$ c sr $^{-1}$ | CH83 |
| B_4C | 18.3 | 19.2 | 0.7 | | 6;8;10;12;14 | $\sigma(\Theta, p)$: b GeV $^{-1}$ c sr $^{-1}$ | AL70 |
| | | | 1.15 | | 6;8;10;12;14 | " " | " |
| | | | 1.72 | | 6;8;10;12;14 | " " | " |

| Target | E_p (GeV) | P_p (GeV/c) | Θ (degrees) | E (GeV) | P (GeV/c) | Measured Quantities: Units | References |
|-----------|-------------|---------------|--------------------|-----------------------|----------------|--|-------------|
| B_4C | 18.3 | 19.2 | 2.29 | | 6;8;10;12;14 | $\sigma(\Theta, p): b \text{ GeV}^{-1} c \text{ sr}^{-1}$ | AL70 |
| | | | 2.86 | | 6;8;10;12;14 | " " | " |
| | | | 3.44 | | 6;8;10;12;14 | " " | " |
| | | | 4.01 | | 6;8;10;12 | " " | " |
| O | 0.585 | 1.200 | 22.5 | | 0.024-0.254 | $\sigma(\Theta, E): \mu b \text{ MeV}^{-1} \text{ sr}^{-1}$ | CR80a |
| | | | 45 | | 0.024-0.192 | " " | " |
| | | | 60 | | 0.024-0.151 | " " | " |
| | | | 90 | | 0.024-0.151 | " " | " |
| | | | 135 | | 0.024-0.151 | " " | " |
| | 0.585 | 1.200 | | | $\sigma_T: mb$ | CR80a | |
| ^{18}O | 0.206 | 0.655 | 30 | | | $\sigma(\Theta, E)$ for $E_x < 19 \text{ MeV}$ in $^{19}Ne: nb \text{ MeV}^{-1} \text{ sr}^{-1}$ | VI82;VI83 |
| Mg | 8.0 | 8.9 | 168 | | 0.500 | $\sigma(\Theta, p): \text{relative units}$ | B084 |
| ^{26}Mg | 0.160 | 0.571 | | | 0.482 b) | $\sigma(\Theta): nb \text{ sr}^{-1}$ | BE80 |
| | 0.180 | 0.609 | | | 0.506;0.600 b) | $\sigma(\Theta): nb \text{ sr}^{-1}$ | BE80 |
| | 0.180 | 0.609 | 40;60;90 | | | $\sigma(\Theta)$ for the G.S. and the 0.78+0.96 MeV excited states in $^{27}Si: nb \text{ sr}^{-1}$ | H078 |
| | 8.0 | 8.9 | 168;180 | 0.38 | | $A^{-1}\sigma(\vec{p}): mb \text{ GeV}^{-2} c^3 \text{ sr}^{-1}$ | BA79 |
| Al | 0.450 | 1.023 | 21.5 | 0.132;0.166; 0.200 | | $\sigma(\Theta, E): \mu b \text{ MeV}^{-1} \text{ sr}^{-1}$ | LI62 |
| | 0.585 | 1.200 | 22.5 | 0.024-0.254 | | $\sigma(\Theta, E): \mu b \text{ MeV}^{-1} \text{ sr}^{-1}$ | CR80a;CR80b |

| Target | E_p (GeV) | P_p (GeV/c) | Θ (degrees) | E(GeV) | P(GeV/c) | Measured Quantities: Units | References |
|--------|-------------|---------------|--------------------|-------------|---|--|-------------|
| Al | 0.585 | 1.200 | 45 | 0.024-0.192 | | $\sigma(\Theta, E): \mu\text{b MeV}^{-1} \text{sr}^{-1}$ | CR80a;CR80b |
| | | | 60 | 0.024-0.151 | | " " | " " |
| | | | 90 | 0.024-0.151 | | " " | " " |
| | | | 135 | 0.024-0.151 | | " " | " " |
| | 0.585 | 1.200 | | | | $\sigma_T: \text{mb}$ | CR80a |
| | 0.600 | 1.219 | 0.8 | 0.050-0.300 | | $\sigma(\Theta, E): \mu\text{b MeV}^{-1} \text{sr}^{-1}$ | HI69 |
| | | | 21.5 | 0.050-0.350 | | " " | " |
| | 0.660 | 1.294 | 105 | 0.010-0.070 | | $\sigma(\Theta, E): \text{mb MeV}^{-1} \text{sr}^{-1}$ | BA77a |
| | 0.725 | 1.373 | 0 | 0.075-0.440 | | $\sigma(\Theta, E): \mu\text{b MeV}^{-1} \text{sr}^{-1}$ | HA64 |
| | 0.730 | 1.380 | 15 | 0.030-0.553 | | $\sigma(\Theta, E): \mu\text{b MeV}^{-1} \text{sr}^{-1}$ | C072 |
| | | | 20 | 0.030-0.553 | | " " | " |
| | | | 30 | 0.030-0.553 | | " " | " |
| | | | 45 | 0.030-0.408 | | " " | " |
| | | | 60 | 0.030-0.358 | | " " | " |
| | | | 75 | 0.030-0.358 | | " " | " |
| | | | 90 | 0.030-0.305 | | " " | " |
| | | | 105 | 0.030-0.255 | | " " | " |
| | | | 120 | 0.030-0.255 | | " " | " |
| | | | 135 | 0.030-0.255 | | " " | " |
| | 150 | 0.030-0.205 | | " " | " | | |
| 0.730 | 1.380 | | | | $\sigma_T: \text{mb}$ | C072 | |
| 1.05 | 1.75 | 180 | | 0.184-0.255 | $\sigma(\Theta, p): \text{mb GeV}^{-1}\text{c sr}^{-1}$ | CH83 | |
| 2.10 | 2.89 | 180 | | 0.186-0.519 | " " | " | |
| 3.12 | 3.95 | 3.55 | | | | $\sigma(\vec{p}): \text{mb GeV}^{-2}\text{c}^3 \text{sr}^{-1}$ | BA79a |
| | | | | | 0.78-2.63 | $\sigma(p, \Theta): \text{mb GeV}^{-1}\text{c sr}^{-1}$ | BA76 |
| 3.17 | 4 | 38-53 | 0-0.8 | | $\sigma(\vec{p}): \text{b GeV}^{-2}\text{c sr}^{-1}$ | EN85 | |
| | | 53-66 | 0-0.8 | | " " | " | |

| Target | E_p (GeV) | P_p (GeV/c) | Θ (degrees) | E(GeV) | P(GeV/c) | Measured Quantities: Units | References |
|--------|-------------|---------------|--------------------|--------------|-------------|--|---------------|
| Al | 3.17 | 4 | 66-78 | 0-0.8 | | $\sigma(\vec{p})$: b $\text{GeV}^{-2}c \text{ sr}^{-1}$ | EN85 |
| | | | 78-90 | 0-0.8 | | " | " |
| | 5.1 | 6 | 180 | 0.109-0.673 | | $2 \sigma(\vec{p})$: mb $\text{GeV}^{-2}c^3$ | BA75 |
| | 5.8 | 6.7 | 3.55 | | 0.81-0.510 | $\sigma(\vec{p})$: mb $\text{GeV}^{-2}c^3 \text{ sr}^{-1}$ $\sigma(p, \Theta)$: mb $\text{GeV}^{-1}c \text{ sr}^{-1}$ | BA79a BA76 |
| | 7.5 | 8.4 | 180 | 0.119-1.072 | | $2 \sigma(\vec{p})$: mb $\text{GeV}^{-2}c^3$ | BA75 |
| | 8.0 | 8.9 | 168 | 0.048-1.010 | | $A^{-1}\sigma(\vec{p})$: mb $\text{GeV}^{-2}c^3 \text{ sr}^{-1}$ | BA79 |
| | | | 180 | 0.380 | | " | " |
| | 8.0 | 8.9 | 90 | | 0.158-1.200 | $A^{-1}\sigma(\vec{p})$: mb $\text{GeV}^{-2}c^3 \text{ sr}^{-1}$ | BA82 |
| | | | 168 | | 0.125-1.200 | " | " |
| | 8.0 | 8.9 | 90 | | 1.100 | $\sigma(\Theta, p)$: relative units | BO84a |
| | | | 162 | | 0.800 | " | BO84 |
| | | | 168 | | 0.500 | " | " |
| | 8.1 | 9 | 10.77 | | 1.59-5.28 | $\sigma(\vec{p})$: mb $\text{GeV}^{-2}c^3 \text{ sr}^{-1}$ | BA79a |
| | 8.1 | 9 | 10.77 | | 1.04-5.28 | $\sigma(\Theta, p)$: mb $\text{GeV}^{-1}c \text{ sr}^{-1}$ | BE77 |
| | 8.8 | 9.7 | 3.55 | | 0.96-7.47 | $\sigma(\vec{p})$: mb $\text{GeV}^{-2}c^3 \text{ sr}^{-1}$ | BA79a |
| | | | | | | $\sigma(\Theta, p)$: mb $\text{GeV}^{-1}c \text{ sr}^{-1}$ | BA76 |
| | 8.8 | 9.7 | | | 5.4 | $\sigma(\Theta, p)$: arbitrary scale | GA76 |
| | 12 | 12.9 | 0 | | 0.735-2.10 | $\sigma(\vec{p})$: mb $\text{GeV}^{-2}c^3$ | YA81 |
| | 18.3 | 19.2 | 0.7 | | 6;8;10;12; | $\sigma(\Theta, p)$: b $\text{GeV}^{-1}c \text{ sr}^{-1}$ | AL70 |
| | | | | 13.5-18.14 | | | |
| | | | | 6;8;10;12;14 | | | |
| | | | | 6;8;10;12;14 | | | |
| | | | | 6;8;10;12;14 | | | |
| | 2.29 | 6;8;10;12;14 | | | | | |

| Target | E_p (GeV) | P_p (GeV/c) | Θ (degrees) | E (GeV) | P (GeV/c) | Measured Quantities: Units | References |
|--------|-------------|---------------|--------------------|-----------|--|--|------------|
| Al | 18.3 | 19.2 | 2.86 | | 6;8;10;12;14 | $\sigma(\Theta,p)$: b $\text{GeV}^{-1}\text{c sr}^{-1}$ | AL70 |
| | | | 3.44 | | 6;8;10;12;14 | " " | " |
| | | | 4.01 | | 6;8;10;12;14 | " " | " |
| | 30 | 30.9 | 4.75-13 | | 1-16.3 | $N(\Theta,p)$: $\text{GeV}^{-1}\text{c sr}^{-1}$ | BA61 |
| | 66.1 | 67 | 0 | | 4-59 | $N(\Theta,p)$ for two target thicknesses: $\text{GeV}^{-1}\text{c sr}^{-1}$ | B079;B080 |
| | | | 0.11 | | 3-59 | " " | " " |
| | | | 0.23 | | 5-57 | " " | " " |
| | | | 0.34 | | 5-57 | " " | " " |
| | | | 0.46 | | 4-57 | " " | " " |
| | | | 0.57 | | 6-57 | " " | " " |
| | | | 0.69 | | 5-56 | " " | " " |
| | | | 0.80 | | 4-52 | " " | " " |
| | | | 0.92 | | 4-50 | " " | " " |
| | | | 1.03 | | 3-45 | " " | " " |
| | | | 1.15 | | 3-42 | " " | " " |
| | | | 1.26 | | 17-43 | " " | " " |
| | | | 1.38 | | 15-44 | " " | " " |
| | | | 1.49 | | 14-42 | " " | " " |
| | | | 1.60 | | 12-38 | " " | " " |
| | | | 1.72 | | 11-34 | " " | " " |
| | | | 2.29 | | 8-33 | " " | " " |
| | 2.41 | | 7-30 | " " | " " | | |
| | 2.52 | | 7-27 | " " | " " | | |
| 2.64 | | 16-25 | " " | " " | | | |
| 2.75 | | 6-23 | " " | " " | | | |
| 66.1 | 67 | 0.11 | | 3-59 | $\sigma(\Theta,p)$: b $\text{GeV}^{-1}\text{c sr}^{-1}$ | B079a;B080a | |
| | | 0.23 | | 5-50 | " " | " " | |
| | | 0.34 | | 6-54 | " " | " " | |
| | | 0.46 | | 8-53 | " " | " " | |
| | | 0.57 | | 5-54 | " " | " " | |
| | | 0.69 | | 5-53 | " " | " " | |

| Target | E_p (GeV) | P_p (GeV/c) | Θ (degrees) | E(GeV) | P(GeV/c) | Measured Quantities: Units | References |
|--------|-------------|---------------|--------------------|----------------|---|--|-------------|
| Al | 66.1 | 67 | 0.80 | | 4-47 | $\sigma(\Theta,p): b \text{ GeV}^{-1}c \text{ sr}^{-1}$ | B079a;B080a |
| | | | 0.92 | | 4-44 | " " | |
| | | | 1.03 | | 3-38 | " " | |
| | | | 1.15 | | 3-38 | " " | |
| | | | 1.26 | | 17-35 | " " | |
| | | | 1.38 | | 15-30 | " " | |
| | | | 1.49 | | 14-27 | " " | |
| | | | 1.60 | | 12-24 | " " | |
| | | | 1.72 | | 11-21 | " " | |
| | | | 2.29 | | 8-19 | " " | |
| | | | 2.41 | | 7-17 | " " | |
| | | | 2.52 | | 6-15 | " " | |
| | | | 2.64 | | 6-14 | " " | |
| | | | 2.75 | | 6-13 | " " | |
| | | | | 69.1 | 70 | 0 | |
| 0.69 | | 25.1;31.0 | | | | " " | |
| 1.2 | | 38.7 | | | | " " | |
| 70 | 70.9 | 70.9 | 0 | | 40.5;50;60;66 | $\sigma(\Theta,E): mb \text{ GeV}^{-1}c \text{ sr}^{-1}$ | BU69;BU70 |
| | | | 0.11 | | 63;69 | " " | |
| | | | 0.17 | | 60 | " " | |
| | | | 0.23 | | 55;66;69 | " " | |
| | | | 0.29 | | 45.3 | " " | |
| | | | 0.34 | | 63 | " " | |
| | | | 0.46 | | 50;60 | " " | |
| | | | 0.57 | | 50.1 | " " | |
| | | | 0.69 | | 40.9 | " " | |
| | | | 0.86 | | 45.3 | " " | |
| 70 | 70.9 | 90 | | 0.480-0.510 a) | $\sigma(\vec{p}):$ arbitrary scale | AB80 | |
| 70 | 70.9 | 0 | | 1.5;2;2.5;3 | $\sigma(\Theta,p): b \text{ GeV}^{-1}c \text{ sr}^{-1}$ | BA82a | |
| 70 | 70.9 | 90 | | 0.99-4.00 a) | $\sigma(\vec{p}): mb \text{ GeV}^{-2}$ | AB84a | |

| Target | E_p (GeV) | P_p (GeV/c) | Θ (degrees) | E (GeV) | P (GeV/c) | Measured Quantities: Units | References |
|-----------|-------------|---------------|--------------------|-------------|-------------|--|-------------------------|
| Al_2O_3 | 66.1 | 67 | 0 | | 4-59 | $N(\Theta, p): GeV^{-1}c sr^{-1}$ | B079;B080 |
| | | | 0.11 | | 3-59 | " " | " " |
| | | | 0.23 | | 5-50 | " " | " " |
| | | | 0.34 | | 5-58 | " " | " " |
| | | | 0.46 | | 4-53 | " " | " " |
| | | | 0.57 | | 5-53 | " " | " " |
| | | | 0.92 | | 3-45 | " " | " " |
| | | | 1.03 | | 3-41 | " " | " " |
| | | | 1.15 | | 3-39 | " " | " " |
| | | | 1.26 | | 17-37 | " " | " " |
| | | | 1.38 | | 15-31 | " " | " " |
| | | | 1.49 | | 12-28 | " " | " " |
| | | | 1.60 | | 12-25 | " " | " " |
| | | | 1.72 | | 10-23 | " " | " " |
| | | | 2.29 | | 8-31 | " " | " " |
| | | | 2.41 | | 7-30 | " " | " " |
| 2.52 | | 6-28 | " " | " " | | | |
| 2.64 | | 6-25 | " " | " " | | | |
| 2.75 | | 6-23 | " " | " " | | | |
| Si | 8.0 | 8.9 | 168 | 0.079;0.380 | | $A^{-1} \sigma(\vec{p}): mb GeV^{-2}c^3 sr^{-1}$ | BA79 |
| | | | 180 | 0.380 | | " " | |
| | 8.0 | 8.9 | 168 | | 0.500 | $\sigma(\Theta, p):$ relative units | B084 |
| ^{40}Ca | 0.190 | 0.627 | 30 | | | $\sigma(\Theta)$ for the ^{41}Tc G.S.: nb sr^{-1} | SH83 |
| ^{42}Ca | 0.206 | 0.655 | 30 | | | $\sigma(\Theta, E)$ for $E_x < 17$ MeV in ^{43}Ti : nb $sr^{-1} MeV^{-1}$ | VI82;VI83; BR83;H084 |
| | | | | | | $\sigma(\Theta)$ for $E_x = 3.1$ MeV in ^{43}Ti : nb sr^{-1} | VI83 |

| Target | E_p (GeV) | P_p (GeV/c) | Θ (degrees) | E (GeV) | P (GeV/c) | Measured Quantities: Units | References |
|------------------|-------------|---------------|--------------------|-----------|--------------|--|--------------------------------------|
| ^{44}Ca | 0.206 | 0.655 | 30 | | | $\sigma(\Theta)$ for $E_x = 4.26$ MeV in ^{45}Ti : nb sr $^{-1}$ | VI83 |
| | | | 30 | | | $\sigma(\Theta, E)$ for $E_x < 6$ MeV in ^{45}Ti : nb MeV $^{-1}$ sr $^{-1}$ | BR83 |
| ^{48}Ca | 0.166 | 0.582 | 45 | | | $\sigma(\Theta, E)$ for $E_x < 7$ MeV in ^{49}Ti : arbitrary units | SH84 |
| | 0.206 | 0.655 | 30 | | 0.52-0.75 b) | $\sigma(\Theta, E)$ for $E_x < 19$ MeV in ^{49}Ti : nb MeV $^{-1}$ sr $^{-1}$ $\sigma(\Theta)$ for $\langle E_x \rangle = 4$ MeV in ^{49}Ti : nb sr $^{-1}$ | VI82;VI83; BR83;H084 VI82;VI83 |
| Ti | 0.730 | 1.380 | | | | σ_T : mb | C072 |
| | 27.6 | 28.5 | 14.6 | | 0.75-2.25 a) | $\sigma(\vec{p})$: $\mu\text{b GeV}^{-2}\text{c}^3$ | BE76 |
| ^{48}Ti | 0.206 | 0.655 | 30 | | | $\sigma(\Theta)$ for $E_x = 4.3$ MeV in ^{49}Cr : nb sr $^{-1}$ | VI83 |
| ^{50}Ti | 0.206 | 0.655 | 30 | | | $\sigma(\Theta)$ for $E_x = 3.3$ MeV in ^{51}Cr : nb sr $^{-1}$ | VI83 |
| | | | | | | $\sigma(\Theta, E)$ for $E_x < 6$ MeV in ^{51}Cr : nb MeV $^{-1}$ sr $^{-1}$ | BR83 |
| ^{52}Cr | 0.206 | 0.655 | 30 | | | $\sigma(\Theta)$ for $E_x = 3.4$ MeV in ^{53}Fe : nb sr $^{-1}$ | VI83 |
| | | | | | | $\sigma(\Theta, E)$ for $E_x < 6$ MeV in ^{53}Fe : nb MeV $^{-1}$ sr $^{-1}$ | BR83 |

| Target | E_p (GeV) | P_p (GeV/c) | Θ (degrees) | E (GeV) | P (GeV/c) | Measured Quantities: Units | References |
|------------------|-------------|---------------|--------------------|---------------|-------------|---|-------------|
| ^{54}Fe | 0.206 | 0.655 | 30 | | | $\sigma(\Theta, E)$ for $E_x < 6$ MeV in ^{55}Ni : nb $\text{MeV}^{-1} \text{sr}^{-1}$ | BR83 |
| | 8.0 | 8.9 | 168;180 | 0.380 | | $A^{-1}\sigma(\vec{p})$: mb $\text{GeV}^{-2} \text{c}^3 \text{sr}^{-1}$ | BA79 |
| | 8.0 | 8.9 | 168 | | 0.500 | $\sigma(\Theta, p)$: relative units | B084 |
| ^{56}Fe | 8.0 | 8.9 | 168;180 | 0.380 | | $A^{-1}\sigma(\vec{p})$: mb $\text{GeV}^{-2} \text{c}^3 \text{sr}^{-1}$ | BA79 |
| | 8.0 | 8.9 | 168 | | 0.500 | $\sigma(\Theta, p)$: relative units | B084 |
| ^{58}Fe | 8.0 | 8.9 | 168;180 | 0.380 | | $A^{-1}\sigma(\vec{p})$: mb $\text{GeV}^{-2} \text{c}^3 \text{sr}^{-1}$ | BA79 |
| | 8.0 | 8.9 | 168 | | 0.500 | $\sigma(\Theta, p)$: relative units | B084 |
| Ni | 0.585 | 1.200 | 22.5 | 0.024-0.254 | | $\sigma(\Theta, E)$: $\mu\text{b MeV}^{-1} \text{sr}^{-1}$ | CR80a;CR80b |
| | | | 45 | 0.024-0.192 | | " " | " " |
| | | | 60 | 0.024-0.151 | | " " | " " |
| | | | 90 | 0.024-0.151 | | " " | " " |
| | | | 135 | 0.024-0.151 | | " " | " " |
| | 0.585 | 1.200 | | | | σ_T : mb | CR80a |
| | 0.590 | 1.207 | 22.5 | 0.0113-0.0301 | | $\sigma(\Theta, E)$: $\mu\text{b MeV}^{-1} \text{sr}^{-1}$ | CR80 |
| 90 | | | 0.0064-0.0335 | | " " | " " | |
| ^{58}Ni | 0.190 | 0.628 | 30 | | | $\sigma(\Theta)$ for the G.S. and at $E_x =$ 0.54;0.90;1.32; 1.74 and 2.68 MeV in ^{59}Zn :nb sr^{-1} | SH83 |
| | 0.660 | 1.294 | 120 | 0-0.080 | | $N(E)$: relative units | BA80 |

| Target | E_p (GeV) | P_p (GeV/c) | Θ (degrees) | E (GeV) | P (GeV/c) | Measured Quantities: Units | References |
|------------------|-------------|---------------|--------------------|-------------|-------------------------------------|--|-------------|
| ^{58}Ni | 8.0 | 8.9 | 83 | 0.079 | | $A^{-1}\sigma(\vec{p})$: mb GeV $^{-2}$ c 3 sr $^{-1}$ | BA79 |
| | | | 168 | 0.079;0.380 | | " " | " |
| | | | 180 | 0.380 | | " " | " |
| | 8.0 | 8.9 | 168 | | 0.500 | $\sigma(\Theta,p)$: relative units | B084 |
| ^{61}Ni | 8.0 | 8.9 | 83 | 0.079 | | $A^{-1}\sigma(\vec{p})$: mb GeV $^{-2}$ c 3 sr $^{-1}$ | BA79 |
| | | | 168 | 0.079;0.380 | | " " | " |
| | | | 180 | 0.380 | | " " | " |
| | 8.0 | 8.9 | 168 | | 0.500 | $\sigma(\Theta,p)$: relative units | B084 |
| ^{64}Ni | 0.660 | 1.294 | 120 | 0-0.080 | | $N(E)$: relative units | BA80 |
| | 8.0 | 8.9 | 83 | 0.079 | | $A^{-1}\sigma(\vec{p})$: mb GeV $^{-2}$ c 3 sr $^{-1}$ | BA79 |
| | | | 168 | 0.079;0.380 | | " " | " |
| | | | 180 | 0.0380 | | " " | " |
| 8.0 | 8.9 | 168 | | 0.500 | $\sigma(\Theta,p)$: relative units | B084 | |
| Cu | 0.450 | 1.023 | 21.5 | 0.132;0.166 | | $\sigma(\Theta,E)$: $\mu\text{b MeV}^{-1}$ sr $^{-1}$ | LI62 |
| | | | 60 | 0.200 | | " " | " |
| | 0.580 | 1.194 | 60 | 0.022-0.076 | | $\sigma(\Theta,E)$: $\mu\text{b MeV}^{-1}$ sr $^{-1}$ | JA75 |
| | | | 90 | 0.022-0.102 | | " " | " |
| | | | 120 | 0.022-0.102 | | " " | " |
| | | | 135 | 0.022-0.076 | | " " | " |
| | 0.580 | 1.194 | | | | σ_T : mb | JA75 |
| | 0.585 | 1.200 | 22.5 | 0.024-0.254 | | $\sigma(\Theta,E)$: $\mu\text{b MeV}^{-1}$ sr $^{-1}$ | CR80a;CR80b |
| | | | 45 | 0.024-0.192 | | " " | " " |

| Target | E_p (GeV) | P_p (GeV/c) | Θ (degrees) | E (GeV) | P (GeV/c) | Measured Quantities: Units | References |
|--------|-------------|---------------|--------------------|-------------|--|---|--------------|
| Cu | 0.585 | 1.200 | 60 | 0.024-0.151 | | $\sigma(\Theta, E): \mu\text{b MeV}^{-1} \text{sr}^{-1}$ | CR80a; CR80b |
| | | | 90 | 0.024-0.151 | | " " | " " |
| | | | 135 | 0.024-0.151 | | " " | " " |
| | 0.585 | 1.200 | | | | $\sigma_T: \text{mb}$ | CR80a |
| | 0.600 | 1.219 | 0.8; 21.5 | 0.050-0.300 | | $\sigma(\Theta, E): \mu\text{b MeV}^{-1} \text{sr}^{-1}$ | HI69 |
| | 0.660 | 1.294 | 105 | 0.015-0.060 | | $\sigma(\Theta, E): \text{mb MeV}^{-1} \text{sr}^{-1}$ | BA77a |
| | 0.725 | 1.374 | 0 | 0.075-0.440 | | $\sigma(\Theta, E): \mu\text{b MeV}^{-1} \text{sr}^{-1}$ | HA64 |
| | 0.730 | 1.380 | 15 | 0.030-0.553 | | $\sigma(\Theta, E): \mu\text{b MeV}^{-1} \text{sr}^{-1}$ | CO72 |
| | | | 20 | 0.030-0.553 | | " " | " |
| | | | 30 | 0.030-0.553 | | " " | " |
| | | | 45 | 0.030-0.486 | | " " | " |
| | | | 60 | 0.030-0.408 | | " " | " |
| | | | 75 | 0.030-0.358 | | " " | " |
| | | | 90 | 0.030-0.305 | | " " | " |
| | | | 105 | 0.030-0.305 | | " " | " |
| | | | 120 | 0.030-0.255 | | " " | " |
| | | | 135 | 0.030-0.255 | | " " | " |
| | 150 | 0.030-0.255 | | " " | " | | |
| | 0.730 | 1.380 | | | | $\sigma_T: \text{mb}$ | CO72; JA75 |
| | 0.800 | 1.464 | 180 | | 0.27-0.41 c) | $\sigma(\vec{p}): \text{mb GeV}^{-2} \text{c}^3 \text{sr}^{-1}$ | SC79 |
| 0.8 | 1.46 | 180 | | 0.189-0.315 | $\sigma(\Theta, p): \text{mb GeV}^{-1} \text{c} \text{sr}^{-1}$ | CH83 | |
| 1 | 1.7 | 17; 32 | | 0.2-0.8 | $\sigma(\Theta, p): \text{cm}^2 \text{MeV}^{-1} \text{c} \text{sr}^{-1}$ | ED76 | |
| 1.05 | 1.75 | 180 | | 0.187-0.419 | $\sigma(\Theta, p): \text{mb GeV}^{-1} \text{c} \text{sr}^{-1}$ | CH83 | |
| 1.05 | 1.75 | 25 | | 0.5-1 | $\sigma(\Theta, p): \text{mb sr}^{-1} \text{GeV}^{-1} \text{c}$ | PA75; PA75a | |

| Target | E_p (GeV) | P_p (GeV/c) | Θ (degrees) | E (GeV) | P (GeV/c) | Measured Quantities: Units | References |
|--------|-------------|---------------|--------------------|-------------|-------------------------|--|-------------|
| Cu | 1.05 | 1.75 | 180 | | 0.2-0.42 ^{c)} | $\sigma(\vec{p})$: mb GeV ⁻² c ³ sr ⁻¹ | SC79 |
| | 1.05 | 1.75 | 0-12 | | | $\sigma(\Theta, p)$: mb GeV ⁻¹ c sr ⁻¹ | M083 |
| | 1.73 | 2.50 | 2.5 | | 0.5-1.75 | $\sigma(\Theta, p)$: mb GeV ⁻¹ c sr ⁻¹ | PA75; PA75a |
| | 2 | 2.8 | 17 | | 0.3-1.2 | $\sigma(\Theta, p)$: cm ² MeV ⁻¹ c sr ⁻¹ | ED76 |
| | | | 32 | | 0.2-1.2 | " " | " |
| | 2.1 | 2.9 | 2.5 | | 0.5-2.0 | $\sigma(\Theta, p)$: mb GeV ⁻¹ c sr ⁻¹ | PA75; PA75a |
| | 2.1 | 2.9 | 180 | | 0.09-0.32 ^{c)} | $\sigma(\vec{p})$: mb GeV ⁻² c ³ sr ⁻¹ | SC79 |
| | 2.10 | 2.89 | 180 | | 0.181-0.595 | $\sigma(\Theta, p)$: mb GeV ⁻¹ c sr ⁻¹ | CH83 |
| | 2.1 | 2.9 | 0-12 | | | $\sigma(\vec{p})$: mb GeV ⁻² c ³ sr ⁻¹ | M083 |
| | 2.66 | 3.47 | 2.5 | | 0.5-2.625 | $\sigma(\Theta, p)$: mb GeV ⁻¹ c sr ⁻¹ | PA75; PA75a |
| | 2 | 2.8 | 17 | | 0.3-1.2 | $\sigma(\Theta, p)$: cm ² MeV ⁻¹ c sr ⁻¹ | ED75 |
| | | | 32 | | 0.2-1.2 | " " | " |
| | 3 | 3.8 | 0 | | 0.8-2.0 | $\sigma(\Theta, p)$: arbitrary scale | ED76 |
| | | | 17 | | 0.4-1.4 | $\sigma(\Theta, p)$: cm ² MeV ⁻¹ c sr ⁻¹ | " |
| | 3.5 | 4.3 | 2.5 | | 0.5-3.25 | $\sigma(\Theta, p)$: mb GeV ⁻¹ c sr ⁻¹ | PA75; PA75a |
| | 4.2 | 5.05 | 2.5 | | 0.5-4.0 | " " | " " |
| | 4.8 | 5.7 | 2.5 | | 0.5-4.75 | " " | " " |
| | 4.89 | 5.75 | 180 | | 0.05-0.18 ^{c)} | $\sigma(\vec{p})$: mb GeV ⁻² c ³ sr ⁻¹ | SC79 |
| | 4.89 | 5.75 | 180 | | 0.188-0.705 | $\sigma(\Theta, p)$: mb GeV ⁻¹ c sr ⁻¹ | CH83 |
| | 5.1 | 6 | 180 | 0.109-0.673 | | 2 $\sigma(\vec{p})$: mb GeV ⁻² c ³ | BA75 |
| | 5.8 | 6.7 | 3.55 | | 0.81-5.10 | $\sigma(\Theta, p)$: mb GeV ⁻¹ c sr ⁻¹ | BA76 |

| Target | E_p (GeV) | P_p (GeV/c) | Θ (degrees) | E(GeV) | P(GeV/c) | Measured Quantities: Units | References |
|--------|-------------|---------------|--------------------|-------------|----------------|--|------------|
| Cu | 5.8 | 6.7 | 3.55 | | 0.81-5.10 | $\sigma(\vec{p})$: mb GeV ⁻² c ³ sr ⁻¹ | BA79a |
| | 7.5 | 8.4 | 180 | 0.119-1.072 | | 2 $\sigma(\vec{p})$: mb GeV ⁻² c ³ | BA75 |
| | 8.0 | 8.9 | 168 | 0.048-0.870 | | A ⁻¹ $\sigma(\vec{p})$: mb GeV ⁻² c ³ sr ⁻¹ | BA79 |
| | | | 180 | 0.380 | | " " | " |
| | 8.0 | 8.9 | 90 | | 1.100 | $\sigma(\Theta, p)$: relative units | BO84a |
| | | | 162 | | 0.800 | " " | BO84 |
| | | | 168 | | 0.500 | " " | " |
| | 8.1 | 9 | 10.77 | | 1.59-5.28 | $\sigma(\vec{p})$: mb GeV ⁻² c ³ sr ⁻¹ | BA79a |
| | | | | | 1.04-5.28 | $\sigma(\Theta, p)$: mb GeV ⁻¹ c sr ⁻¹ | BE77 |
| | 8.8 | 9.7 | 3.55 | | 0.96-7.47 | $\sigma(\vec{p})$: mb GeV ⁻² c ³ sr ⁻¹ | BA79a |
| | | | | | 0.96-7.47 | $\sigma(\Theta, p)$: mb GeV ⁻¹ c sr ⁻¹ | BA76 |
| | 8.8 | 9.7 | | | 5.4 | $\sigma(\Theta, p)$: arbitrary scale | GA76 |
| | 10 | 10.9 | 0 | | 0.40;1.40 | $\sigma(\Theta, p)$: mb GeV ⁻¹ c sr ⁻¹ | AM82 |
| | 11.4 | 12.3 | 0;5;10 | | 0.51;0.82;1.03 | $\sigma(\Theta, p)$: mb GeV ⁻¹ c sr ⁻¹ | MA69 |
| | 12.0 | 12.9 | 0 | | 0.735-2.10 | $\sigma(\vec{p})$: mb GeV ⁻² c ³ | YA81 |
| | 18 | 18.9 | 0 | | 1.06 | $\sigma(\Theta, p)$: mb GeV ⁻¹ c sr ⁻¹ | AM82 |
| | 18.3 | 19.2 | 0.7 | | 6;8;10;12;14 | $\sigma(\Theta, p)$: mb GeV ⁻¹ c sr ⁻¹ | AL70 |
| | | | 1.15 | | 6;8;10;12;14 | " " | " |
| | | | 1.72 | | 6;8;10;12;14 | " " | " |
| | | | 2.29 | | 6;8;10;12;14 | " " | " |
| | | | 2.86 | | 6;8;10;12;14 | " " | " |
| | | | 3.44 | | 6;8;10;12;14 | " " | " |
| | | | 4.01 | | 6;8;10;12 | " " | " |
| | 24 | 24.9 | 0 | | 0.40;1.06;1.40 | $\sigma(\Theta, p)$: mb GeV ⁻¹ c sr ⁻¹ | AM82 |

| Target | E_p (GeV) | P_p (GeV/c) | Θ (degrees) | E (GeV) | P (GeV/c) | Measured Quantities: Units | References |
|------------------|-------------|---------------|--------------------|--------------|--|---|--------------|
| Cu | 50 | 50.9 | 70 | | 1.8-3.0 a) | $\sigma(\vec{p})$: $\text{cm}^2 \text{GeV}^{-2} \text{c}^3$ | AB76 |
| | 66.1 | 67 | 0.11 | | 3-32 | $\sigma(\Theta, p)$: $\text{b GeV}^{-1} \text{c sr}^{-1}$ | B079a; B080a |
| | | | 0.23 | | 5-40 | " " | " " |
| | | | 0.34 | | 6-50 | " " | " " |
| | | | 0.46 | | 8-51 | " " | " " |
| | | | 0.57 | | 10-53 | " " | " " |
| | | | 0.69 | | 15-53 | " " | " " |
| | | | 0.80 | | 13-49 | " " | " " |
| | | | 0.92 | | 12-44 | " " | " " |
| | | | 1.03 | | 11-39 | " " | " " |
| | | | 1.15 | | 10-34 | " " | " " |
| | 70 | 70.9 | 79 | | 1.9-3.1 a) | $\sigma(\vec{p})$: $\text{cm}^2 \text{GeV}^{-2} \text{c}^3$ | AB76 |
| | 70 | 70.9 | 90 | | 0.480-2.510 | $\sigma(\vec{p})$: relative units | AB80 |
| 70 | 70.9 | 90 | | 0.99-4.20 a) | $\sigma(\vec{p})$: mb GeV^{-2} | AB84a | |
| ^{64}Zn | 8.0 | 8.9 | 168 | 0.079; 0.380 | | $A^{-1}\sigma(\vec{p})$: $\text{mb GeV}^{-2} \text{c}^3 \text{sr}^{-1}$ | BA79 |
| | | | 180 | 0.380 | | " " | " " |
| | 8.0 | 8.9 | 168 | | 0.500 | $\sigma(\Theta, p)$: relative units | B084 |
| ^{88}Sr | 0.175 | 0.599 | 45; 90 | | | $\sigma(\Theta, E)$ for $E_x < 15 \text{ MeV}$ in ^{89}Zr : $\text{nb MeV}^{-1} \text{sr}^{-1}$ | GR84; J084 |
| | | | 31-110 | | | $\sigma(\Theta)$ for $E_x = 3.8 \text{ MeV}$ in ^{89}Zr : nb sr^{-1} | GR84 |
| | | | 31-130 | | | $\sigma(\Theta)$ for $E_x = 4.2 \text{ MeV}$ in ^{89}Zr : nb sr^{-1} | GR84 |
| | 0.206 | 0.655 | 30 | | | $\sigma(\Theta)$ for $E_x = 3.9 \text{ MeV}$ in ^{89}Zr : nb sr^{-1} | VI83 |

| Target | E_p (GeV) | P_p (GeV/c) | Θ (degrees) | E(GeV) | P(GeV/c) | Measured Quantities: Units | References |
|------------------|-------------|---------------|--------------------|-------------|---|---|-----------------|
| ^{89}Y | 0.180 | 0.609 | 30;90 | 0.020-0.035 | | $\sigma(\Theta, E)$: nb MeV ⁻¹ sr ⁻¹ | BI85 |
| | | | 60 | 0.020-0.030 | | " " | " |
| | | | 30-90 | 0.020-0.035 | | $\sigma(\Theta)$: $\mu\text{b sr}^{-1}$ | " |
| | | 0.201 | 0.646 | | | $\sigma(E)$: $\mu\text{b MeV}^{-1}$ | " |
| | | | | 0.020-0.055 | | σ_T : μb | " |
| | | | | 0.020-0.050 | | $\sigma(\Theta, E)$: $\mu\text{b MeV}^{-1} \text{sr}^{-1}$ | BI85 |
| | 0.201 | 0.646 | 30-90 | 0.020-0.040 | | " " | BI85;BI85a |
| | | | | | $\sigma(\Theta)$: $\mu\text{b sr}^{-1}$ | " " | |
| | 0.206 | 0.655 | 30 | | | $\sigma(\Theta)$ for $E_x = 3.0 \text{ MeV}$ in ^{90}Nb : nb sr ⁻¹ | VI83 |
| | | | 30 | | $\sigma(\Theta, E)$ for $E_x < 19 \text{ MeV}$ in ^{90}Nb : nb MeV ⁻¹ sr ⁻¹ | VI82;VI83 | |
| ^{90}Zr | 0.206 | 0.655 | 30 | | | $\sigma(\Theta, E)$ for $E_x < 19\text{MeV}$ in ^{91}Mo : nb MeV ⁻¹ sr ⁻¹ | VI82;VI83 |
| | 0.206 | 0.655 | 30 | | 0.53-0.62 b) | $\sigma(\Theta)$ for $\langle E_x \rangle = 3.1\text{MeV}$ in ^{91}Mo : nb sr ⁻¹ | VI82;VI83 |
| Mo | 0.585 | 1.200 | 22.5 | 0.024-0.254 | | $\sigma(\Theta, E)$: $\mu\text{b MeV}^{-1} \text{sr}^{-1}$ | CR80a |
| | | | 45 | 0.024-0.192 | | " " | " |
| | | | 60 | 0.024-0.151 | | " " | " |
| | | | 90 | 0.024-0.151 | | " " | " |
| | | | 135 | 0.024-0.151 | | " " | " |
| | | 0.585 | 1.200 | | | | σ_T : mb |

| Target | E_p (GeV) | P_p (GeV/c) | Θ (degrees) | E (GeV) | P (GeV/c) | Measured Quantities: Units | References |
|------------------|-------------|---------------|--------------------|-------------|-----------------------|--|---------------|
| ^{92}Mo | 0.206 | 0.655 | 30 | | | $\sigma(\Theta)$ for $E_x = 2.5\text{MeV}$ in ^{93}Ru : nb sr $^{-1}$ | VI83 |
| Ag | 0.600 | 1.219 | 0.8;21.5 | 0.050-0.300 | | $\sigma(\Theta, E)$: $\mu\text{b MeV}^{-1} \text{sr}^{-1}$ | HI69 |
| | 0.725 | 1.374 | 0 | 0.075-0.440 | | $\sigma(\Theta, E)$: $\mu\text{b MeV}^{-1} \text{sr}^{-1}$ | HA64 |
| | 0.730 | 1.380 | | | | σ_T : mb | CO72 |
| | 0.80 | 1.46 | 180 | | 0.190-0.316 | $\sigma(\Theta, p)$: mb GeV $^{-1}\text{c} \text{sr}^{-1}$ | CH83 |
| | 3.121 | 3.95 | 3.55 | | 0.78-2.63 | $\sigma(\vec{p})$: mb GeV $^{-2}\text{c}^3 \text{sr}^{-1}$ $\sigma(\Theta, p)$: mb GeV $^{-1}\text{c} \text{sr}^{-1}$ | BA79a BA76 |
| | 8.8 | 9.7 | 3.55 | | 0.96-7.47 | $\sigma(\vec{p})$: mb GeV $^{-2}\text{c}^3 \text{sr}^{-1}$ $\sigma(\Theta, p)$: mb GeV $^{-1}\text{c} \text{sr}^{-1}$ | BA79a BA76 |
| | 8.8 | 9.7 | | | 5.4 | $\sigma(\Theta, p)$: arbitrary scale | GA76 |
| Sn | 0.450 | 1.023 | 21.5 | | 0.132;0.166; 0.200 | $\sigma(\Theta, E)$: $\mu\text{b MeV}^{-1} \text{sr}^{-1}$ | LI62 |
| | 1.05 | 1.75 | 180 | | 0.184-0.255 | $\sigma(\Theta, p)$: mb GeV $^{-1}\text{c} \text{sr}^{-1}$ | CH83 |
| | 2.10 | 2.89 | 180 | | 0.184-0.595 | " " | " |
| | 8.0 | 8.9 | 168 | 0.048-1.010 | | $A^{-1}\sigma(\vec{p})$: mb GeV $^{-2}\text{c}^3 \text{sr}^{-1}$ | BA79 |
| | 8.0 | 8.9 | 90 | | 1.100 | $\sigma(\Theta, p)$: relative units | BO84a |
| | 70 | 70.9 | 90 | | 0.480-2.510 a) | $\sigma(\vec{p})$: relative units | AB80 |
| | 70 | 70.9 | 90 | | 0.99-3.34 a) | $\sigma(\vec{p})$: mb GeV $^{-2}$ | AB84a |

| Target | E_p (GeV) | P_p (GeV/c) | Θ (degrees) | E (GeV) | P (GeV/c) | Measured Quantities: Units | References |
|-------------------|-------------|---------------|--------------------|-----------------------|-------------------------------------|---|------------|
| ^{112}Sn | 0.660 | 1.294 | 120 | 0-0.080 | | $N(E)$: relative units | BA80 |
| | 8.0 | 8.9 | 83 | 0.079 | | $A^{-1}\sigma(\vec{p})$: mb $\text{GeV}^{-2}\text{c}^3 \text{sr}^{-1}$ | BA79 |
| | | | 168 | 0.079;0.380 | | " " | " |
| | | | 180 | 0.380 | | " " | " |
| 8.0 | 8.9 | 168 | | 0.500 | $\sigma(\Theta,p)$: relative units | B084 | |
| ^{114}Sn | 8.0 | 8.9 | 162 | | 0.800 | $\sigma(\Theta,p)$: relative units | B084 |
| ^{118}Sn | 8.0 | 8.9 | 83 | 0.079 | | $A^{-1}\sigma(\vec{p})$: mb $\text{GeV}^{-2}\text{c}^3 \text{sr}^{-1}$ | BA79 |
| | | | 168 | 0.079;0.380 | | " " | " |
| | | | 180 | 0.380 | | " " | " |
| | 8.0 | 8.9 | 162 | | 0.800 | $\sigma(\Theta,p)$: relative units | B084 |
| | | | 168 | | 0.500 | " " | " |
| ^{124}Sn | 0.660 | 1.294 | 120 | 0-0.080 | | $N(E)$: relative units | BA80 |
| | 8.0 | 8.9 | 83 | 0.079 | | $A^{-1}\sigma(\vec{p})$: mb $\text{GeV}^{-2}\text{c}^3 \text{sr}^{-1}$ | BA79 |
| | | | 168 | 0.079;0.380 | | " " | " |
| | | | 180 | 0.380 | | " " | " |
| 8.0 | 8.9 | 162 | | 0.800 | $\sigma(\Theta,p)$: relative units | B084 | |
| | | | 168 | | 0.500 | " " | " |
| Sb | 0.450 | 1.023 | 21.5 | 0.132;0.166; 0.200 | | $\sigma(\Theta,E)$: $\mu\text{b MeV}^{-1} \text{sr}^{-1}$ | LI62 |

| Target | $E_p(\text{GeV})$ | $P_p(\text{GeV}/c)$ | $\Theta(\text{degrees})$ | $E(\text{GeV})$ | $P(\text{GeV}/c)$ | Measured Quantities: Units | References |
|-------------------|-------------------|---------------------|--------------------------|-----------------|-------------------|--|---------------|
| ^{144}Sm | 8.0 | 8.9 | 168 | 0.380 | | $A^{-1}\sigma(\vec{p})$: mb $\text{GeV}^{-2}c^3 \text{sr}^{-1}$ | BA79 |
| | 8.0 | 8.9 | 168 | | 0.500 | $\sigma(\Theta, p)$: relative units | B084 |
| ^{154}Sm | 8.0 | 8.9 | 168 | 0.380 | | $A^{-1}\sigma(\vec{p})$: mb $\text{GeV}^{-2}c^3 \text{sr}^{-1}$ | BA79 |
| | 8.0 | 8.9 | 168 | | 0.500 | $\sigma(\Theta, p)$: relative units | B084 |
| Ta | 0.730 | 1.380 | | | | σ_T : mb | C072 |
| | 8.8 | 9.7 | 3.55 | | 0.96-7.47 | $\sigma(\vec{p})$: mb $\text{GeV}^{-2}c^3 \text{sr}^{-1}$ $\sigma(\Theta, p)$: mb $\text{GeV}^{-1}c \text{sr}^{-1}$ | BA79a BA76 |
| | 8.8 | 9.7 | | | 5.4 | $\sigma(\Theta, p)$: arbitrary scale | GA76 |
| W | 8.0 | 8.9 | 162 | | 0.800 | $\sigma(\Theta, p)$: relative units | B084 |
| | 10 | 10.9 | 0 | | 0.40;1.06;1.40 | $\sigma(\Theta, p)$: mb $\text{GeV}^{-1}c \text{sr}^{-1}$ | AM82 |
| | 18 | 18.9 | 0 | | 0.40;1.40 | $\sigma(\Theta, p)$: mb $\text{GeV}^{-1}c \text{sr}^{-1}$ | AM82 |
| | 24 | 24.9 | 0 | | 0.40;1.06;1.40 | $\sigma(\Theta, p)$: mb $\text{GeV}^{-1}c \text{sr}^{-1}$ | AM82 |
| | 27.6 | 28.5 | 14.6 | | 0.75-2.25 a) | $\sigma(\vec{p})$: $\mu\text{b} \text{GeV}^{-2}c^3$ | BE76 |
| | 70 | 70.9 | 0 | | 1.5;2;2.5;3 | $\sigma(p, \Theta)$: b $\text{GeV}^{-1}c \text{sr}^{-1}$ | BA82a |
| ^{182}W | 8.0 | 8.9 | 168 | 0.380 | | $A^{-1}\sigma(\vec{p})$: mb $\text{GeV}^{-2}c^3 \text{sr}^{-1}$ | BA79 |
| | 8.0 | 8.9 | 168 | | 0.500 | $\sigma(\Theta, p)$: relative units | B084 |

| Target | E_p (GeV) | P_p (GeV/c) | Θ (degrees) | E (GeV) | P (GeV/c) | Measured Quantities: Units | References |
|------------------|-------------|---------------|--------------------|--------------------------------|-------------------------|---|---------------|
| ^{186}W | 8.0 | 8.9 | 168 | 0.380 | | $A^{-1}\sigma(\vec{p})$: mb GeV $^{-2}$ c 3 sr $^{-1}$ | BA79 |
| | 8.0 | 8.9 | 168 | | 0.500 | $\sigma(\Theta, p)$: relative units | B084 |
| Pt | 0.725 | 1.374 | 0 | 0.075-0.500 | | $\sigma(\Theta, E)$: $\mu\text{b MeV}^{-1}$ sr $^{-1}$ | HA64 |
| | 12 | 12.9 | 0 0 | | 0.735-2.10 0.53-2.10 | $\sigma(\vec{p})$: mb GeV $^{-2}$ c 3 N(E) for different target thicknesses: relative units | YA81 " |
| Au | 0.450 | 1.023 | 60 21.5 | 0.099 0.132;0.166; 0.200 | | $\sigma(\Theta, E)$: $\mu\text{b MeV}^{-1}$ sr $^{-1}$ " " | LI62 " |
| | 3.12 | 3.95 | 3.55 | | 0.78-2.63 | $\sigma(\vec{p})$: mb GeV $^{-2}$ c 3 sr $^{-1}$ $\sigma(\Theta, p)$: mb GeV $^{-1}$ c sr $^{-1}$ | BA79a BA76 |
| | 5.8 | 6.7 | 3.55 | | 0.81-5.10 | $\sigma(\vec{p})$: mb GeV $^{-2}$ c 3 sr $^{-1}$ $\sigma(\Theta, p)$: mb GeV $^{-1}$ c sr $^{-1}$ | BA79a BA76 |
| | 8.1 | 9 | 10.77 | | 1.59-5.28 1.04-5.28 | $\sigma(\vec{p})$: mb GeV $^{-2}$ c 3 sr $^{-1}$ $\sigma(\Theta, p)$: mb GeV $^{-1}$ c sr $^{-1}$ | BA79a BE77 |
| Pb | 0.180 | 0.609 | 30 60;90 | 0.020-0.035 0.020-0.030 | | $\sigma(\Theta, E)$: nb MeV $^{-1}$ sr $^{-1}$ " " | BI85 " |
| | | | | 0.020-0.030 | | $\sigma(E)$: $\mu\text{b MeV}^{-1}$ | BI85 |
| | | | 30-90 | | | $\sigma(\Theta)$: $\mu\text{b sr}^{-1}$ | BI85 |
| | 0.180 | 0.609 | | | | σ_T : μb | BI85 |

| Target | E_p (GeV) | P_p (GeV/c) | Θ (degrees) | E (GeV) | P (GeV/c) | Measured Quantities: Units | References |
|--------|-------------|---------------|--------------------|-------------|--|--|-------------|
| Pb | 0.201 | 0.646 | 30 | 0.020-0.045 | | $\sigma(\Theta, E): \mu\text{b MeV}^{-1} \text{sr}^{-1}$ | BI85 |
| | | | 60;90 | 0.020;0.035 | | " " | " |
| | | | | 0.020;0.035 | | $\sigma(E): \mu\text{b MeV}^{-1}$ | BI85;BI85a |
| | | | 30-90 | | | $\sigma(\Theta): \mu\text{b sr}^{-1}$ | " " |
| | | | | | | $\sigma_T: \mu\text{b}$ | " " |
| | 0.450 | 1.023 | 21.5 | 0.132;0.250 | | $\sigma(\Theta, E): \mu\text{b MeV}^{-1} \text{sr}^{-1}$ | LI62 |
| | | | 60 | 0.099 | | " " | " |
| | 0.580 | 1.194 | 60 | 0.022-0.102 | | $\sigma(\Theta, E): \mu\text{b MeV}^{-1} \text{sr}^{-1}$ | JA75 |
| | | | 90 | 0.022-0.076 | | " " | " |
| | | | 120 | 0.022-0.102 | | " " | " |
| | | | 135 | 0.022-0.076 | | " " | " |
| | 0.580 | 1.194 | | | | $\sigma_T: \text{mb}$ | JA75 |
| | 0.585 | 1.200 | 22.5 | 0.024-0.254 | | $\sigma(\Theta, E): \mu\text{b MeV}^{-1} \text{sr}^{-1}$ | CR80a;CR80b |
| | | | 45 | 0.024-0.192 | | " " | " " |
| | | | 60 | 0.024-0.151 | | " " | " " |
| | | 90 | 0.024-0.151 | | " " | " " | |
| | | 135 | 0.024-0.151 | | " " | " " | |
| 0.585 | 1.200 | | | | $\sigma_T: \text{mb}$ | CR80a | |
| 0.600 | 1.219 | 0.8 | 0.050-0.300 | | $\sigma(\Theta, E): \mu\text{b MeV}^{-1} \text{sr}^{-1}$ | HI69 | |
| | | 21.5 | 0.050-0.300 | | " " | " | |
| 0.660 | 1.294 | 105 | 0.015-0.050 | | $\sigma(\Theta, E): \text{mb MeV}^{-1} \text{sr}^{-1}$ | BA77a | |
| 0.730 | 1.380 | 15 | 0.030-0.553 | | $\sigma(\Theta, E): \mu\text{b MeV}^{-1} \text{sr}^{-1}$ | C072 | |
| | | 20 | 0.030-0.553 | | " " | " | |
| | | 30 | 0.030-0.486 | | " " | " | |
| | | 45 | 0.030-0.408 | | " " | " | |
| | | 60 | 0.030-0.408 | | " " | " | |

| Target | E_p (GeV) | P_p (GeV/c) | Θ (degrees) | E(GeV) | P(GeV/c) | Measured Quantities: Units | References | |
|--------|-------------|---------------|--------------------|-------------|---|---|---|------|
| Pb | 0.730 | 1.380 | 75 | 0.030-0.358 | | $\sigma(\Theta, E): \mu\text{b MeV}^{-1} \text{sr}^{-1}$ | C072 | |
| | | | 90 | 0.030-0.358 | | " " | " | |
| | | | 105 | 0.030-0.305 | | " " | " | |
| | | | 120 | 0.030-0.305 | | " " | " | |
| | | | 135 | 0.030-0.255 | | " " | " | |
| | | | 150 | 0.030-0.255 | | " " | " | |
| | 0.730 | 1.380 | | | | $\sigma_T: \text{mb}$ | C072;JA75 | |
| | 0.80 | 1.46 | 180 | | 0.191-0.312 | $\sigma(\Theta, p): \text{mb GeV}^{-1} \text{c sr}^{-1}$ | CH83 | |
| | 1 | 1.7 | 17;32 | | 0.2-0.8 | $\sigma(\Theta, p): \text{cm}^2 \text{MeV}^{-1} \text{c sr}^{-1}$ | ED76 | |
| | 1.05 | 1.75 | 180 | | 0.187-0.419 | $\sigma(\Theta, p): \text{mb GeV}^{-1} \text{c sr}^{-1}$ | CH83 | |
| | 1.05 | 1.75 | 0-12 | | | $\sigma(\vec{p}): \text{mb GeV}^{-2} \text{c}^3 \text{sr}^{-1}$ | M083 | |
| | 1.05 | 1.75 | 2.5 | | 0.5-1 | $\sigma(\Theta, p): \text{mb GeV}^{-1} \text{c sr}^{-1}$ | PA75;PA75a | |
| | 1.73 | 2.50 | 2.5 | | 0.5-1.75 | " " | " " | |
| | 2 | 2.8 | | 17 | | 0.3-1.2 | $\sigma(\Theta, p): \text{cm}^2 \text{MeV}^{-1} \text{c sr}^{-1}$ | ED76 |
| | | | | 32 | | 0.2-1.2 | " " | " |
| | 2.1 | 2.9 | 2.5 | | 0.5-2.0 | $\sigma(\Theta, p): \text{mb GeV}^{-1} \text{c sr}^{-1}$ | PA75;PA75a | |
| | 2.10 | 2.89 | 180 | | 0.186-0.626 | $\sigma(\Theta, p): \text{mb GeV}^{-1} \text{c sr}^{-1}$ | CH83 | |
| | 2.1 | 2.9 | 0-12 | | | $\sigma(\vec{p}): \text{mb GeV}^{-2} \text{c}^3 \text{sr}^{-1}$ | M083 | |
| | 2.66 | 3.47 | 2.5 | | 0.5-2.625 | $\sigma(\Theta, p): \text{mb GeV}^{-1} \text{c sr}^{-1}$ | PA75;PA75a | |
| | 3 | 3.8 | | 0 | | 0.8-2.0 | $\sigma(\Theta, p): \text{arbitrary scale}$ | ED76 |
| 17 | | | | | 0.7-1.4 | $\sigma(\Theta, p): \text{cm}^2 \text{MeV}^{-1} \text{c sr}^{-1}$ | " | |
| 3.17 | 4 | 38-53 | | 0-0.8 | $\sigma(\vec{p}): \text{b GeV}^{-2} \text{c sr}^{-1}$ | EN85 | | |

| Target | E_p (GeV) | P_p (GeV/c) | Θ (degrees) | E (GeV) | P (GeV/c) | Measured Quantities: Units | References |
|--------|-------------|---------------|--------------------|------------------|------------------|---|-------------|
| Pb | 3.17 | 4 | 53-66 | 0-0.8 | | $\sigma(\vec{p})$: b GeV ⁻² c sr ⁻¹ | EN85 |
| | | | 66-78 | 0-0.8 | | " " | " |
| | | | 78-90 | 0-0.8 | | " " | " |
| | 3.5 | 4.3 | 2.5 | | 0.5-3.25 | $\sigma(\Theta, p)$: mb GeV ⁻¹ c sr ⁻¹ | PA75; PA75a |
| | 4.2 | 5.05 | 2.5 | | 0.5-4.0 | " " | " " |
| | 4.8 | 5.7 | 2.5 | | 0.5-4.75 | " " | " " |
| | 4.89 | 5.75 | 180 | | 0.188-0.706 | $\sigma(\Theta, p)$: mb GeV ⁻¹ c sr ⁻¹ | CH83 |
| | 5.1 | 6 | 180 | 0.477; 0.673 | | $2 \sigma(\vec{p})$: mb GeV ⁻² c ³ | BA75 |
| | 7.5 | 8.4 | 180 | 0.119-1.072 | | " " | " |
| | 8.0 | 8.9 | 168 | 0.048-1.010 | | $A^{-1} \sigma(\vec{p})$: mb GeV ⁻² c ³ sr ⁻¹ | BA79 |
| | | | 180 | 0.380 | | " " | " |
| | 8.0 | 8.9 | 90 | 0.5; 0.6; 0.7; | | $A^{-1} \sigma(\vec{p})$: mb GeV ⁻² c ³ sr ⁻¹ | BA82 |
| | | | 168 | 1.0 | | " " | " |
| | | | | 0.125-1.200 | | " " | " |
| | 8.0 | 8.9 | 90 | | 1.100 | $\sigma(\Theta, p)$: relative units | B084a |
| | | | 162 | | 0.800 | " " | B084 |
| | | | 168 | | 0.500 | " " | " |
| | 17.9 | 18.8 | 0 | | 1-12 | $\sigma(\Theta, p)$: mb GeV ⁻¹ c sr ⁻¹ | DE65 |
| | 18.3 | 19.2 | 0.7 | | 6; 8; 10; 12; 14 | $\sigma(\Theta, p)$: b GeV ⁻¹ c sr ⁻¹ | AL70 |
| | | | 1.15 | | 6; 8; 10; 12; 14 | " " | " |
| | | 1.72 | | 6; 8; 10; 12; 14 | " " | " | |
| | | 2.29 | | 6; 8; 10; 12; 14 | " " | " | |
| | | 2.86 | | 6; 8; 10; 12; 14 | " " | " | |
| | | 3.44 | | 6; 8; 10; 12; 14 | " " | " | |
| | | 4.01 | | 6; 8; 10; 12 | " " | " | |

| Target | E_p (GeV) | P_p (GeV/c) | Θ (degrees) | E (GeV) | P (GeV/c) | Measured Quantities: Units | References |
|--------|-------------|---------------|--------------------|-----------------------|----------------|--|------------|
| Pb | 22.2 | 23.1 | 0;5.7 | | 4;6;8;10;12 | $\sigma(\Theta, p)$: mb GeV ⁻¹ c sr ⁻¹ | DE65 |
| | 69.1 | 70 | 90 | | 0.480-2.510 a) | $\sigma(\vec{p})$: relative units | AB80 |
| | 70 | 70.9 | 90 | | 0.99-4.65 a) | $\sigma(\vec{p})$: mb GeV ⁻² | AB84a |
| 209Bi | 0.120-0.800 | 0.49-1.46 | | | | σ_T for several At isotopes: μ b | D085 |
| | 0.200 | 0.645 | | | | σ_T : μ b | CL82 |
| Th | 0.730 | 1.380 | 15 | 0.030;0.155 | | $\sigma(\Theta, E)$: mb MeV ⁻¹ sr ⁻¹ | C072 |
| | | | 20 | 0.030;0.155 | | " " | " |
| | | | 30 | 0.030;0.155 | | " " | " |
| | | | 45 | 0.030;0.155 | | " " | " |
| | | | 60 | 0.030;0.155 | | " " | " |
| | | | 75 | 0.030;0.155 | | " " | " |
| | | | 90 | 0.030;0.155 | | " " | " |
| | | | 105 | 0.030;0.155 | | " " | " |
| | | | 120 | 0.030;0.155 | | " " | " |
| | | | 135 | 0.030;0.155 | | " " | " |
| | | | 150 | 0.030;0.155 | | " " | " |
| | | | | | | | |
| U | 0.450 | 1.023 | 21.5 | 0.132;0.166; 0.200 | | $\sigma(\Theta, E)$: μ b MeV ⁻¹ sr ⁻¹ | LI62 |
| | | | 60 | 0.099 | | " " | " |
| | 8.0 | 8.9 | 168 180 | 0.048-0.770 0.380 | | $A^{-1}\sigma(\vec{p})$: mb GeV ⁻² c ³ sr ⁻¹ | BA79 |
| | | | | | " " | " | " |

| Target | E_p (GeV) | P_p (GeV/c) | Θ (degrees) | E (GeV) | P (GeV/c) | Measured Quantities: Units | References |
|--------|-------------|---------------|--------------------|-----------|-------------|-------------------------------------|------------|
| 238U | 0.330 | 0.853 | | | | σ_T : mb | DI85 |
| | 0.400 | 0.954 | | | | σ_T : mb | DI85 |
| | 0.500 | 1.090 | | | | σ_T : mb | DI85 |
| | 8.0 | 8.9 | 168 | | 0.500 | $\sigma(\Theta,p)$: relative units | B084 |

* * * * *

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