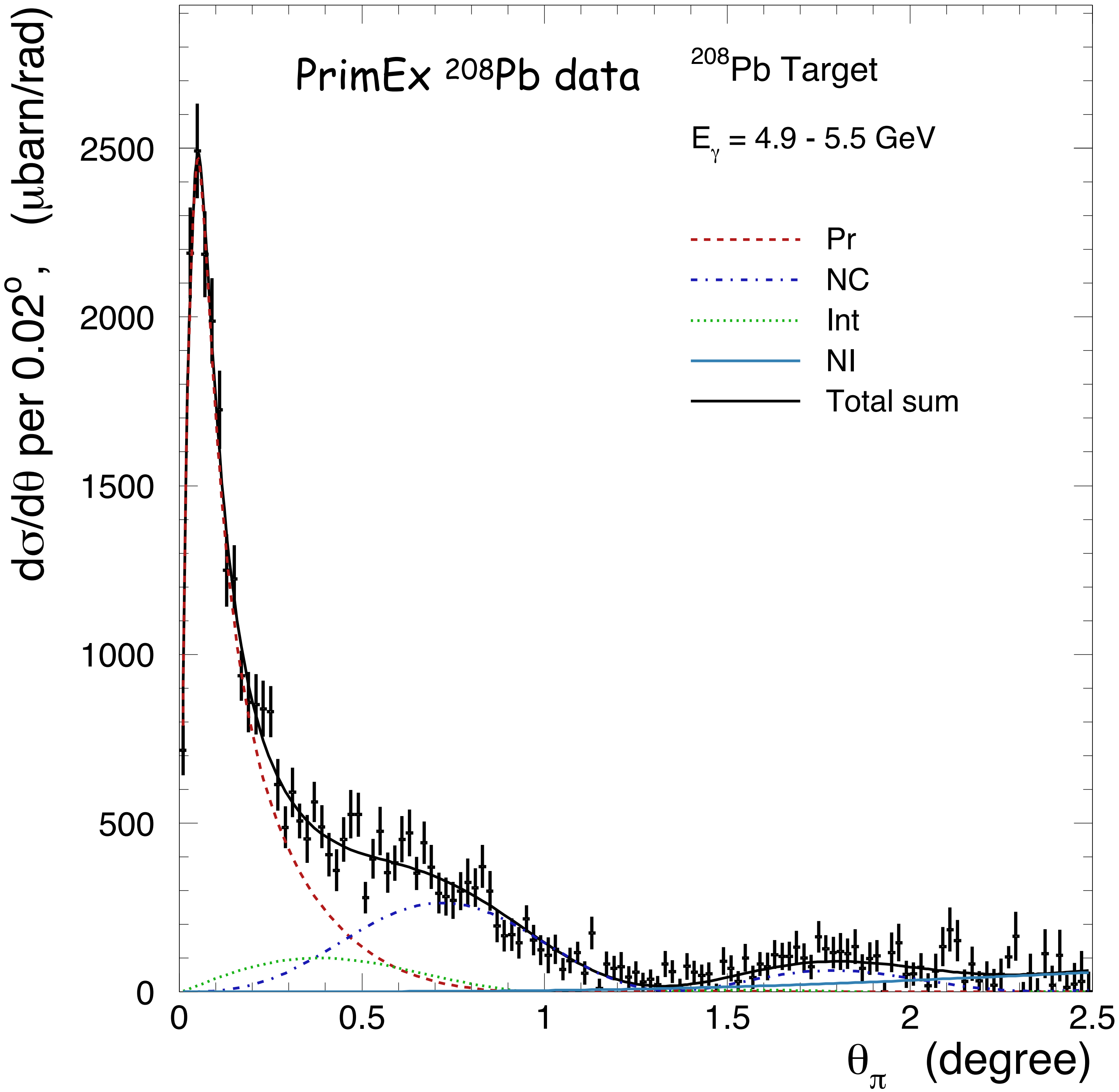
Scaling the Primakoff, coherent and incoherent signals seen in PrimEx to CPP and NPP



Scaling the Primakoff signal seen in PrimEx to NPP

Primakoff production of π^0

$$\frac{d\sigma_{PrimEx}}{d\Omega} = \Gamma_{\gamma\gamma}\frac{8\alpha Z^2}{M_\pi^3}\frac{\beta^3 E^4}{Q^4}F_{EM}^2(Q^2)sin^2\theta$$

$$\Gamma_{\gamma\gamma} = 7.7\ eV$$

Primakoff production of $\pi^0\pi^0$

$$\frac{d\sigma_{NPP}}{d\Omega dM_{\pi\pi}} = \frac{2\alpha Z^2}{\pi^2 M_{\pi\pi}}\frac{\beta^2 E^4}{Q^4}F_{EM}^2(Q^2)sin^2\theta\ \sigma(\gamma\gamma \to \pi^0\pi^0)$$

$$\frac{d\sigma_{NPP}}{d\Omega dM_{\pi\pi}} = \left[\frac{1}{4\pi^2}\frac{M_{\pi\pi}^2}{\beta}\sigma(\gamma\gamma \to \pi^0\pi^0)\right]\frac{8\alpha Z^2}{M_{\pi\pi}^3}\frac{\beta^3 E^4}{Q^4}F_{EM}^2(Q^2)sin^2\theta$$

$$\frac{d\sigma_{NPP}}{d\Omega} \approx \left[\frac{1}{4\pi^2}\frac{M_{\pi\pi}^2}{\beta}\sigma(\gamma\gamma \rightarrow \pi^0\pi^0)\Delta M_{\pi\pi}\right]\frac{8\alpha Z^2}{M_{\pi\pi}^3}\frac{\beta^3 E^4}{Q^4}F_{EM}^2(Q^2)sin^2\theta$$

$$\frac{d\sigma_{NPP}}{d\Omega} \approx \Gamma_{NPP}\frac{8\alpha Z^2}{M_{\pi\pi}^3}\frac{\beta^3 E^4}{Q^4}F_{EM}^2(Q^2)sin^2\theta$$

$$\Gamma_{NPP} \equiv \frac{1}{4\pi^2}\frac{M_{\pi\pi}^2}{\beta}\sigma(\gamma\gamma \rightarrow \pi^0\pi^0)\Delta M_{\pi\pi}$$

$M_{\pi\pi} \approx 0.4\ GeV$ $\quad$ $\Delta M_{\pi\pi} \approx 0.4\ GeV$ $\quad$ $\beta = 1$ $\quad$ $\sigma(\gamma\gamma \rightarrow \pi^0\pi^0) \approx 10nb$

$\Gamma_{NPP} = 42\ eV$

$$\frac{d\sigma_{NPP}}{d\Omega dM_{\pi\pi}}\Delta M_{\pi\pi} / \frac{d\sigma_{PrimEx}}{d\Omega} \approx 5.5$$

Scaling the coherent signal seen in PrimEx to NPP

$$\frac{d\sigma_{\gamma A\to A\pi^0\pi^0}}{dt} \approx \eta^2 A^2 \frac{d\sigma_{\gamma N\to N\pi^0\pi^0}}{dt} F^2(t)$$

η = nuclear absorption factor for one π^0

A = nuclear mass number

$\frac{d\sigma_{\gamma N\to N\pi^0\pi^0}}{dt}$ = photoproduction cross section on the nucleon

$F^2(t)$ = nuclear form factor

Data for $f_0(500)$

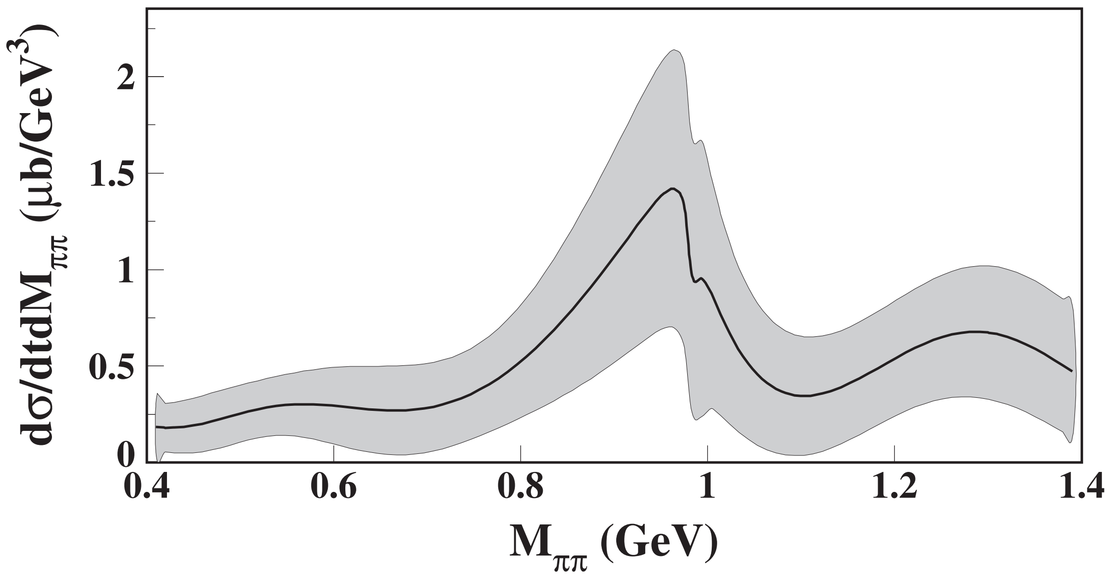
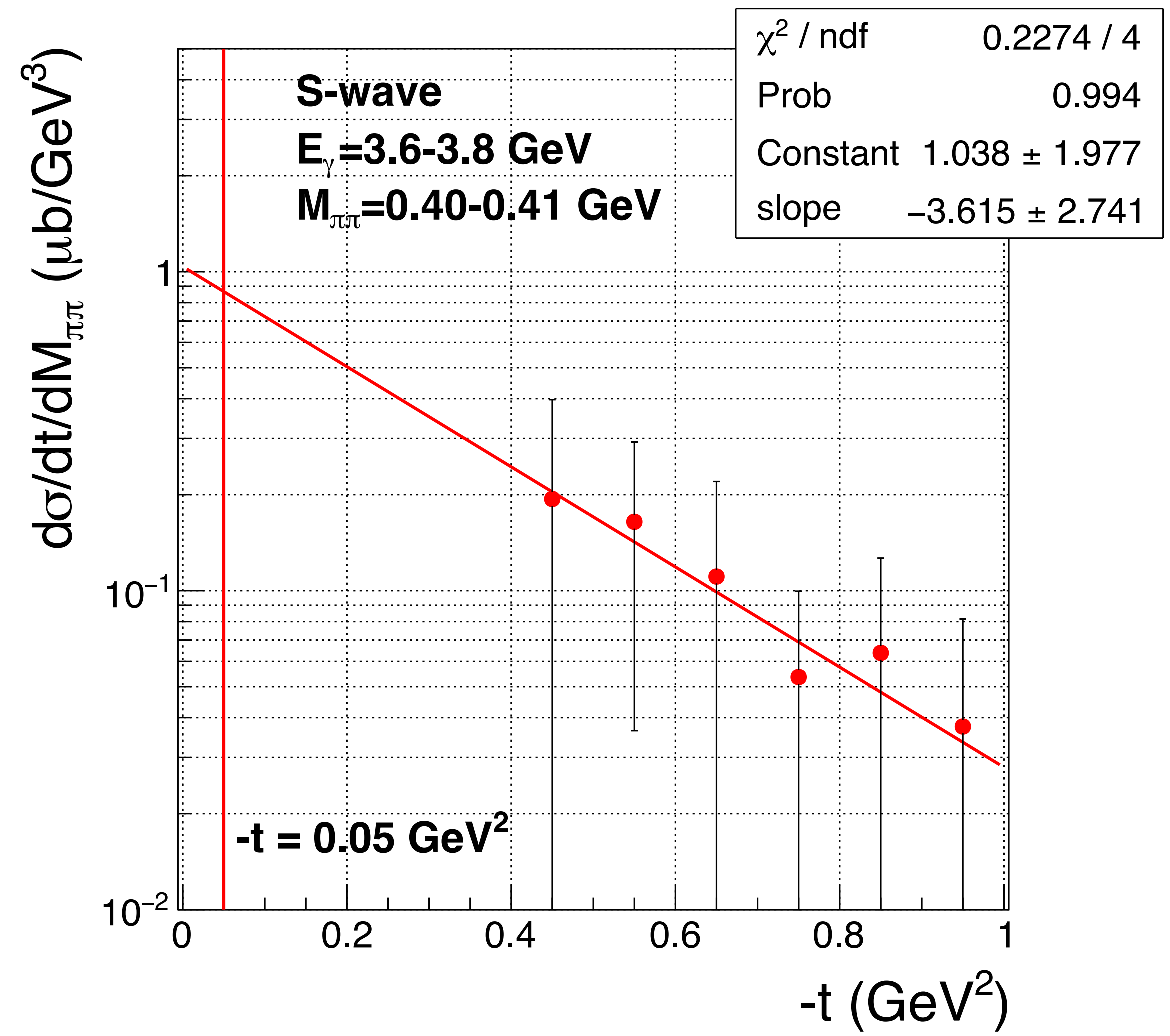


FIG. 12. S-wave cross section derived by the fit in the $3.2 < E_\gamma < 3.4$ GeV and $0.5 < -t < 0.6$ GeV^2 bin. The systematic and the fit uncertainties are added in quadrature and are shown by the gray band.

Battaglieri et al., PRD80 (2009) 072005



$$\frac{d\sigma_{\gamma N \to N\pi\pi}}{dt} = 1.0\frac{\mu b}{GeV^3} \times 0.4\ GeV \times \frac{1}{2} = 0.2\frac{\mu b}{GeV^2}$$

I expect the cross section to be smaller at 6.0 GeV

Data for π^0 photo-production on the nucleon

$$\frac{d\sigma_{\gamma N \to N\pi^0}}{dt} = 1.5\frac{\mu b}{GeV^2} \text{ @ } 6\ GeV$$

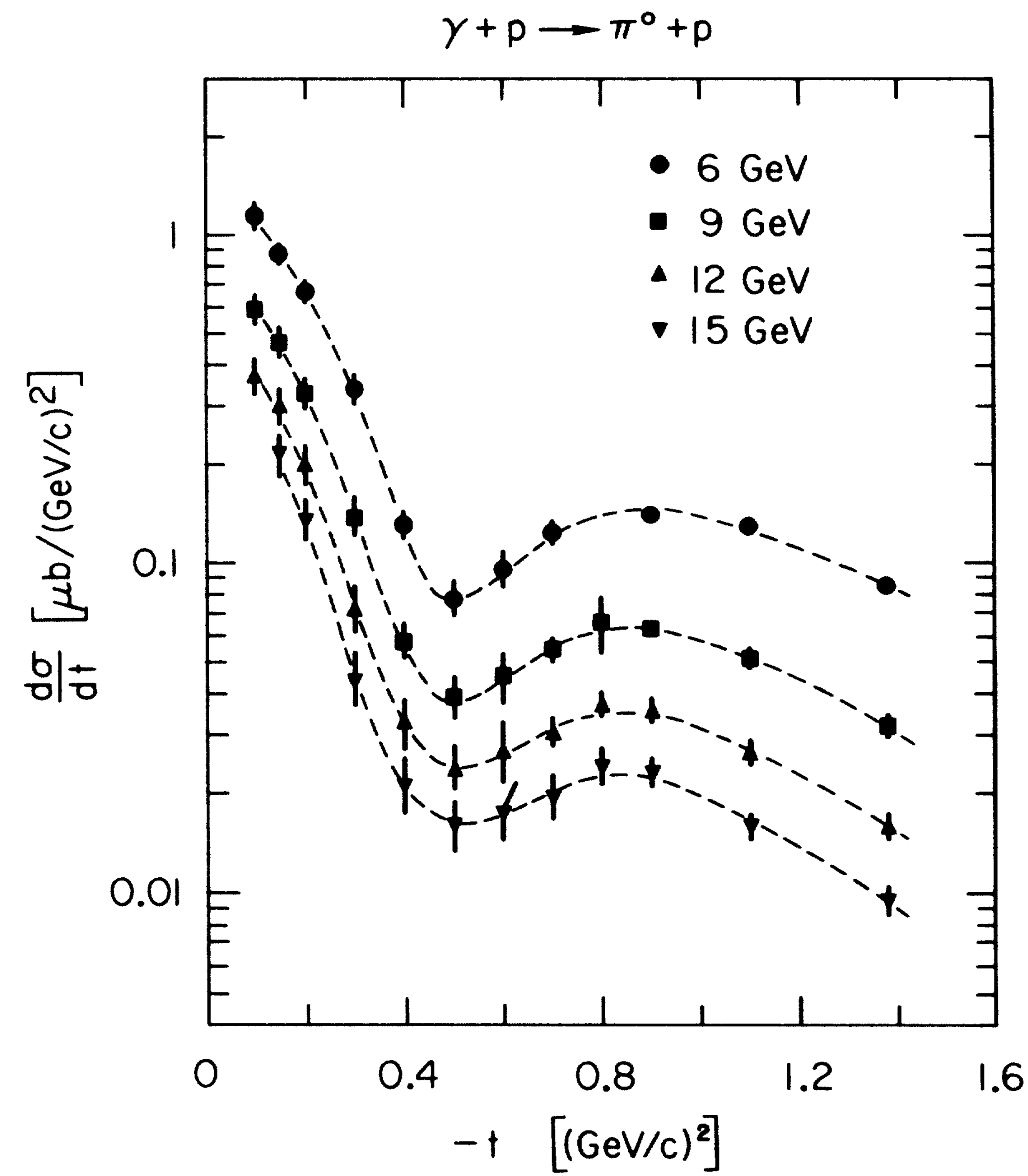


Fig. 5. $d\sigma/dt$ in μb/(GeV/c)^2 is plotted versus $|t|$ for incident photon energies of 6, 9, 12, and 15 GeV. The dashed lines are only to guide the eye.

η = nuclear absorption factor for second π^0 = 0.45 (Is this correct ?)

$$\frac{d\sigma_{\gamma N \to N\pi^0\pi^0}}{dt} / \frac{d\sigma_{\gamma N \to N\pi^0}}{dt} = \frac{0.2}{1.5} = 0.13$$

Assume $F^2_{NPP}(t)/F^2_{PrimEx}(t) \approx 1$

$$\frac{d\sigma_{\gamma A \to A\pi^0\pi^0}}{dt} / \frac{d\sigma_{\gamma A \to A\pi^0}}{dt} \approx 0.06$$

Scaling the incoherent signal seen in PrimEx to NPP

$$\frac{d\sigma_{\gamma A \to \pi^0\pi^0}}{dt} \approx \eta^2 A \left(1 - G(t)\right) \frac{d\sigma_{\gamma N \to N\pi^0\pi^0}}{dt}$$

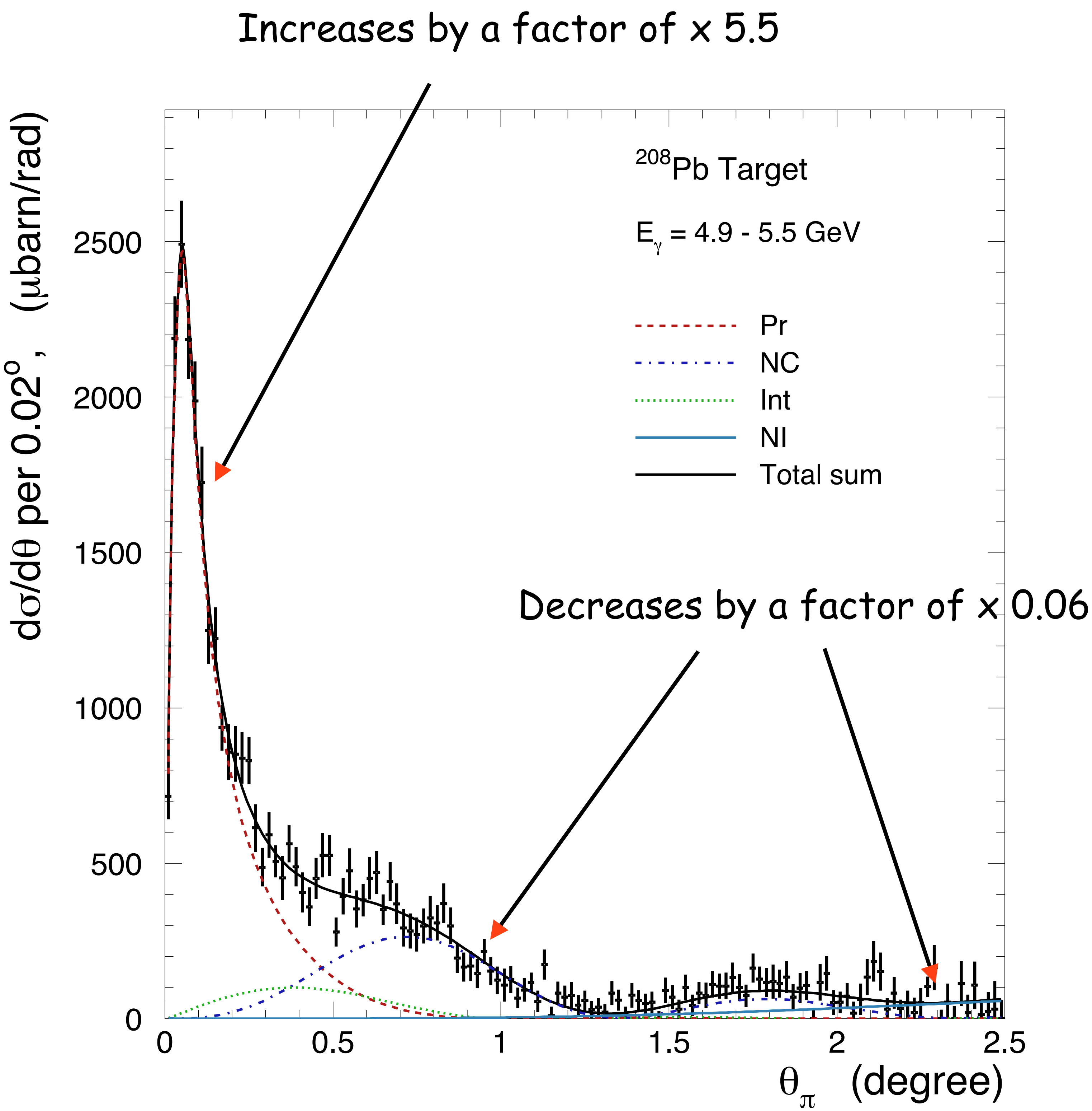
η = nuclear absorption factor for one π^0 = .45 ?

A = nuclear mass number

$\frac{d\sigma_{\gamma N \to N\pi^0\pi^0}}{dt}$ = photoproduction cross section on the nucleon

1-G(t) = Pauli suppression factor, assumed equal for PrimEx and NPP

$$\frac{d\sigma_{\gamma A \to \pi^0\pi^0}}{dt} / \frac{d\sigma_{\gamma A \to \pi^0}}{dt} \approx 0.06$$



Increases by a factor of x 5.5
Decreases by a factor of x 0.06
208Pb Target
Eγ = 4.9 - 5.5 GeV
Pr
NC
Int
NI
Total sum
dσ/dθ per 0.02°, (μbarn/rad)
θπ (degree)
0
500
1000
1500
2000
2500
0.5
1
1.5
2
2.5