

# Pion production at High $P_T$

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# Introduction

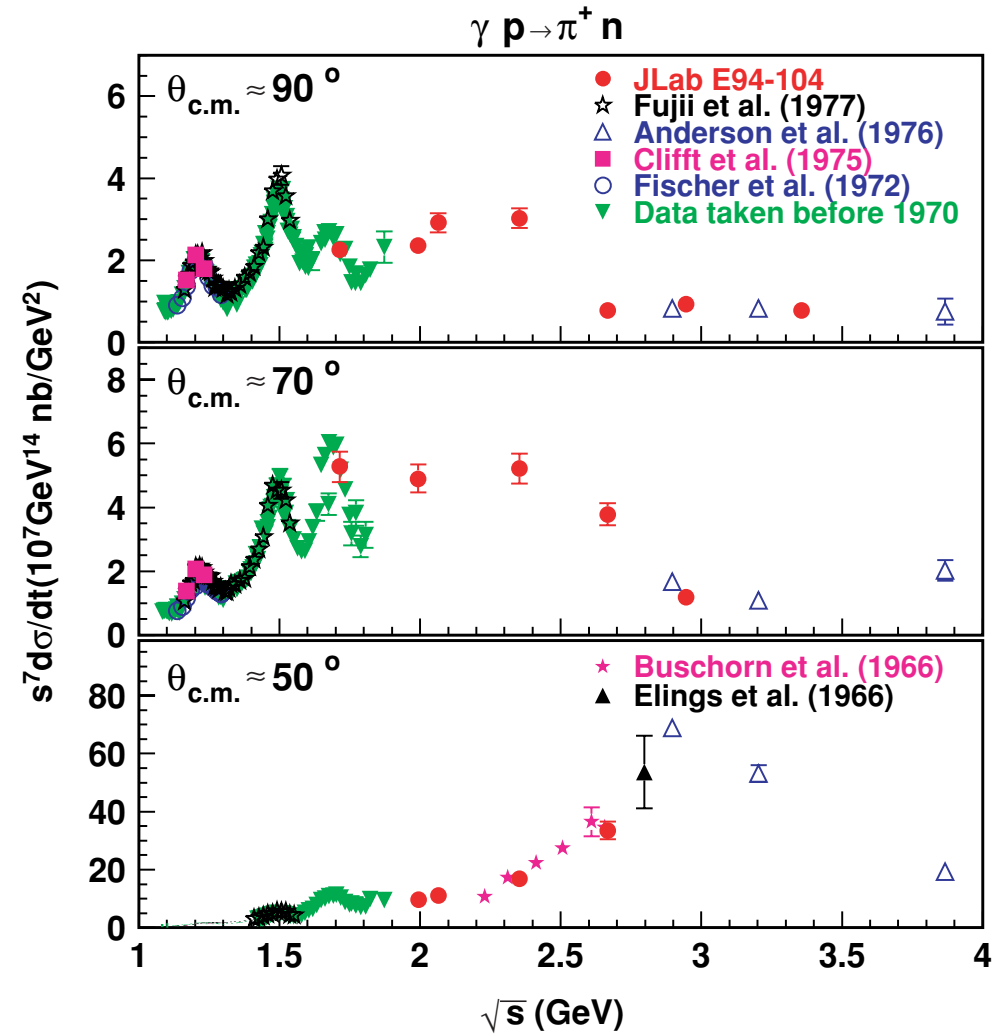
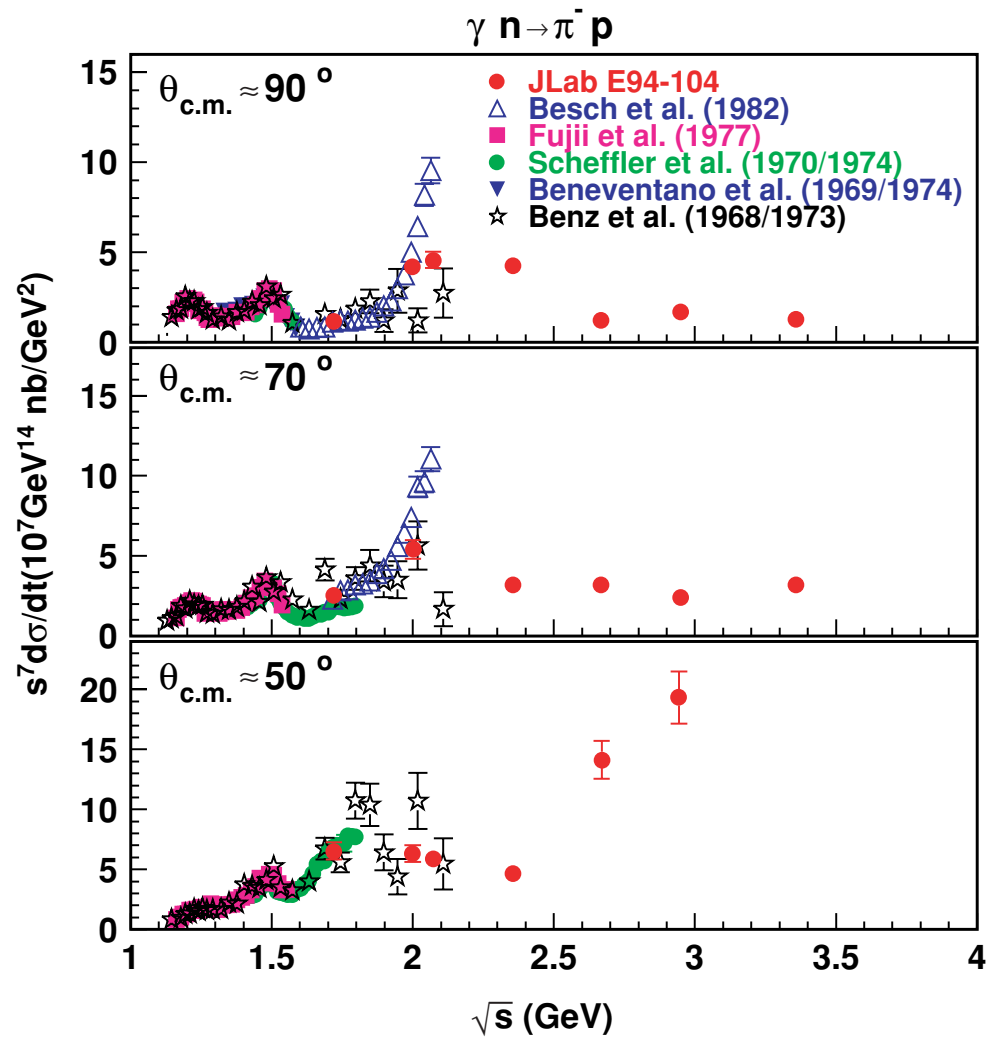
- High  $P_T$  reactions probe transition region between meson-nucleon and quark-gluon degrees of freedom

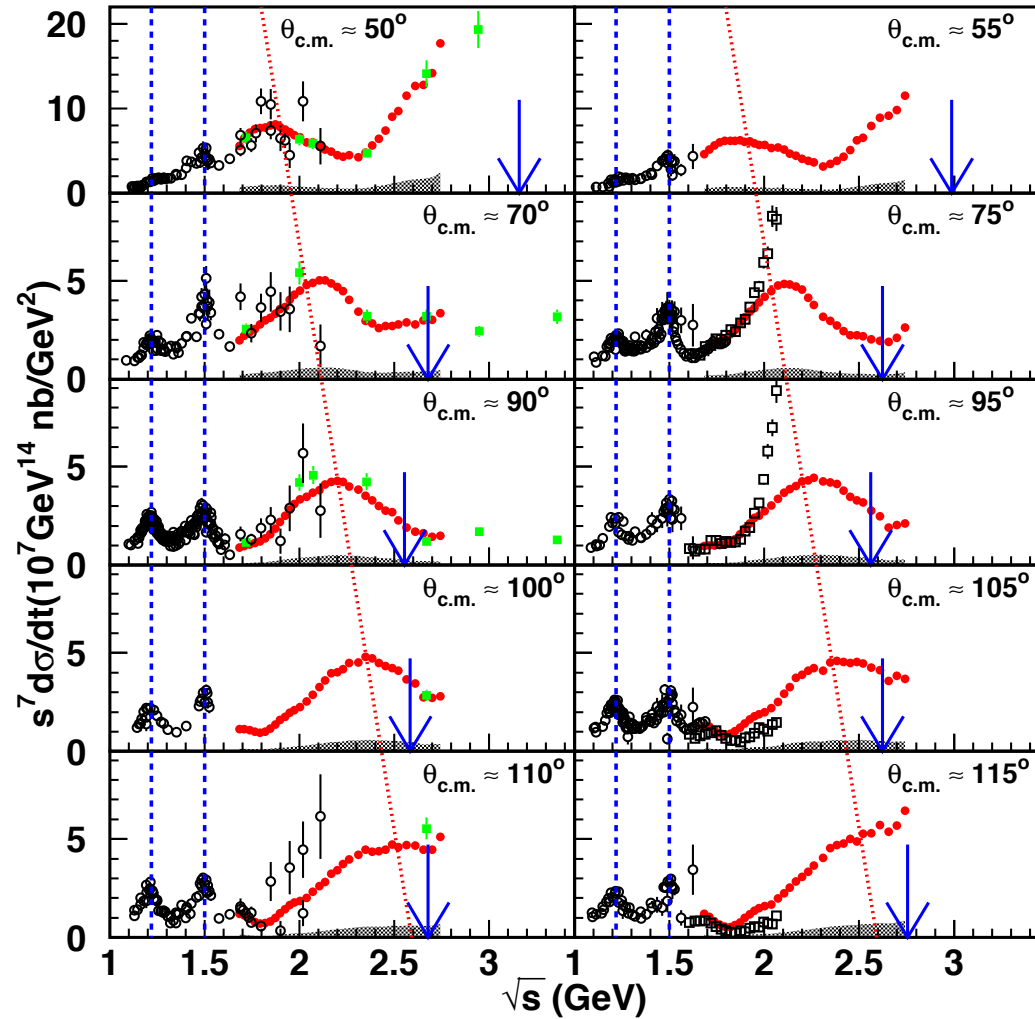
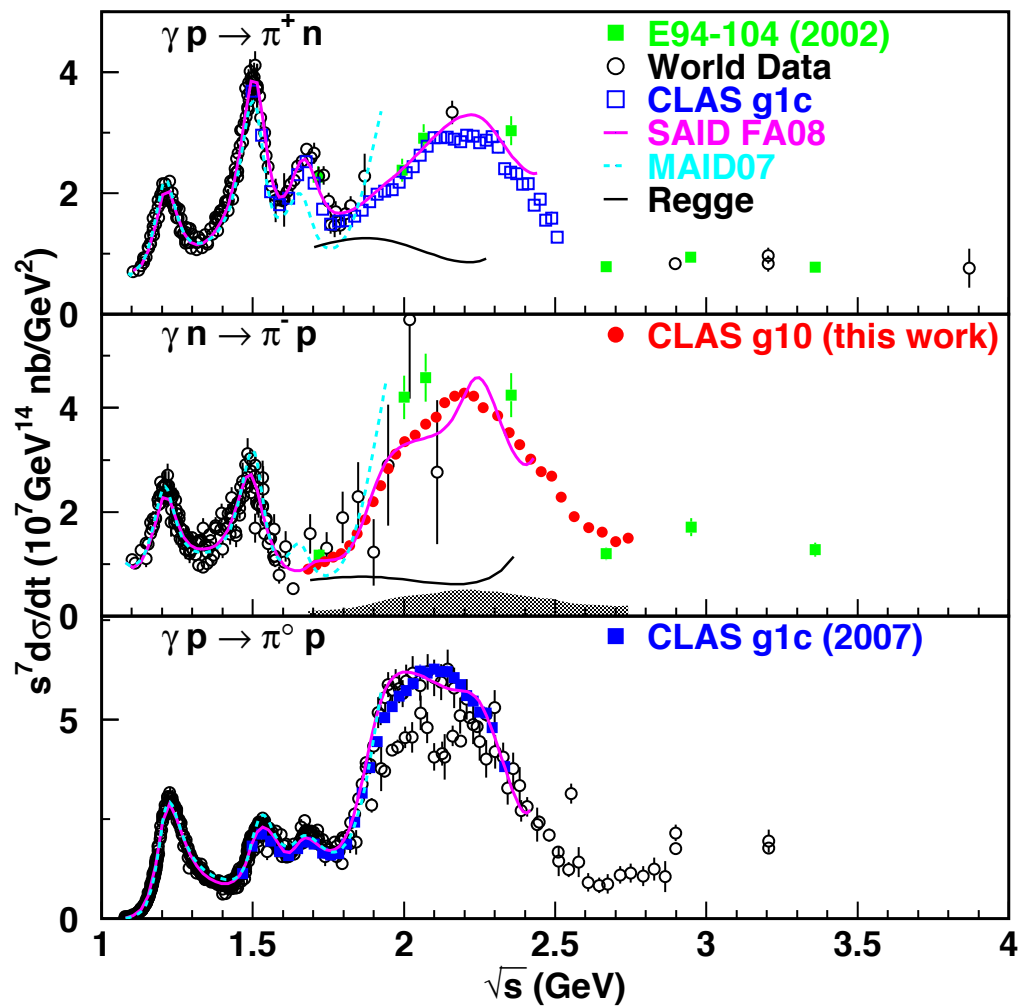
- Signature of onset of perturbative regime: constituent counting rule is valid

$$\frac{d\sigma}{dt} \propto s^{n-2} f(\theta_{CM})$$

- Helicity conservation : small final state polarization
- High precision data exist from 6 GeV area CLAS and Hall A experiments explored the low energy limit
- Reactions:  $\gamma p \rightarrow \pi^+ n$   $\gamma p \rightarrow \pi^0 p$  ( $\gamma p \rightarrow \pi^- \Delta^{++}$ )  $\gamma n \rightarrow \pi^- p$  (requires D target)
- Explore the possibility of extending kinematic region using the GlueX detector

# Existing Results

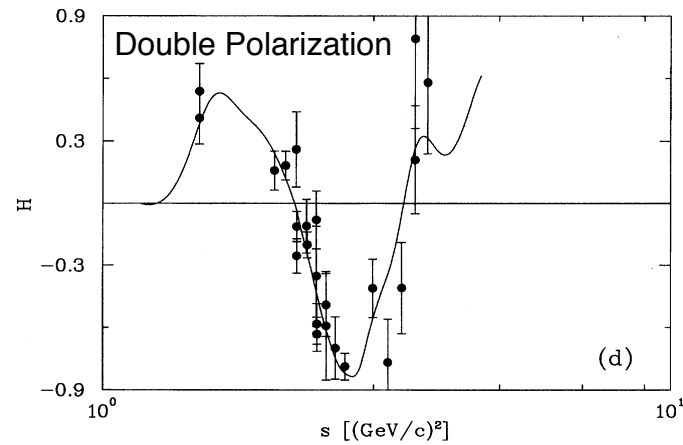
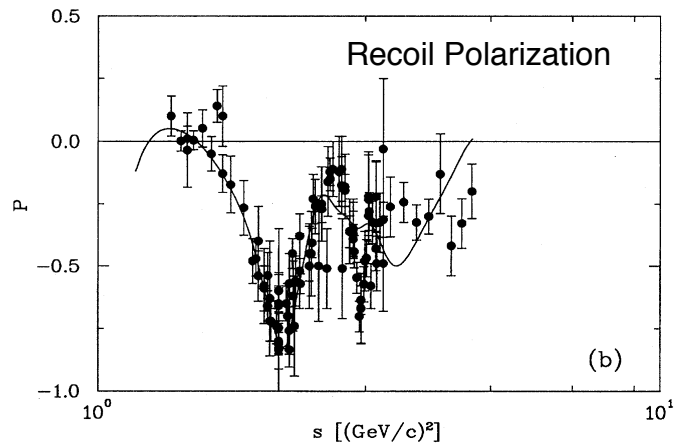
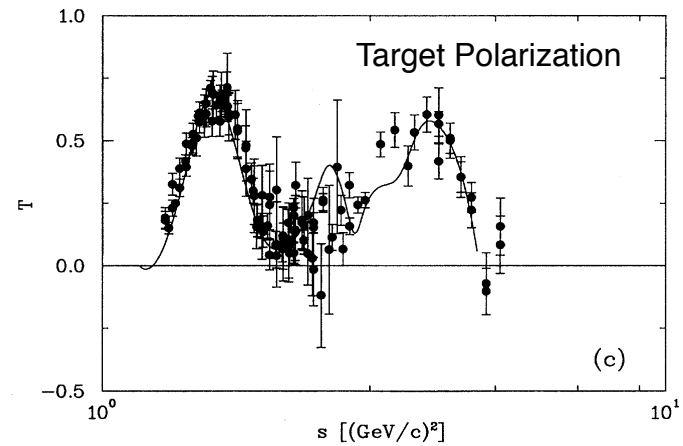
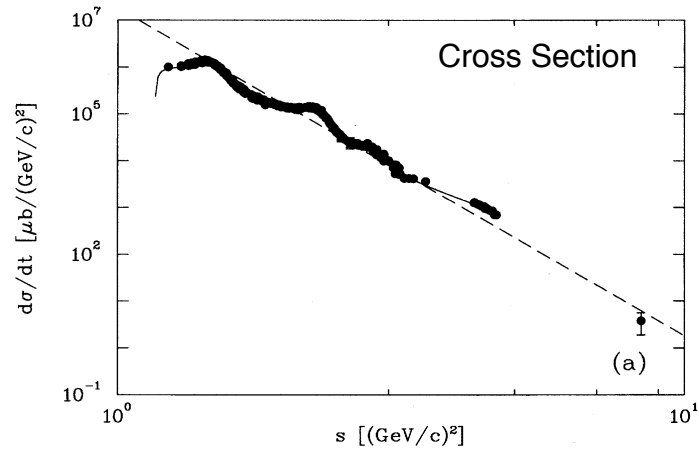




W. Chen et al. PRL 103 (2009)

$$\gamma p \rightarrow \pi^0 p$$

$$\theta_{CM} = 90^\circ$$



D.A.Jenkins & I.I. Strakovsky PRC 52 (1995) 3499

CLAS data: M.Dugger et al. PRC 76 (2007) 025211

O. Bartholomy et al. (CB-ELSA Collaboration) PRL 94 (2005) 012003

# Extension in GlueX

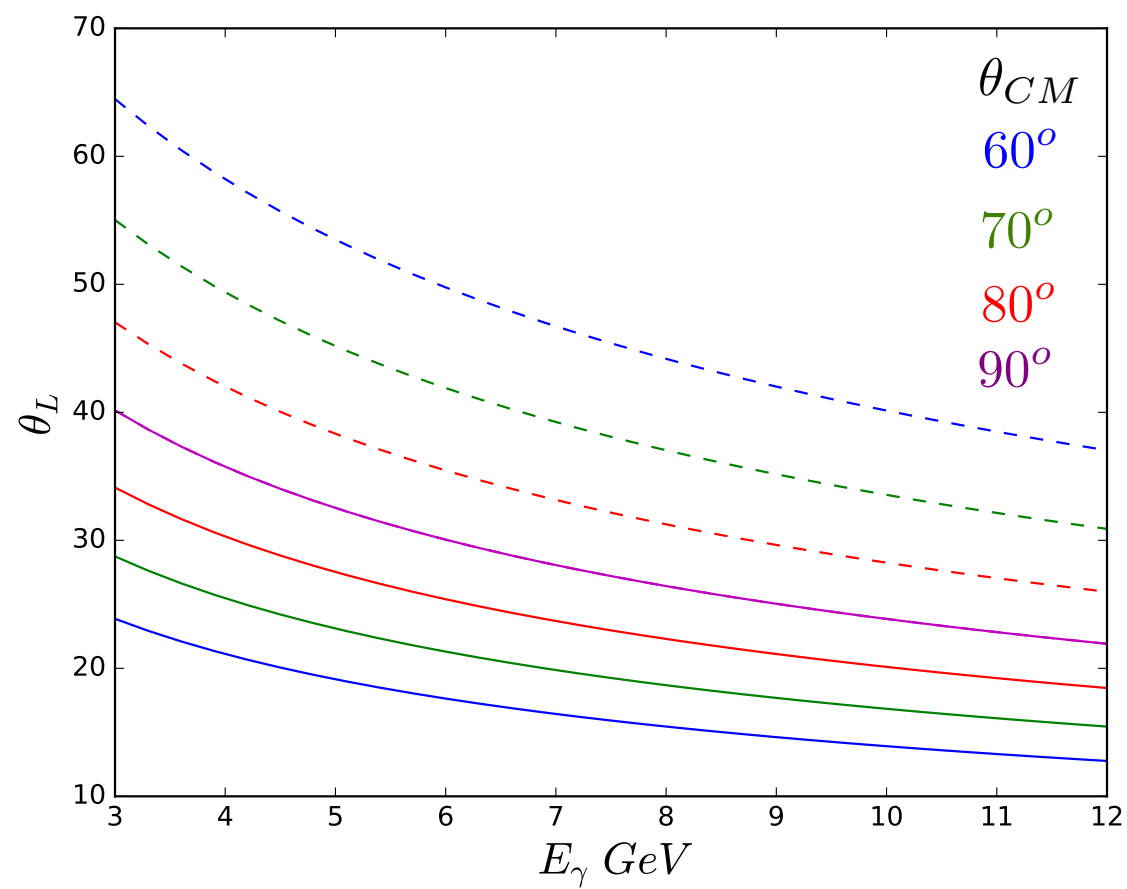
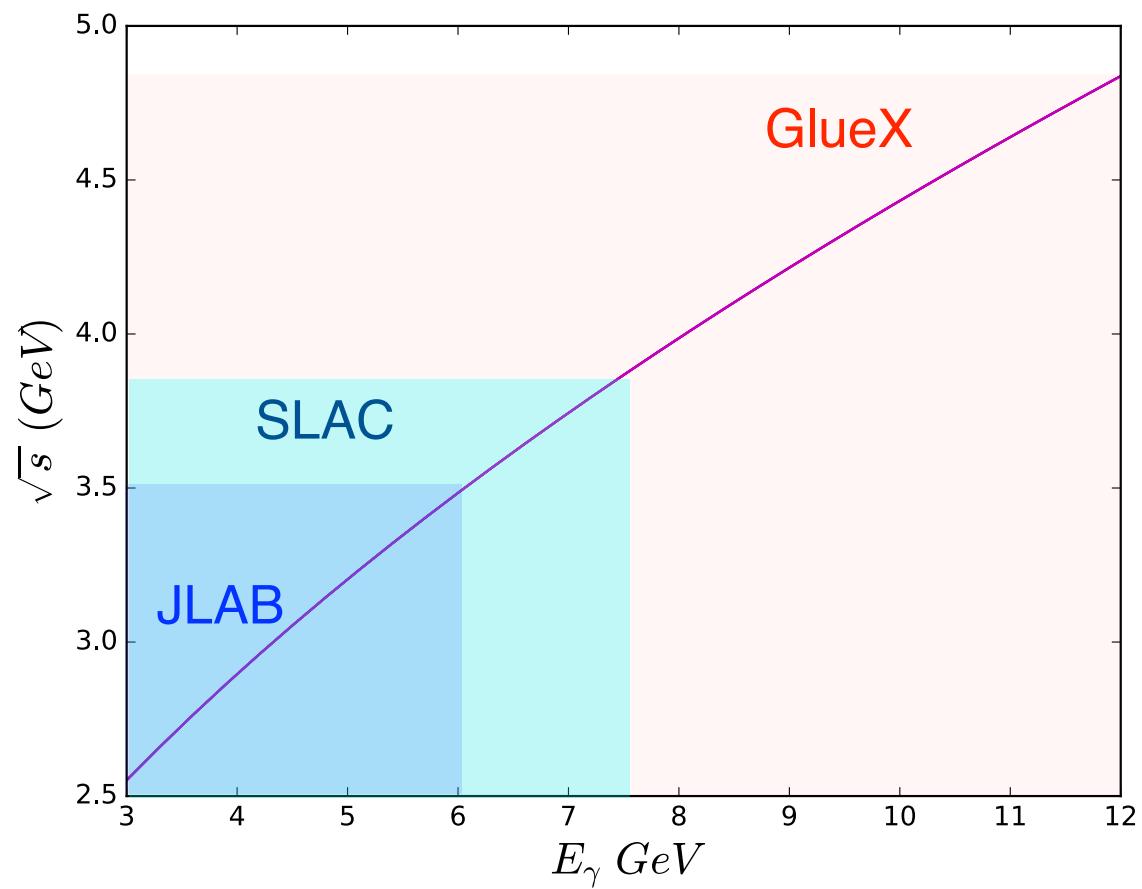
- Cross section estimated using scaling and fit to data:

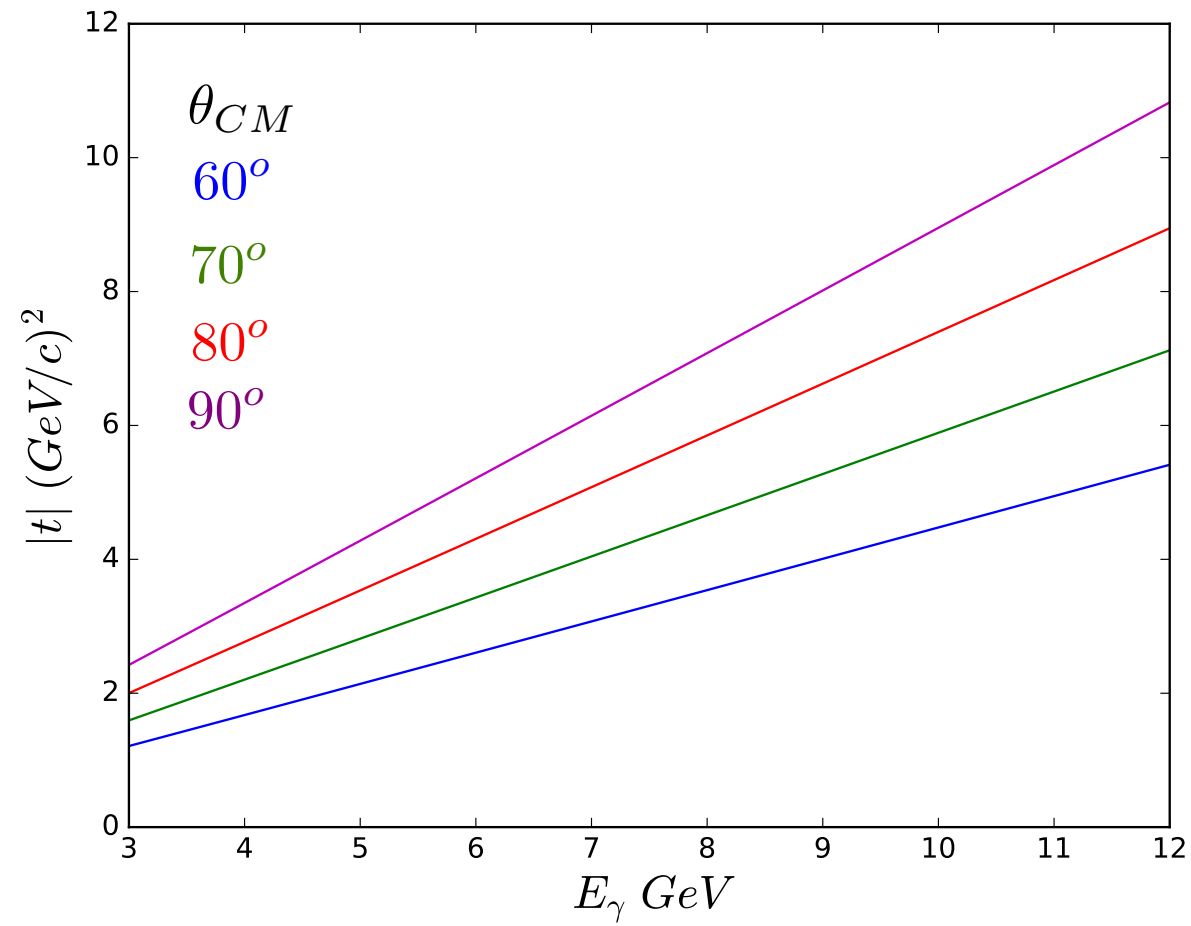
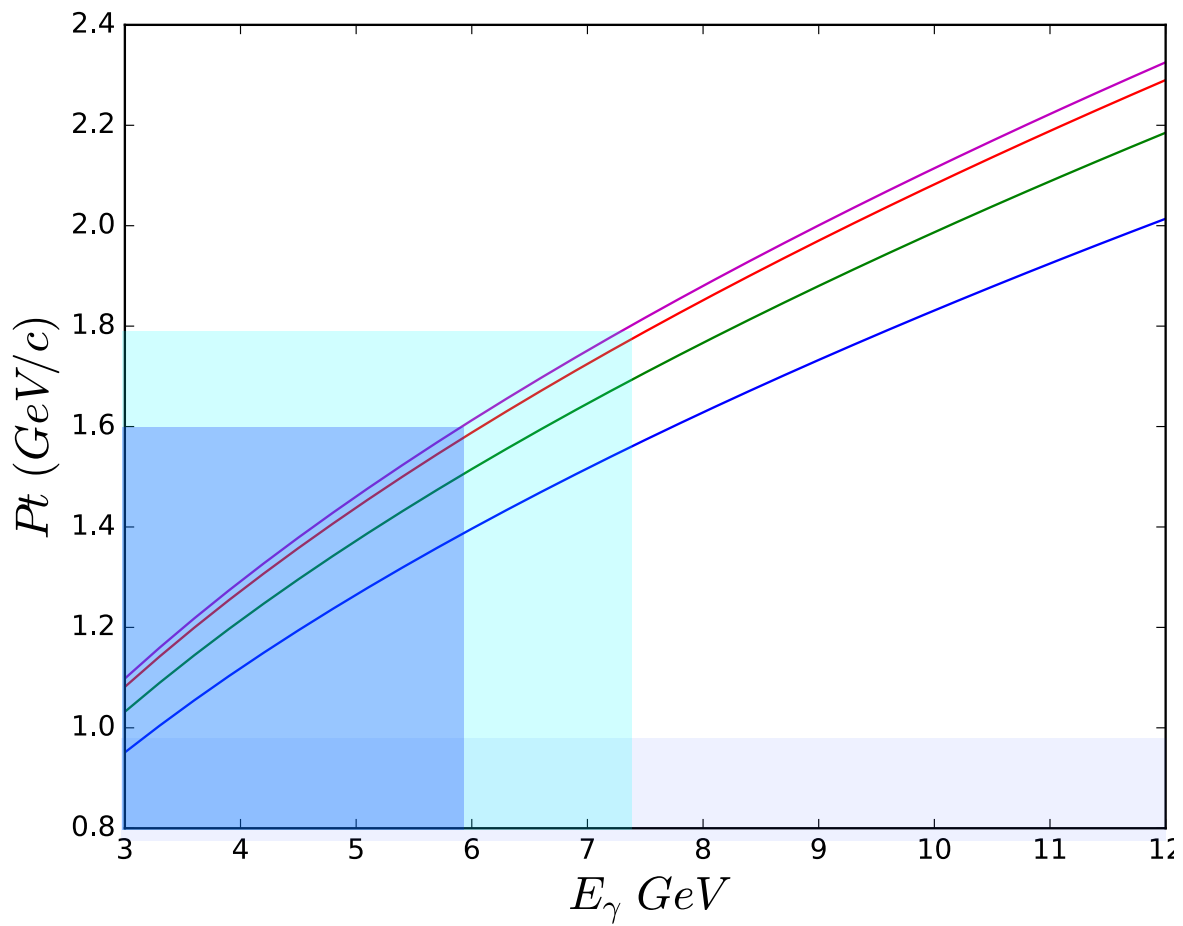
From Zhu et al. PRC 71 (2005), 044603

$$\frac{d\sigma}{dt} = \frac{0.69 f_s}{(1 + \cos \theta_{CM})^4 (1 - \cos \theta_{CM})^5} \cdot \left(\frac{s_0}{s}\right)^7$$

- Fit to angular distributions of SLAC data
- Reproduces exp. data reasonably well
  
- Select typical photon rate of  $10^7$  photons/s
- 30 cm LH2
- Overall Luminosity:  $1.3 \cdot 10^{31}$

# Kinematic coverage

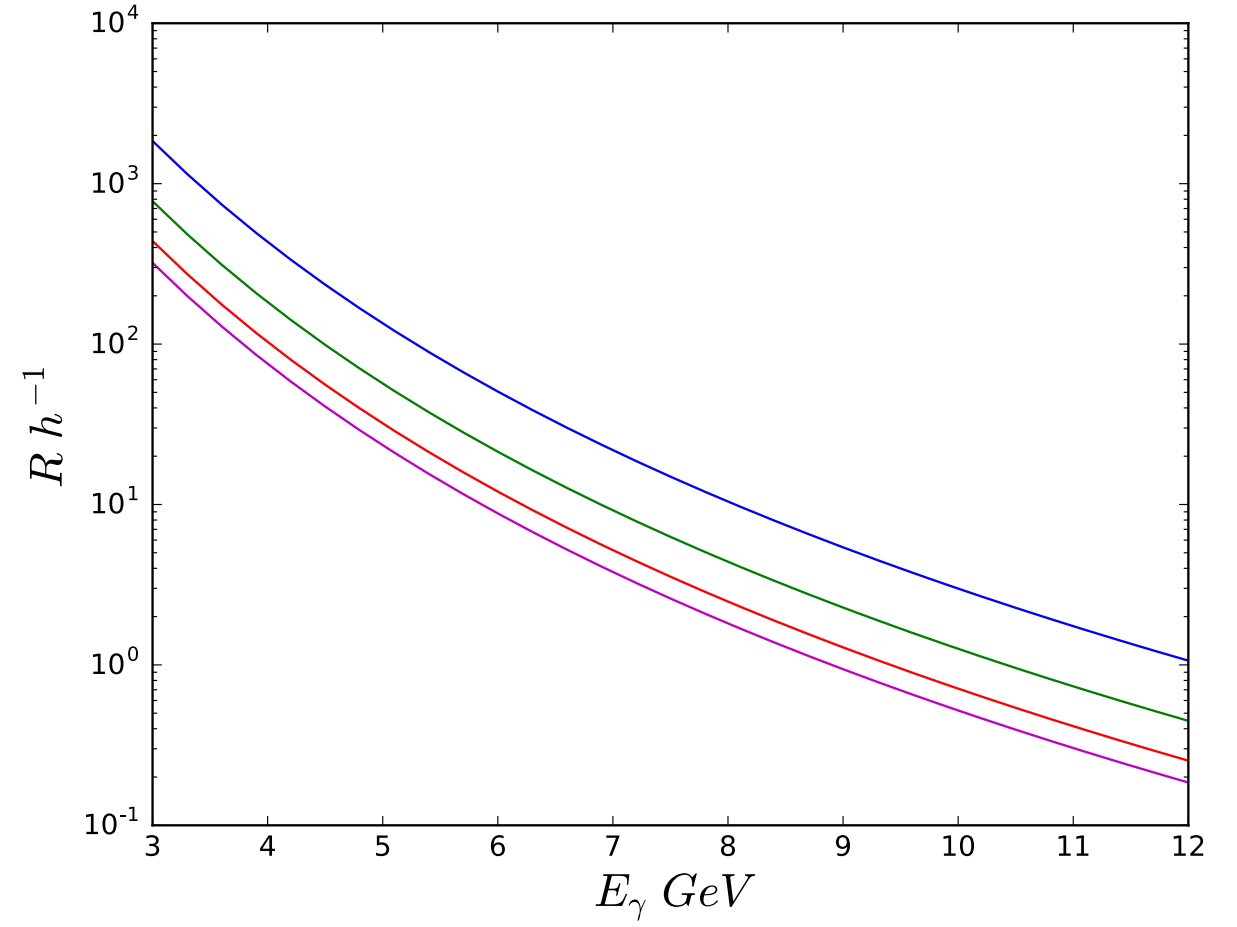
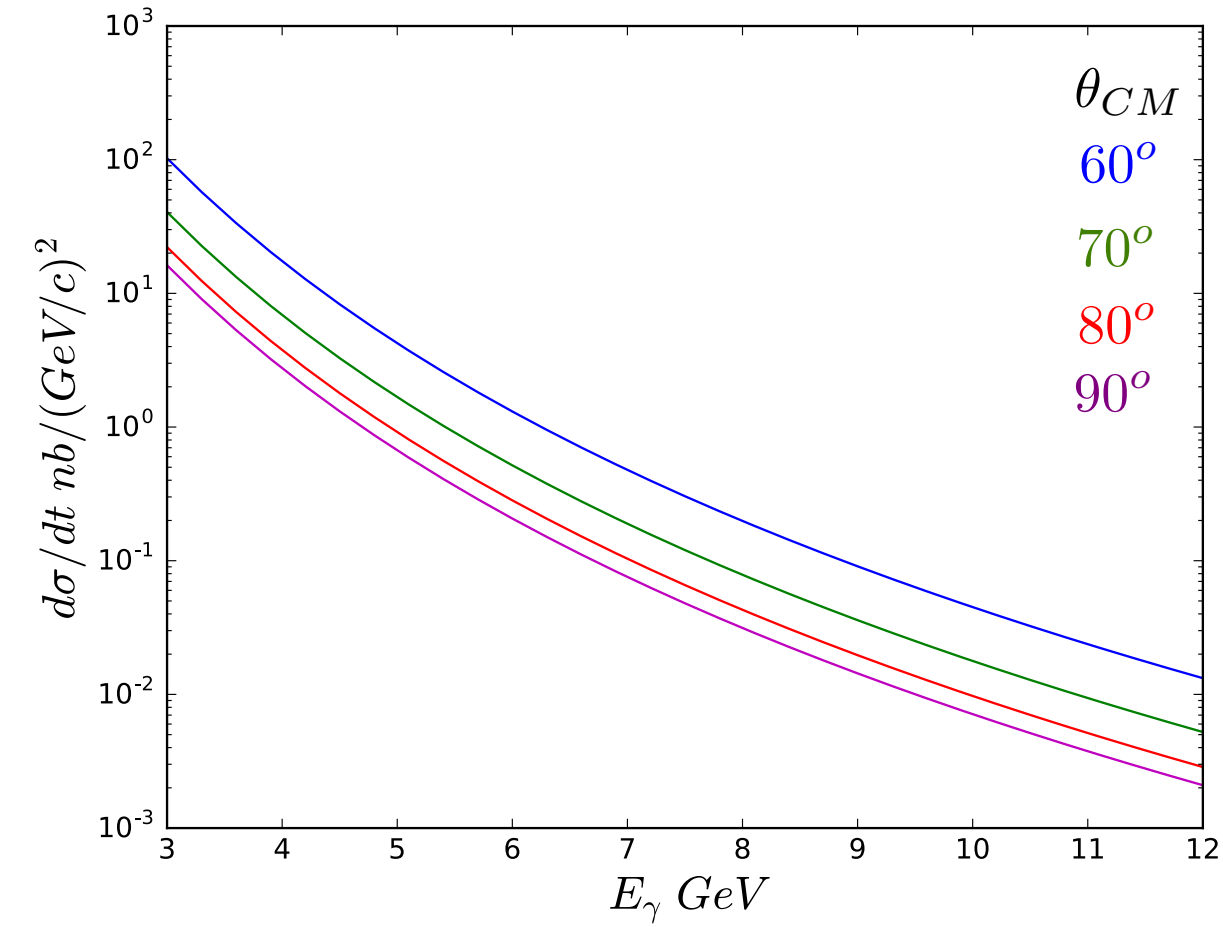




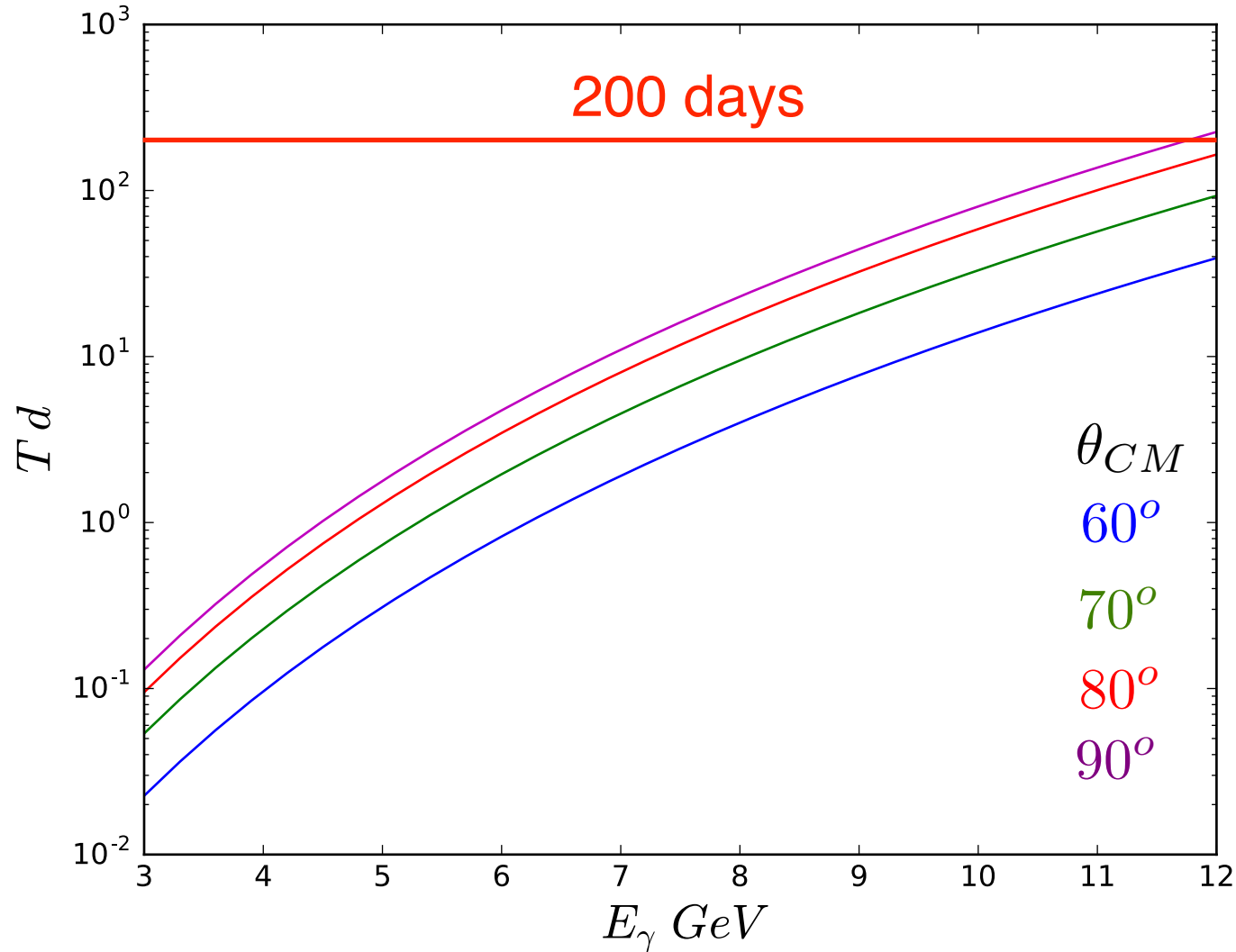
Large  $P_T$  and large  $|t|$



# Cross Sections / Rates

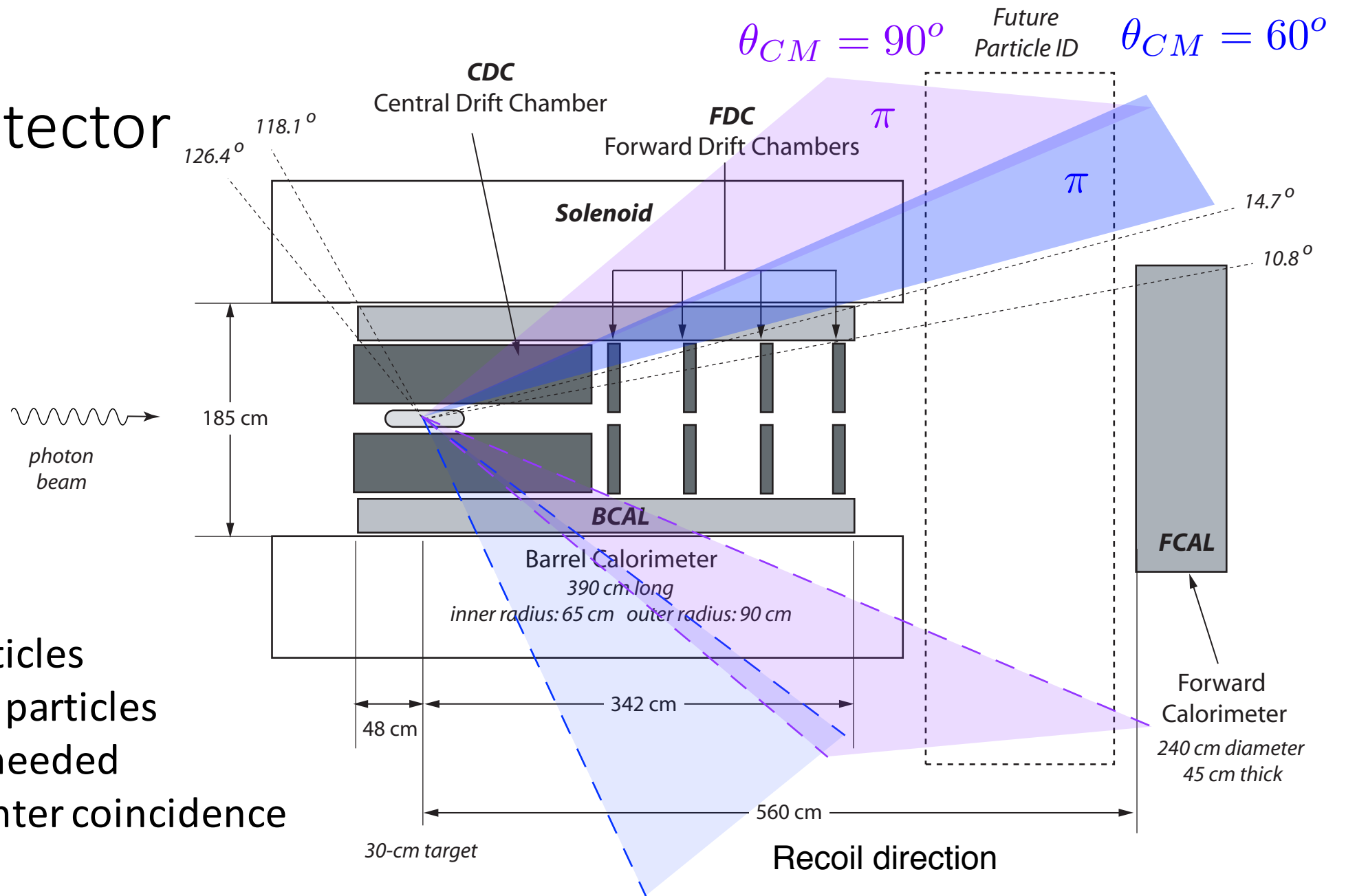


# Beam times for 1000 events



- Small cross sections
- Large amount of beam time needed
- Run parallel to existing and new program (especially on D)
- Polarization degree measurements at lower energies (and larger  $\sigma$ )

# GlueX detector



- No forward particles
- Pairs of large  $P_T$  particles
- Special trigger needed
- BCAL start counter coincidence

# Summary

- GlueX/Hall D has the potential to significantly increase kinematic range of  $\pi$  production at high  $P_T$  ( $> 1$  GeV/c)
- Small cross sections: optimize trigger (for large angles) and PID
- Background needs to be studied
- Hydrogen target data can be taken in parallel to meson spectroscopy program
- Deuteron target opens new possibilities
- High  $P_T$  studies for other mesons interesting ( $\rho$ ,  $\omega$ )
- Polarized photons: new possibilities