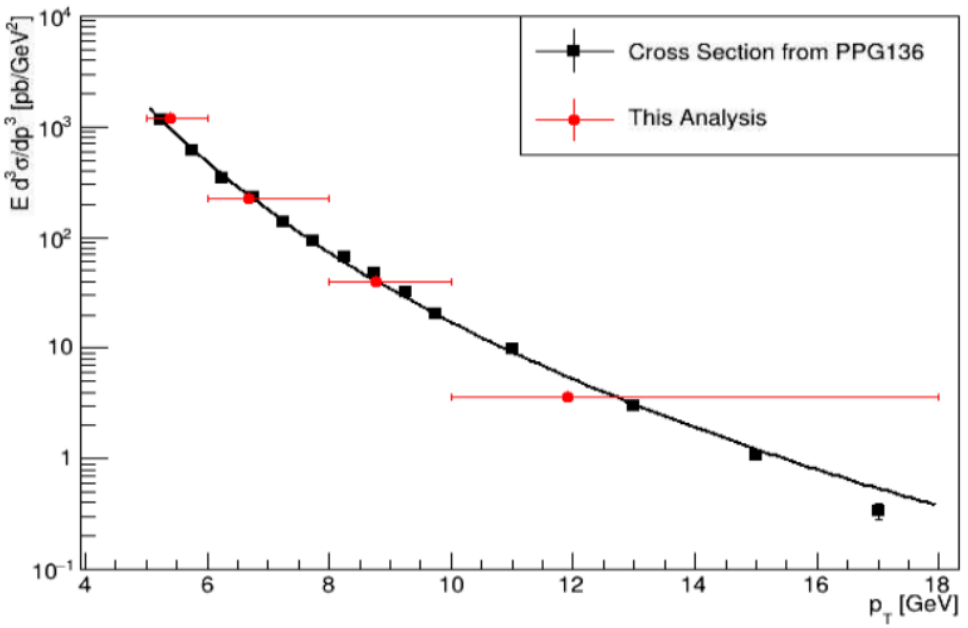
PHENIX Preliminary Request

Transverse Single Spin Asymmetry of Midrapidity Isolated Direct Photons in $p + p$ collisions at $\sqrt{s} = 200$ GeV

Final Cross Section From Last Week

p_T [GeV]	This Result $E\frac{d^3\sigma}{dp^3}$ [pb/GeV^2]	PPG136 $E\frac{d^3\sigma}{dp^3}$ [pb/GeV^2]	Percent Differ-ence
5 to 6	1181.87	908.11	23.2%
6 to 8	221.21	208.06	5.9%
8 to 10	39.20	37.82	3.5%
10 to 18	3.61	3.74	3.6%



Misremembered how I got the comparison values for PPG136.

Averaged the PPG136 cross section over the wider p_T bins of this analysis by fitting a power law, integrating over the p_T bins and the dividing by the p_T bin width.

Last week I said I plugged in the p_T bin's average value

PHENIX Preliminary Data Request Plenary Presentation

Name: Nicole Lewis

PWG: Spin

What Observable: direct photon A_N

System, Energy, Run: p+p, 200 GeV, Run-15

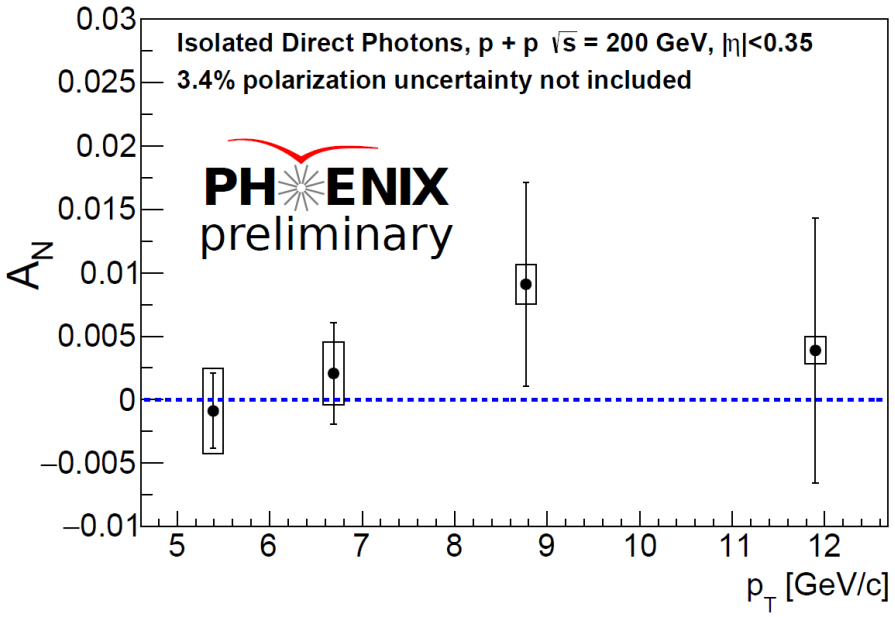
Last PWG Presentation Date: 3/4/20

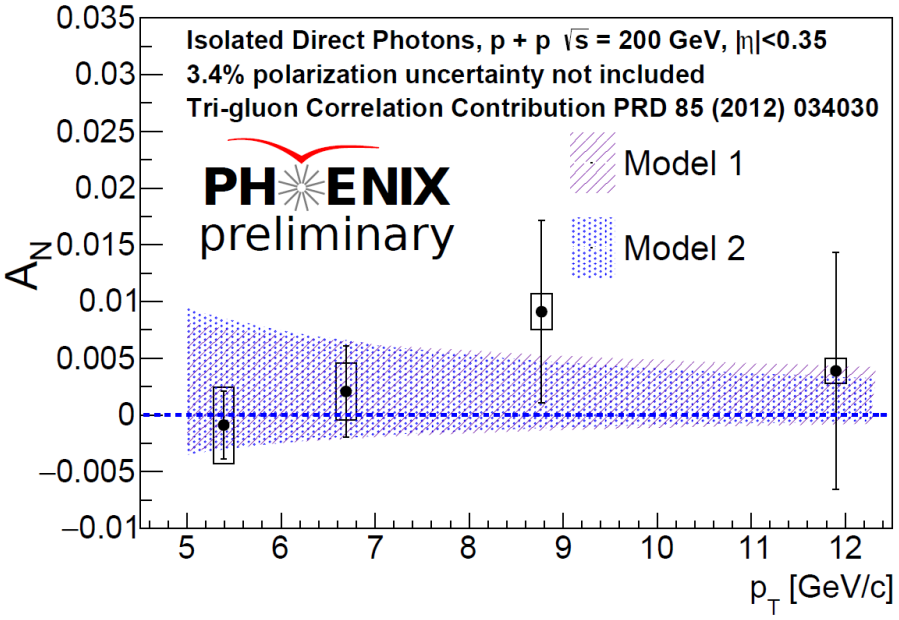
Last PWG Presentation Link: https://www.phenix.bnl.gov/cdsagenda/askArchive.php?base=agenda&categ=a2048&id=a2048s1t181/moreinfo

Analysis Note #: 1326

Analysis Note Web Link: https://www.phenix.bnl.gov/phenix/WWW/p/draft/nialewis/photonA_N/Run15DirectPhotonA_N-version6.pdf

What plots are requested preliminary?





Basic Information

Data set: Run-15 p+p

Data provenance (i.e. reconstruction tag)

Pro104

Analysis code location in CVS (required)

offline/AnalysisTrain/Run15ppPhotons

Basic analysis cuts used

Events: $|z_{vtx}| < 30\ cm$, Fires one of the ERT A, B, or C triggers, no empty xings

Photons: prob_photon > 0.02, $|tof| < 5\ ns$, warn and dead map cut, edge tower cut, hot tower cut, must pass charged veto cut, ERT supermodule check

Tagging cut – remove photons tagged as coming from $\pi^0 \rightarrow \gamma\gamma$ or $\eta \rightarrow \gamma\gamma$ decays

Isolation cut – $E_\gamma * 10\% > E_{cone}$ where E_{cone} is the sum of energies of surrounding clusters and momenta of surrounding tracks with $\sqrt{(\Delta\phi)^2 + (\Delta\eta)^2} < 0.4$ radians

Basic Information & Provenance, part 2

Recalibrations:

Used the tof recalibrator for the Run 15 π^0 A_N

(N. Novitzky)

All other recalibrators are in the MasterRecalibrator

Location in CVS of Recalibrator codes

/offline/AnalysisTrain/Run15ppPhotons

With necessary text files included

What's the observable

What observable is analyzed?

A_N of isolated direct photons

What will be plotted?

A_N vs p_T

What's new about this result?

Never measured at RHIC

What is the question that this new result will answer?

Provides sensitivity to spin-momentum correlations in the proton, without sensitivity to hadronization

Analysis Issues

What were the main issues in the analysis?

Background

What concerns were raised in PWG meetings?

Verifying that direct photon yields were correct without access to simple cross check like an invariant mass plot

What was the resolution for these issues?

Calculate direct photon cross section and show that it agreed with previously published results, PPG136

Page number / figure in AN with the details…

AN1326 Background fraction Section 5, pages 15-24

Cross Section Cross Check Section 6.2, pages 26-30

Relation to Previous Analyses

Are there previous results for the same observable?

No

Are there previous results for a related observable?

Direct Photon Cross Section in p+p at $\sqrt{s} = 200\ GeV$

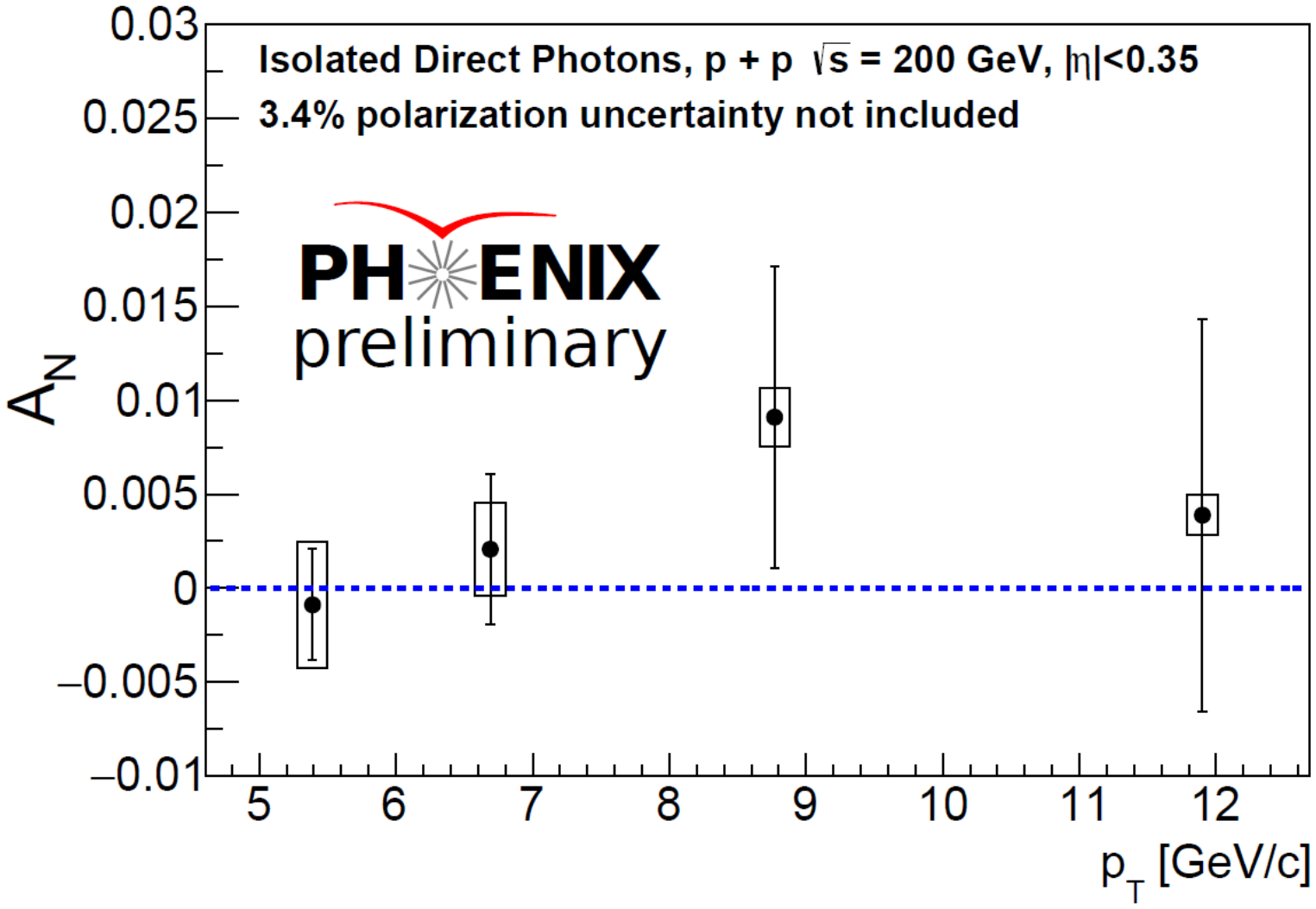
PPG049, PPG060, PPG136

Are there any non-PHENIX results for this observable?

Fermilab E704: DL Adams, *et al* Phys. Lett B 345 (1995) 569

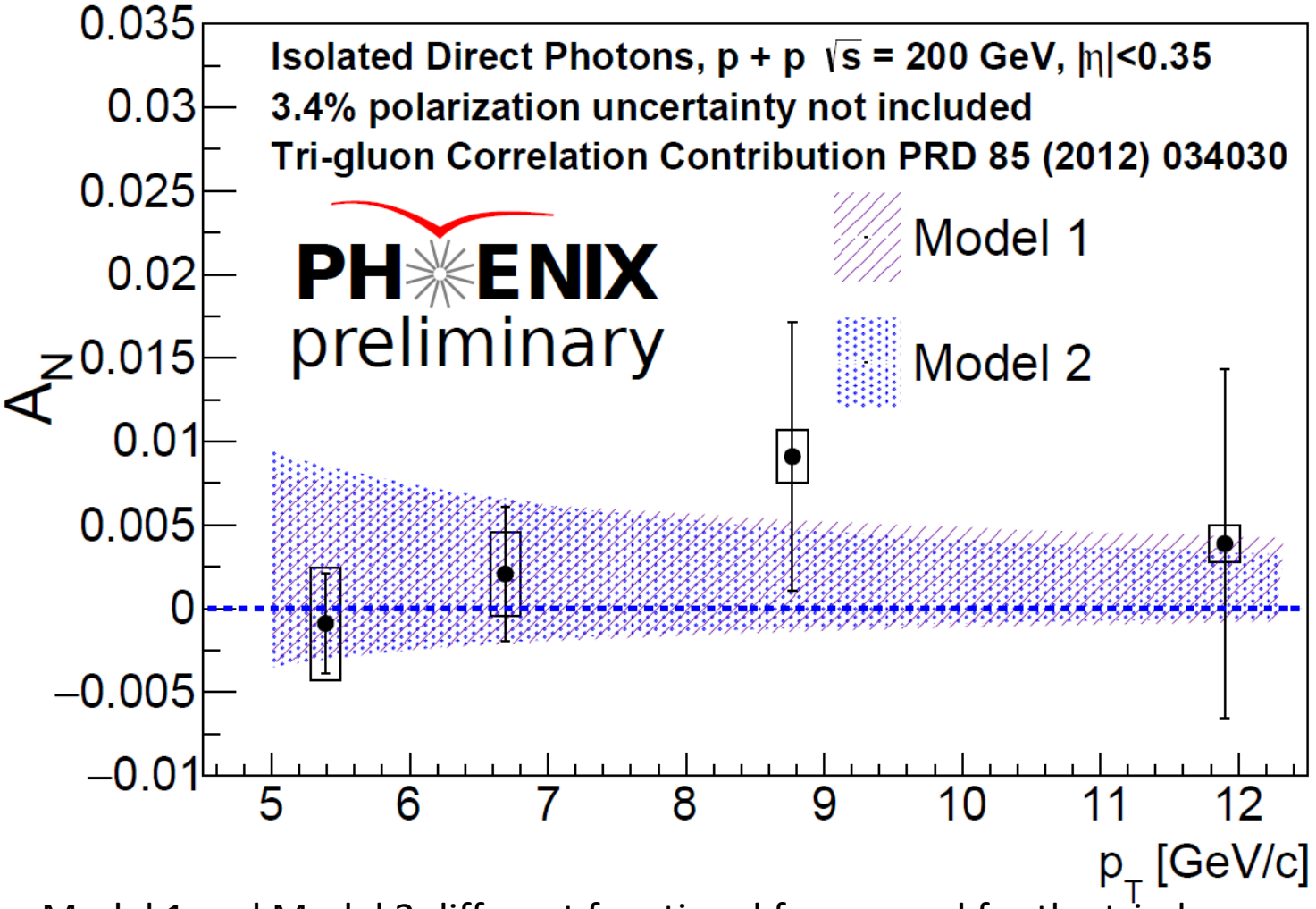
inclusive direct photon A_N with $2.5 < p_T^\gamma < 3.1$ GeV and $-0.15 < x_F < 0.15$. Consistent with zero with large error bars: https://www.sciencedirect.com/science/article/pii/0370269394016959

Plots Requested for PHENIX Preliminary



PHENIX

Plots Requested for PHENIX Preliminary



Model 1 and Model 2 different functional forms used for the tri-gluon correlator
Calculations done for A_N^γ at forward rapidity and recalculated at $\eta = 0$

Physics Knowledge Gained

Isolated direct photon A_N at midrapidity

Sensitive to only initial-state effects and will help constrain the twist-3 collinear trigluon correlation function for the polarized proton

The Path to Final Results

What improvements are expected for the final results ?

None

Is all the data available used ? Yes

What is the timescale to achieve final result?

Results are final

Back Up

Direct Photon Cross Section Cross Check

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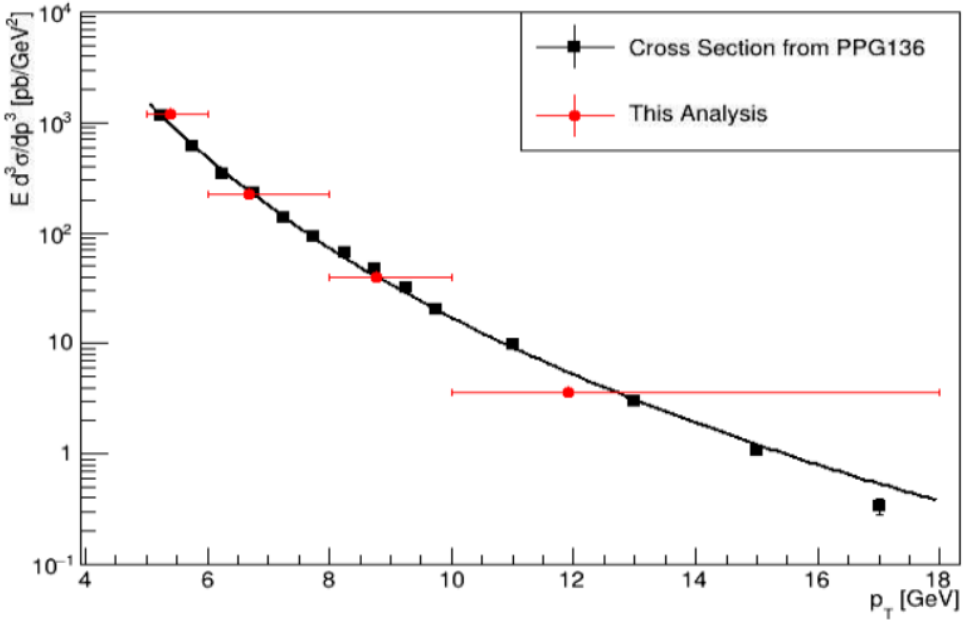

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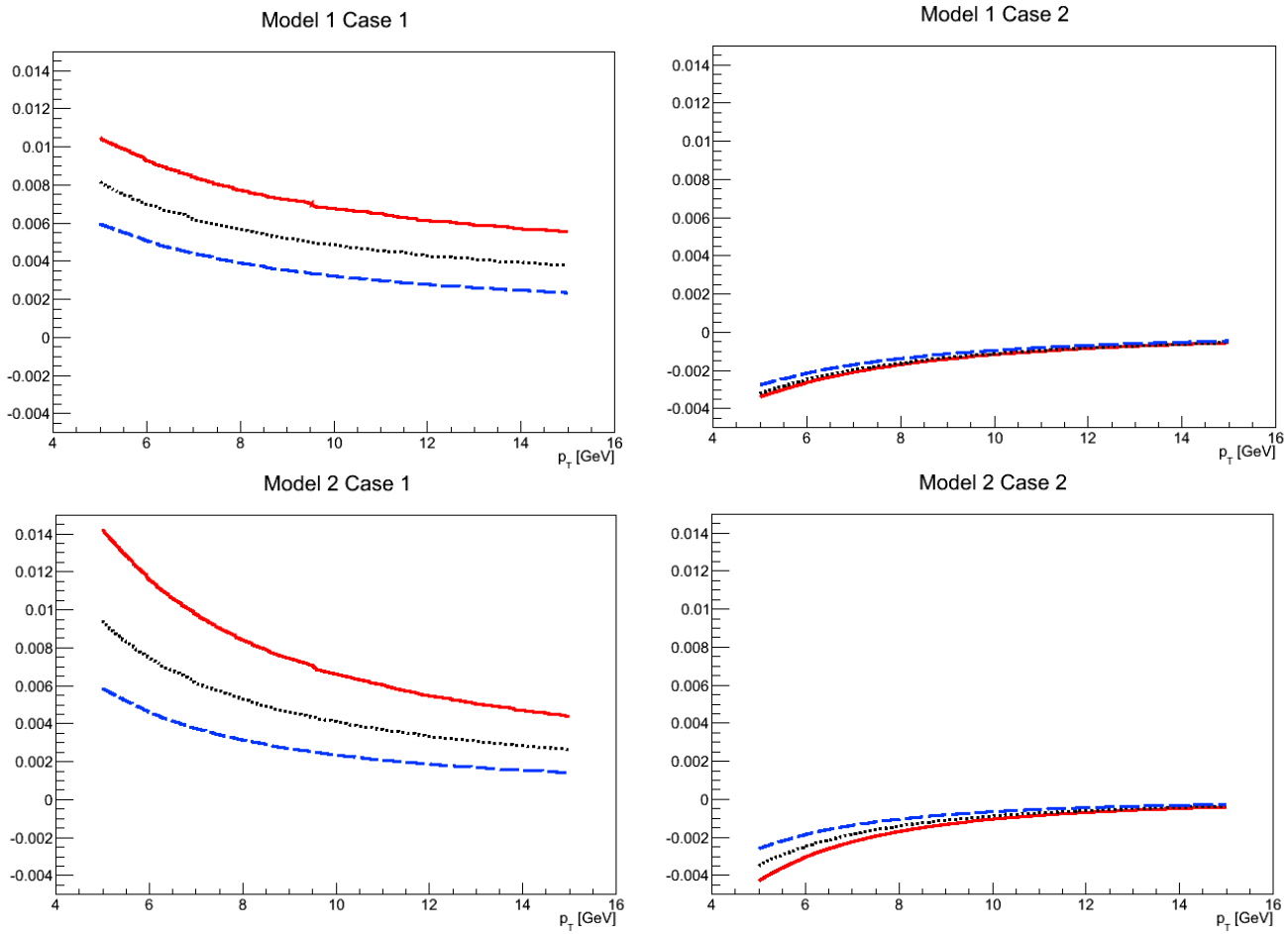
Trigluon Correlation Contribution to direct photon A_N



$\eta = +0.35$
$\eta = 0$
$\eta = -0.35$

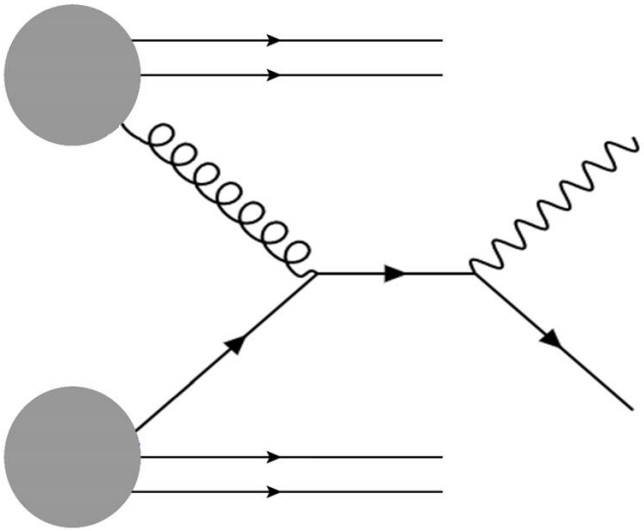
- Different models are different 3-gluon correlation functions
- Case 1 maximizes the asymmetry and case 2 minimizes it

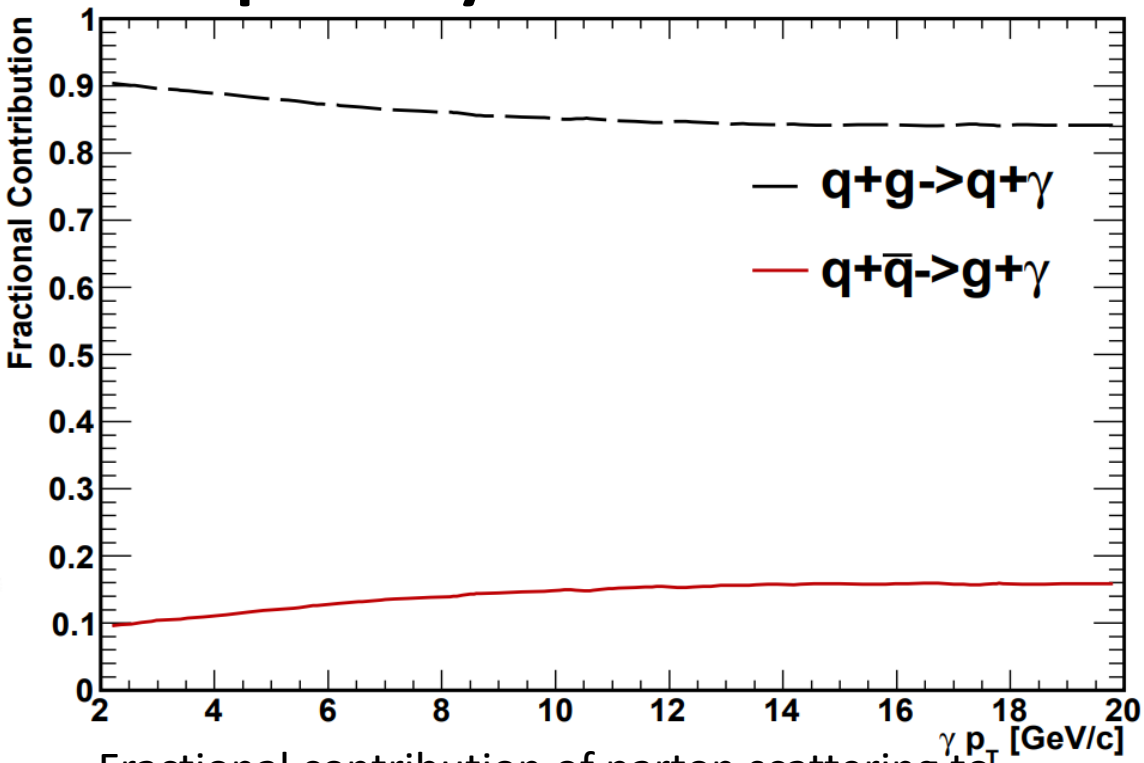
Y. Koike, S. Yoshida PRD**85** (2012) 034030

Direct Photons in $p + p$ at Midrapidity

Only sensitive to initial state effects, no effects from fragmentation

Strong sensitivity to gluon PDFs





Fractional contribution of parton scattering to inclusive direct photon production at LO for $p + p$ collisions at $\sqrt{s} = 200\ GeV$ for midrapidity

(PHENIX Collaboration), Phys. Rev. D **82,** 072001 (2010)