Direct Photon Search in $\sqrt{s}$ = 200 GeV p+p Collisions with the Statistical Background Subtraction Method

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Motivation

Measurement of the direct photon cross section in p+p:

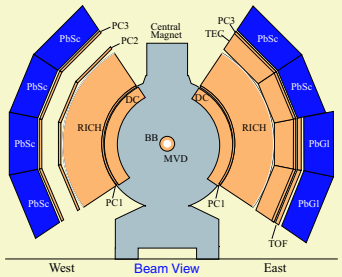
1. Reference for Direct Photon R_{AA}

   High p_T neutral pion and charged hadron production is suppressed in central Au+Au collisions at RHIC relative to a scaled p+p reference. Parton energy loss in a medium of high color charge density is a possible explanation. Direct photons, however, leave the reaction zone unaltered and are thus not expected to be suppressed.

2. Constraint for the Gluon Distribution Function of the Proton

   Direct photon production is sensitive to the gluon distribution of the proton via quark-gluon Compton scattering q+g→q+γ. At the same time, this is a test of pQCD.

Detector



PHENIX EMCal:

- Two Subsystems:
  - Lead Scintillator (PbSc)
  - Lead Glass (PbGl)
- Both used in this analysis

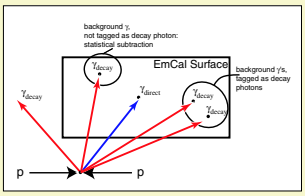
EMCal Trigger

- Used to select events which contain high p_T photons
- Trigger threshold: ~0.8 GeV

Pad Chamber (PC3)

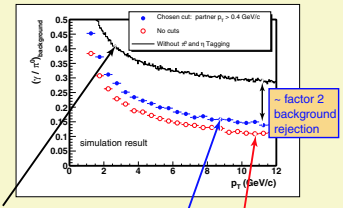
- Used as charged particle veto detector

Method



- Photon hits which form an invariant mass in the π^0 or η mass range are rejected as direct photon candidates
- Accidental loss of genuine direct photons corrected for by embedding fake photon hits in real events
- The remaining background of decay photons is subtracted on a statistical basis
- An isolation cut is not applied

Background Reduction

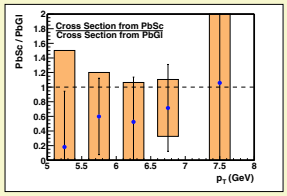


Decay photon background without π^0 and η tagging

Chosen compromise (Partner p_T > 0.4 GeV)

Maximal possible background rejection with the tagging method (but large loss of genuine direct photons)

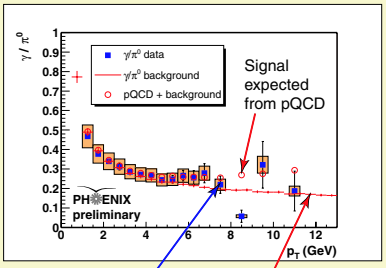
Systematic Errors



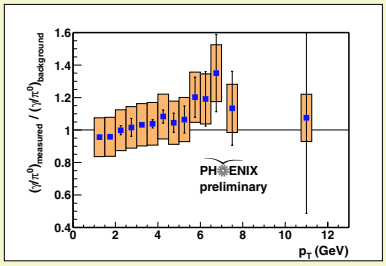
- The current systematic error of the direct photon cross section is on the order of 50%
- The error estimate is confirmed by comparing independent results from PbGl and PbSc

Results

γ/π^0 Ratio

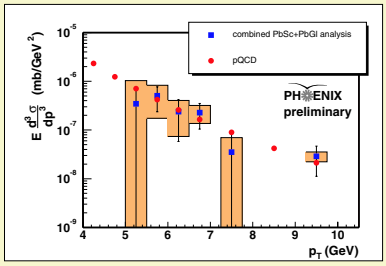


Photon Excess



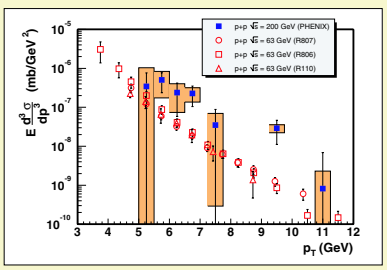
- Measured photons over expected background photons

Direct Photon Cross Section



- Measured cross section agrees with NLO pQCD (calculation by W. Vogelsang)
- CTEQ6 gluon distribution used in pQCD calculation

Comparison to ISR Results



- Direct Photon Cross Section at $\sqrt{s}$ = 200 GeV higher than at $\sqrt{s}$ = 63 GeV
- More statistics needed to draw stronger conclusions

Conclusions

- Direct photon signal extracted from $\sqrt{s}$ = 200 GeV p+p data (RHIC run II)
- Direct Photon Cross Section consistent with NLO pQCD calculation based on CTEQ6 gluon distribution function