The Coherent Photon and Pomeron Physics Program at STAR

Janet Seger

Creighton University

for the ☆STAR Collaboration

Defining Peripheral Collisions

- b > 2R

  – no hadronic interactions
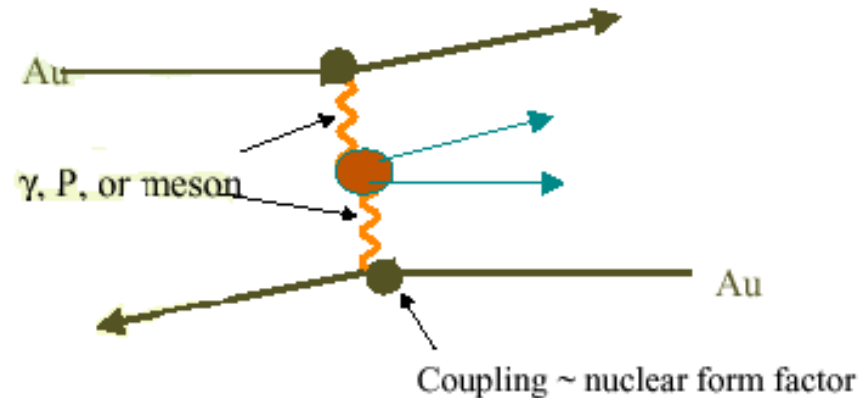
- ions typically remain unchanged

$$A + A \to A + A + X$$

- ions are *coherent* sources of intense fields

  – $Z\alpha = 0.6$

  – photon, Pomeron, meson interactions

Coherent Interactions

Au

γ, P, or meson

Au

Coupling ~ nuclear form factor

■ Low p_T $p_T < 1/R \approx 50$ MeV

■ Low Energy $E_{CM}^{Max} < \gamma/R$

  – CERN SPS $E_{CM}^{Max} = 0.5$ GeV

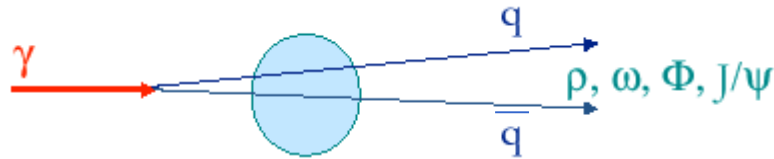 – RHIC $E_{CM}^{Max} = 6$ GeV

  – CERN LHC $E_{CM}^{Max} = 160$ GeV

RHIC first to study hadronic final states

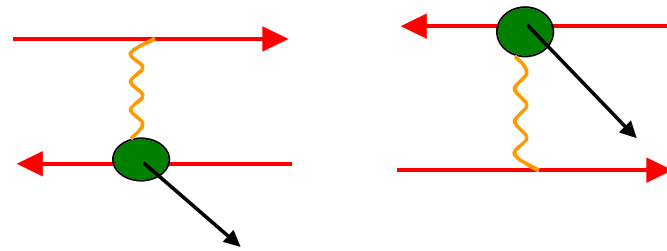# $\gamma\gamma$ Luminosity $\propto Z^4$
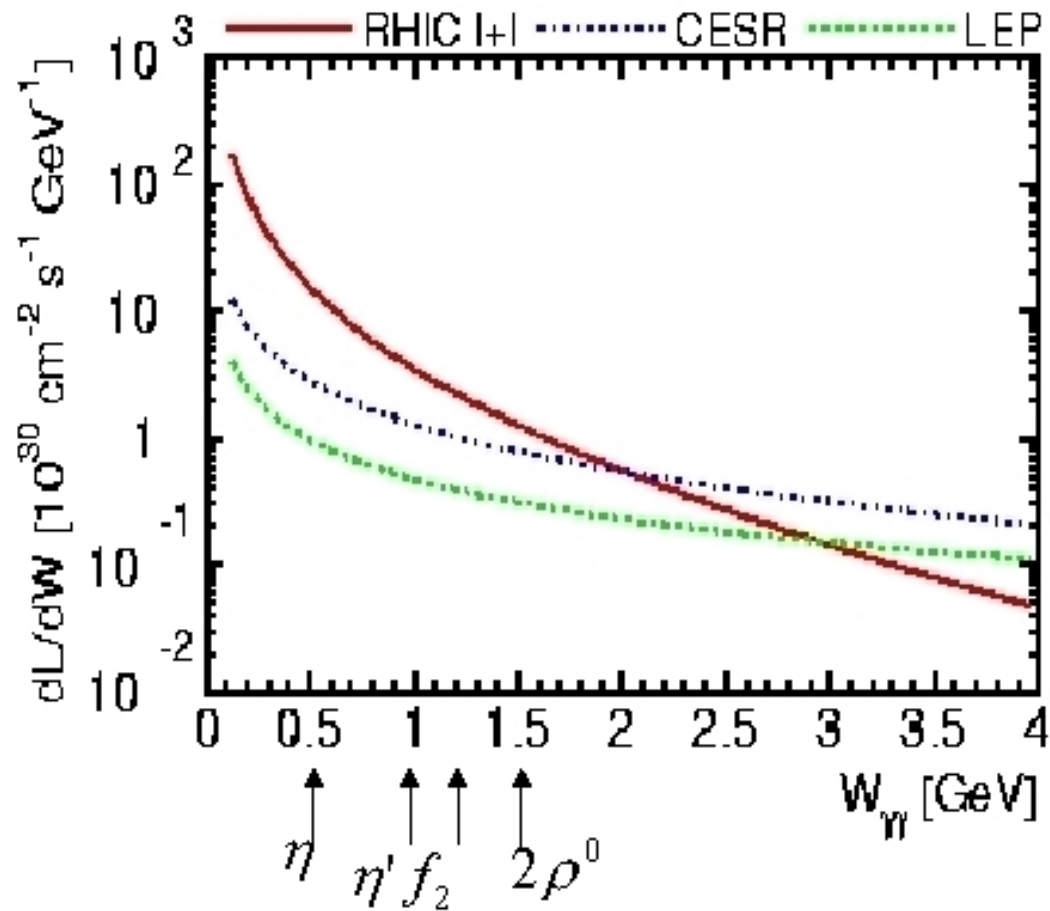
Photonuclear interactions

- ■ Photon fluctuates to $q\bar{q}$ pair
- ■ $q\bar{q}$ pair can emerge as vector meson
  - – $\rho, \omega, \Phi, J/\psi$
- ■ Rates are large-- 1% probability of ρ-production when b=2R
  - – look for rare decays, multiple vector meson production, excited state spectroscopy
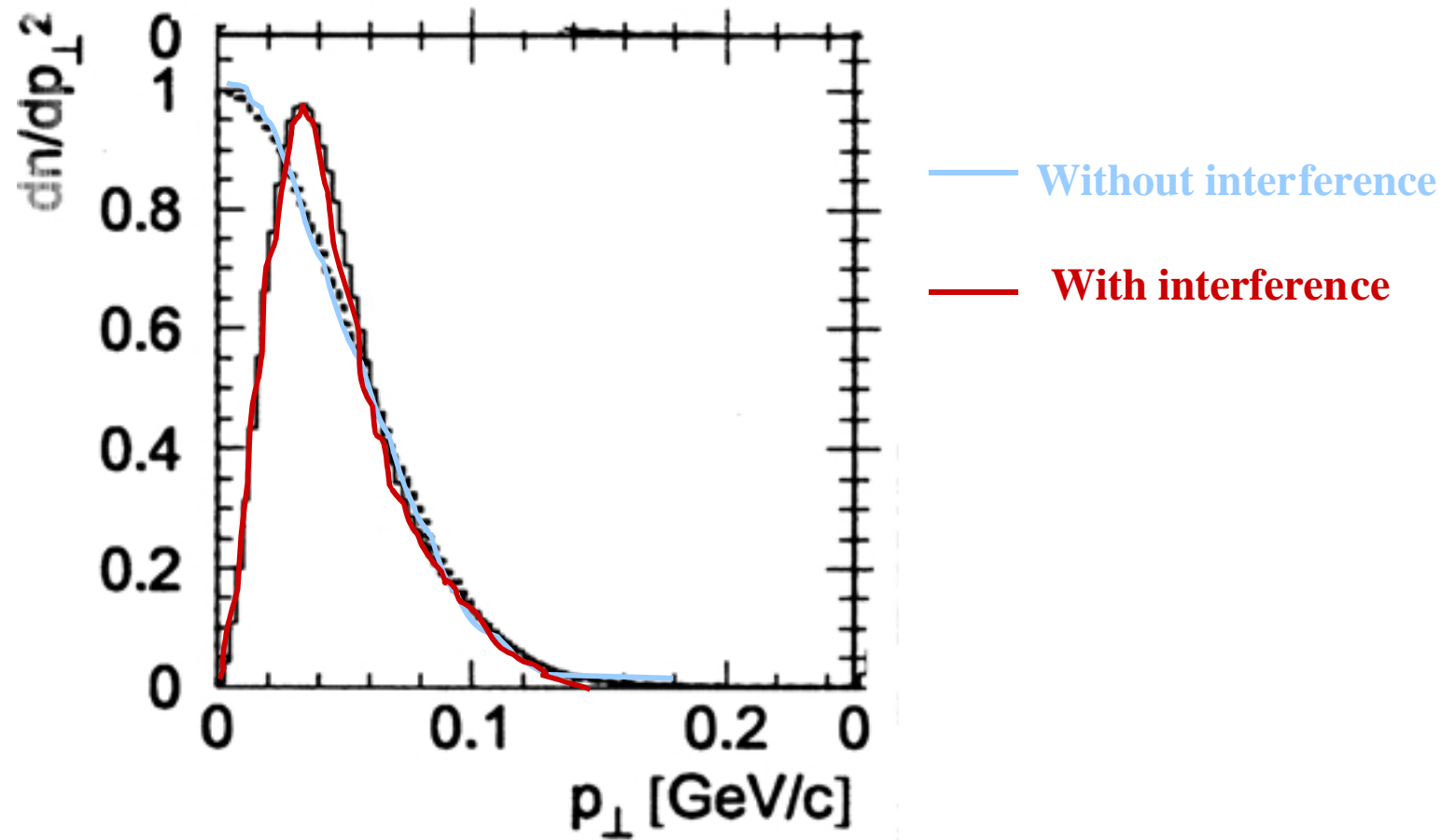
Interference

■ Nuclei can emit or scatter $q\bar{q}$ pair
  – two indistinguishable possibilities

■ Amplitudes add
  – Vector meson has negative parity
    • $\sigma \sim |A_1 - A_2 e^{ip \cdot b}|^2$
    • Destructive interference when $p_T \ll 1/b$

Interference modifies p_T distribution

Without interference

With interference

Signals

- Low multiplicity $N=2,4,6$
- Low p_T $\Sigma p_T < \sim 50$ MeV
- Charge conservation $\Sigma Q = 0$

Backgrounds

- Incoherent photo-nuclear interactions
- Beam-gas events
- Cosmic rays
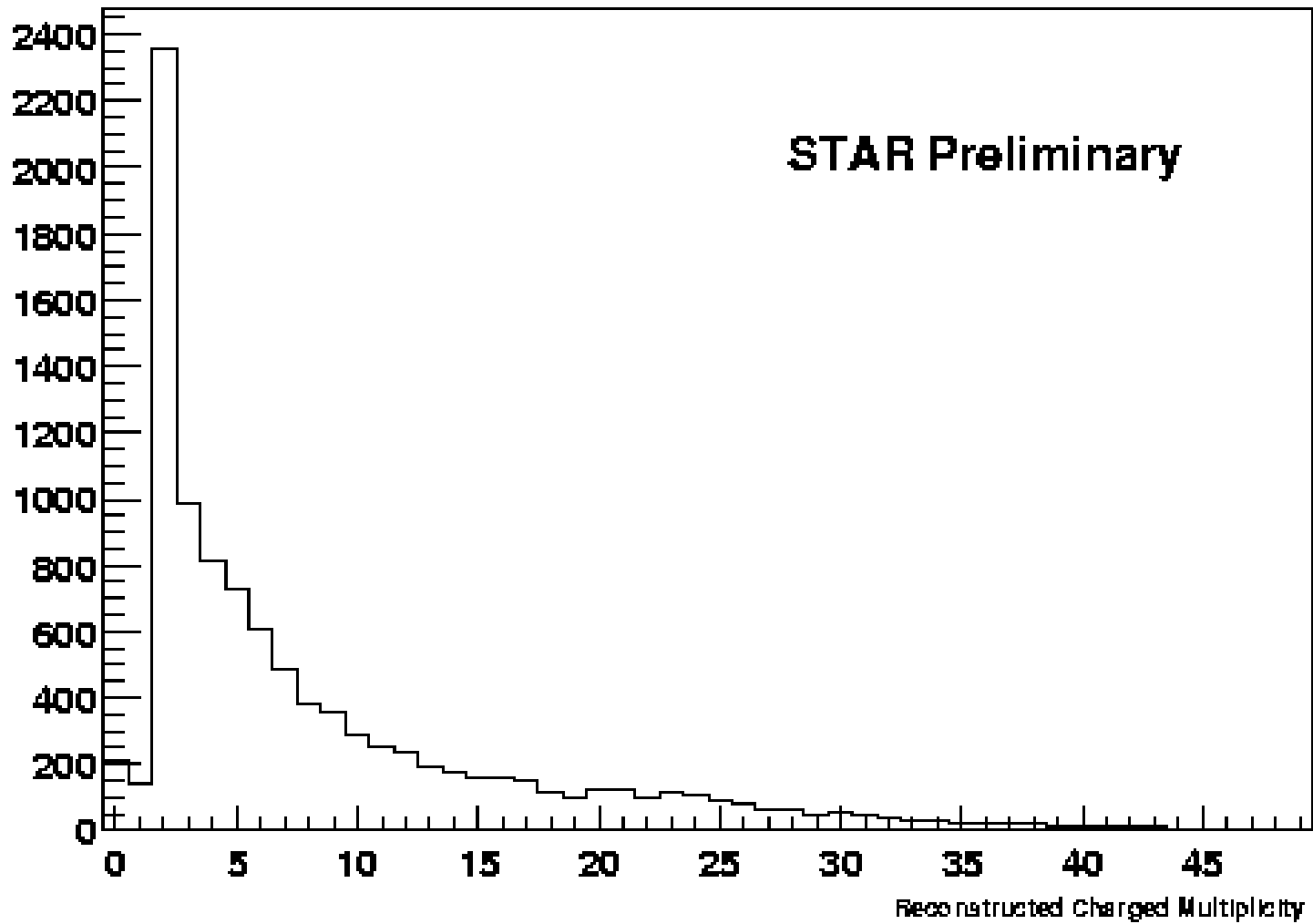- Hadronic interactions (peripheral AA)
- Upstream interactions

Triggering is critical!

STAR Trigger for Summer 2000

- Level 0   CTB only
  - low multiplicity, topology, cosmic veto

- Level 3   adds tracking
  - low multiplicity, vertex location

Multiplicity with Peripheral Trigger

STAR Preliminary

Reconstructed Charged Multiplicity
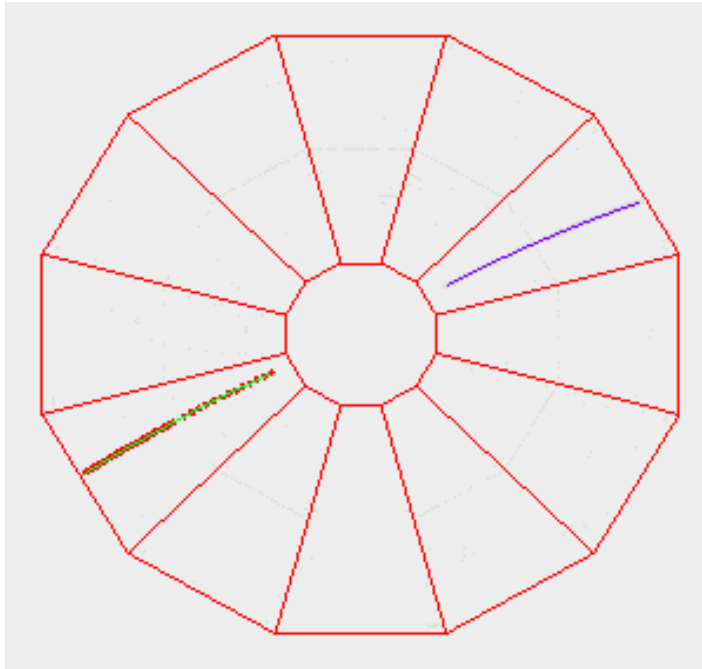
First goal: the Rho

- ## Cuts we use
  - primary vertex found
  - 2 tracks from primary vertex
  - vertex position
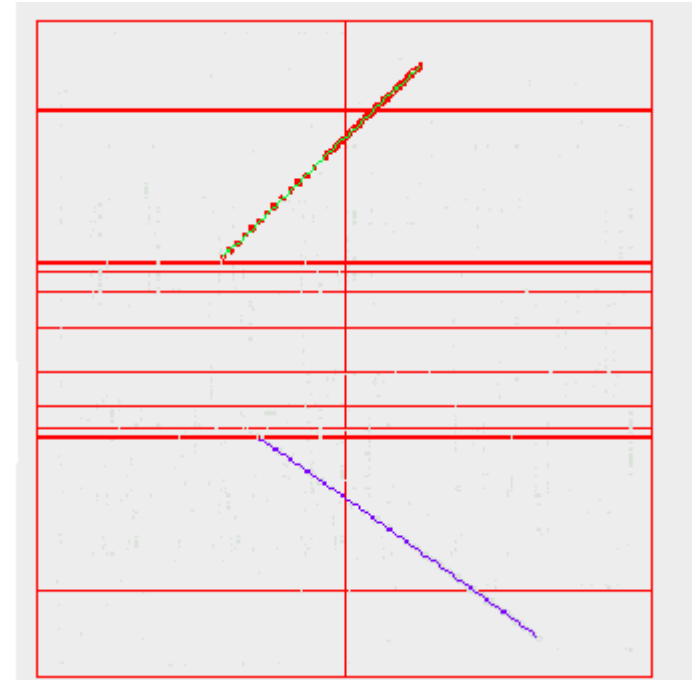 - sum Q = 0
  - small Σp_T
  - opening angle

  ~300 events of interest from 7 hours of running time during Summer 2000 run

Candidate Rho event

End view

Side view

Conclusions

- RHIC has large luminosity for 2-photon and photonuclear interactions
- STAR triggering is effective for peripheral events
- A rich 2-photon and photonuclear program will be possible with STAR