Run-8 p+p

optimizing the goals of the Spin Program
with 6 weeks of p+p

→ version 2
goals for 200 GeV running

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for the PHENIX Collaboration
January 22, 2008

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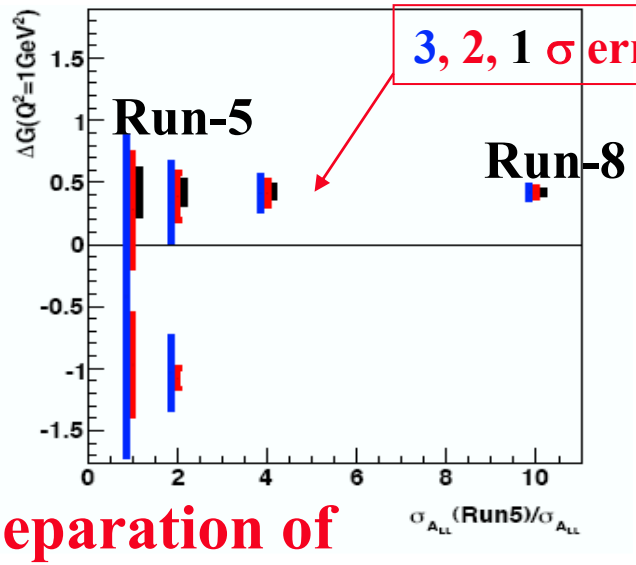
Long term goals of PHENIX Spin Program

- **Measure ΔG**
  must add ≥ 71 pb^{-1} 200 GeV p+p
  NB: DOE milestone in 2008



- **Precision measurement + flavor separation of Δq(x), Δq(x) in W-production**
  requires 500 GeV polarized p+p
  NB: RIKEN milestone for first W observation in 2011
- **Transverse spin measurements**
  – priority #3 for PHENIX

reminder of spin program considerations

- **Spin Program requires high luminosity and polarization**

- **Long-term health of Spin Program → in Run-8**
  machine development for luminosity
  machine/polarimetry development for 500 GeV
  complete one of our goals, if possible

- **What can be done with 200 GeV $\vec{p}+\vec{p}$?**
  A_{LL} impact impossible in short run at current L
  A_N would drive this run if we can complete the required transverse running
    goal: no return to transverse in PHENIX in Run-9

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200 GeV p+p in Run-8

- **assume: 1.2 pb^{-1}/week recorded, P = 0.5**

  3-4 weeks data taking → 3.6 – 4.8 pb^{-1}

  IS THIS CORRECT???
  WOULD ADDITIONAL SET UP TIME IMPROVE LUMINOSITY, POLARIZATION?

- **Spin goals in Run-8 and beyond would be best served by luminosity development!!**
  P=0.6 would be much more efficient than P=0.5

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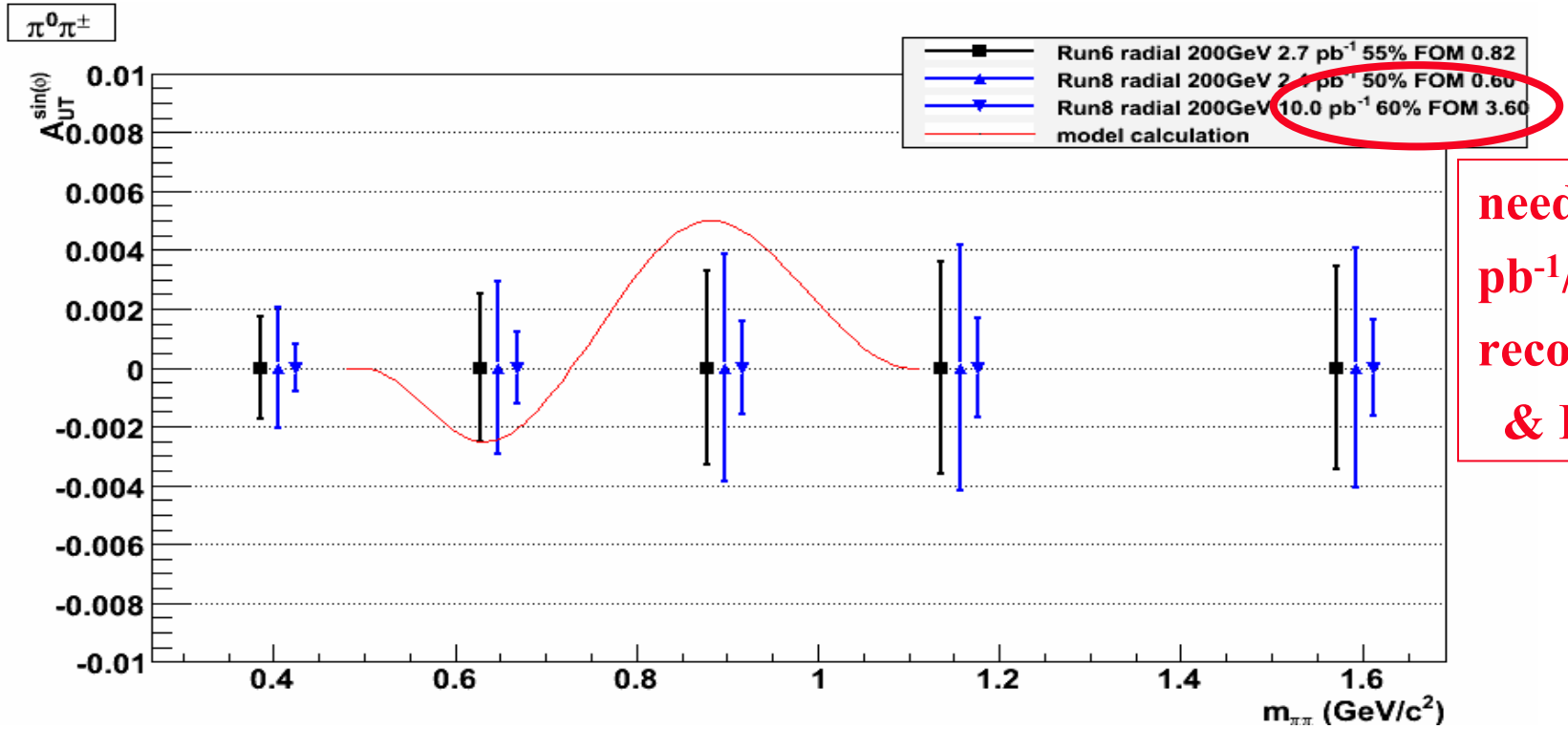
√s=200: Interference Fragmentation Fn.



needs > 1.2 pb^{-1}/week recorded & P=0.6

Estimate of asymmetries based on:

✓Transverse distribution from global analysis: Anselmino et al hep-ph/0701006

✓Interference Fragmentation Function (IFF) modeled by Tang/Jaffe: PRL 80 (1998) 166

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Goals for Run-8 p+p

- **Plan A**

  If higher luminosity, polarization achievable in Run-8

  7.5-10 pb^{-1} recorded, at P=0.6

  if we must plan on 1.2 pb^{-1}/week at P=0.5

  will be forced to return to transverse spin running in a future year

  we'll tell you when, when you tell us the luminosity

- **Plan B**

  2.5 pb-1 recorded at the maximum P you can give us

  Switch ASAP to 500 GeV p+p for ≥ 2 weeks

  We consider development so important we'll risk the very short physics run

  Skip the low energy test run in Run-8

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Summary (1)

We are still far from reaching the required performance goals for the RHIC spin Program.

Runs spent for data accumulation without significant luminosity and polarization development are pretty nearly lost time.

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Summary (2)

- PHENIX Spin physics goals
  best addressed by p+p at 500 GeV in Run-8
- 200 GeV goals Spin starved for luminosity
  impossible to address in Run-8, without 9MHz cavity?
- Highest priority is luminosity development
  sufficient success would provide new spin data in
  ~ 4 weeks of physics with 200 GeV p+p
  7.5-10 pb^{-1} recorded, preferably with P>0.5
- Else, split the time
  We are happy to switch over to p+p ~today!
  2 weeks of 500 GeV higher priority than the low energy test run

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- **backup slides**

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√s=200 GeV: Sivers

- Central-Central correlations
  - Run-6 analysis uses 1.9 pb^{-1}
    - ERT triggers
  - Run-8 expects 2.4 pb^{-1} sampled (2 week projection)
    - Not really much of a help
- Central-Muon correlations
  - Run-6 analysis uses 1D muon triggers
  - New for Run-8 – "1H" hadron trigger
    - Should be a better jet trigger
- No good argument for central-central correlations
    - Sensitivity is still below STAR's PRL99, 142003

  ∴ Only benefit: central-muon correlations
  - 1H trigger adds benefit beyond additional statistics
    - Needs more study to quantify improvement
    - Not compelling reason for 200 GeV running

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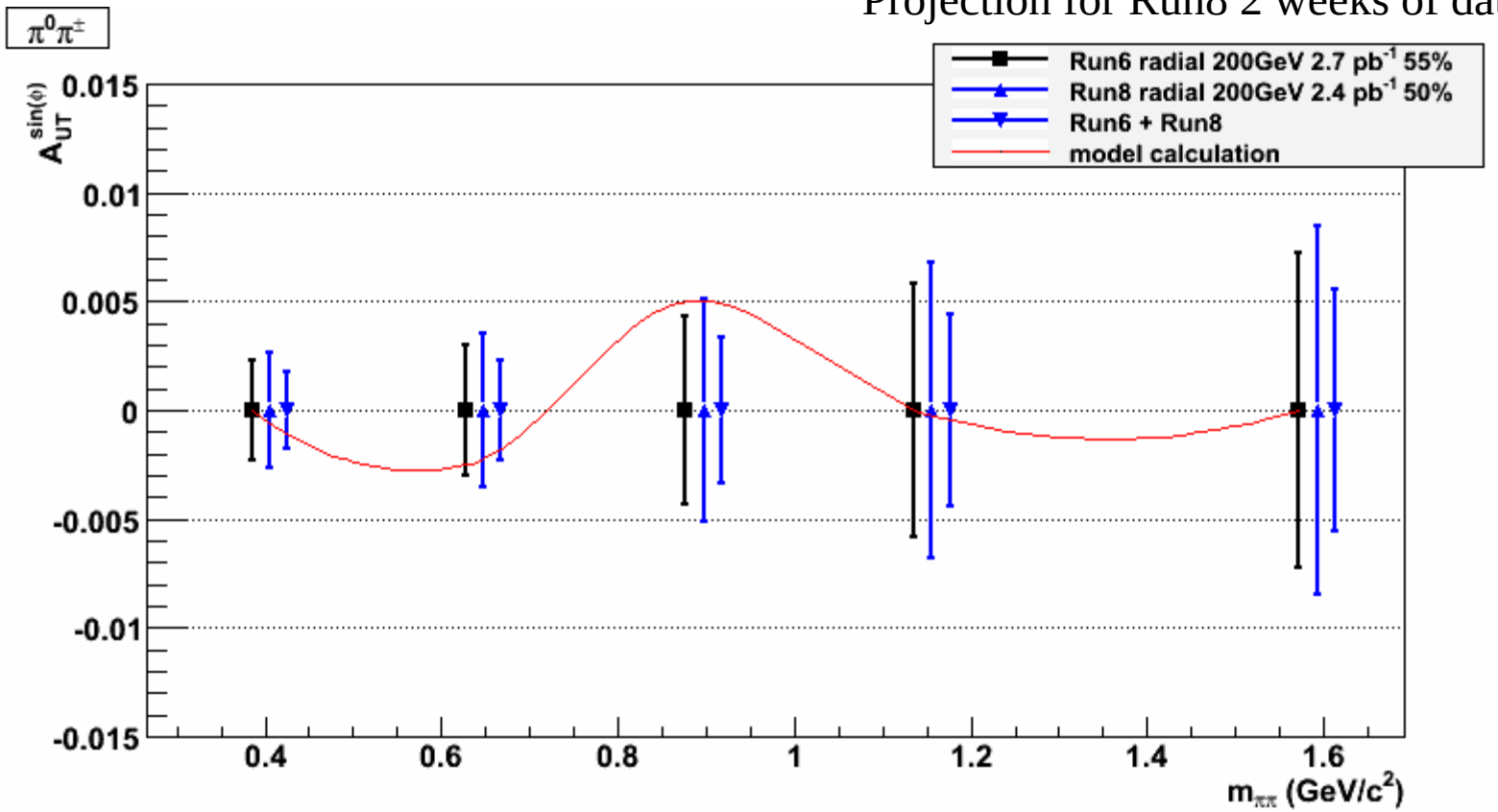
√s=200: Interference Fragmentation Fn.

Projection for Run8 2 weeks of data taking



Estimate of asymmetries based on:

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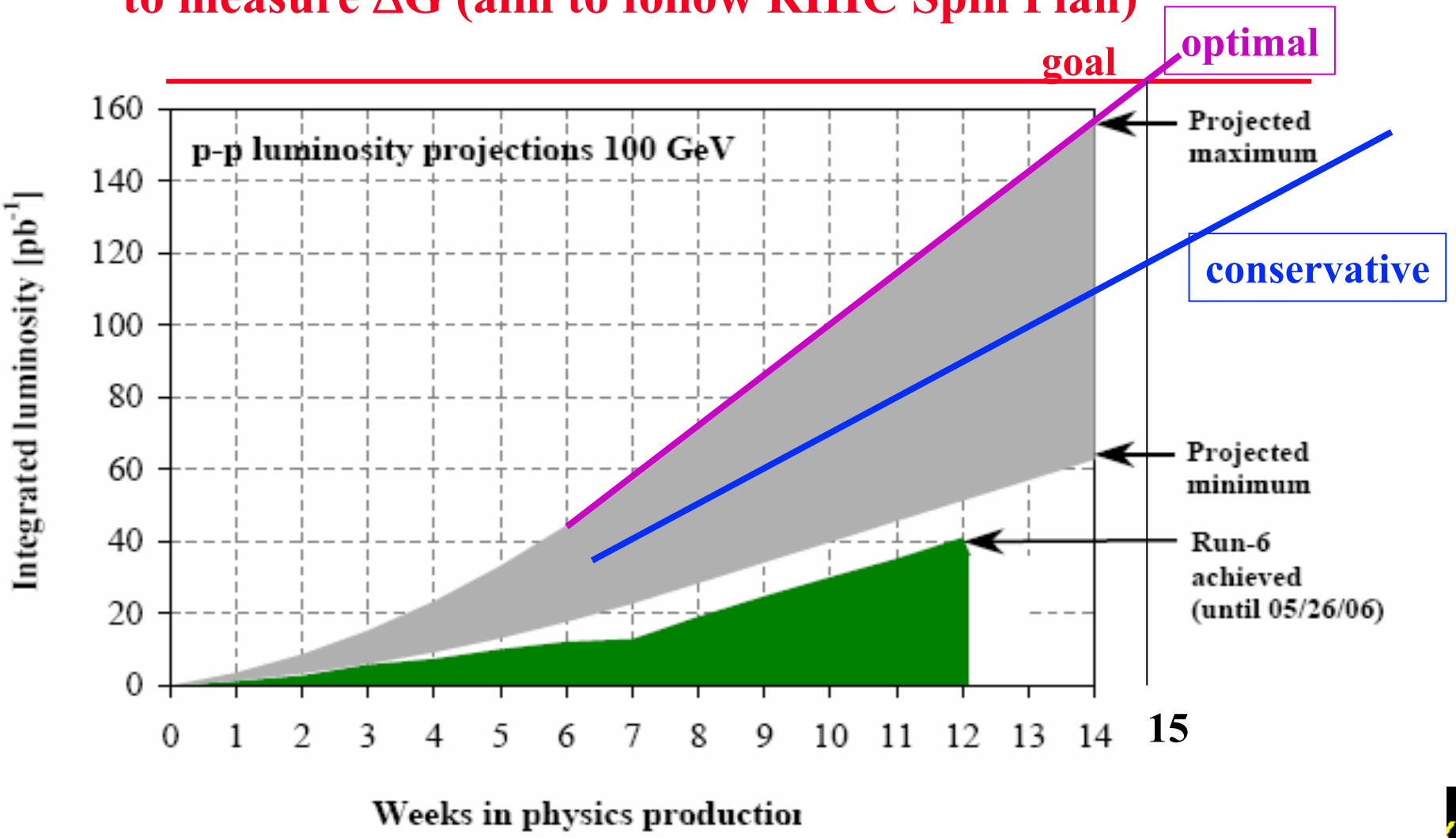
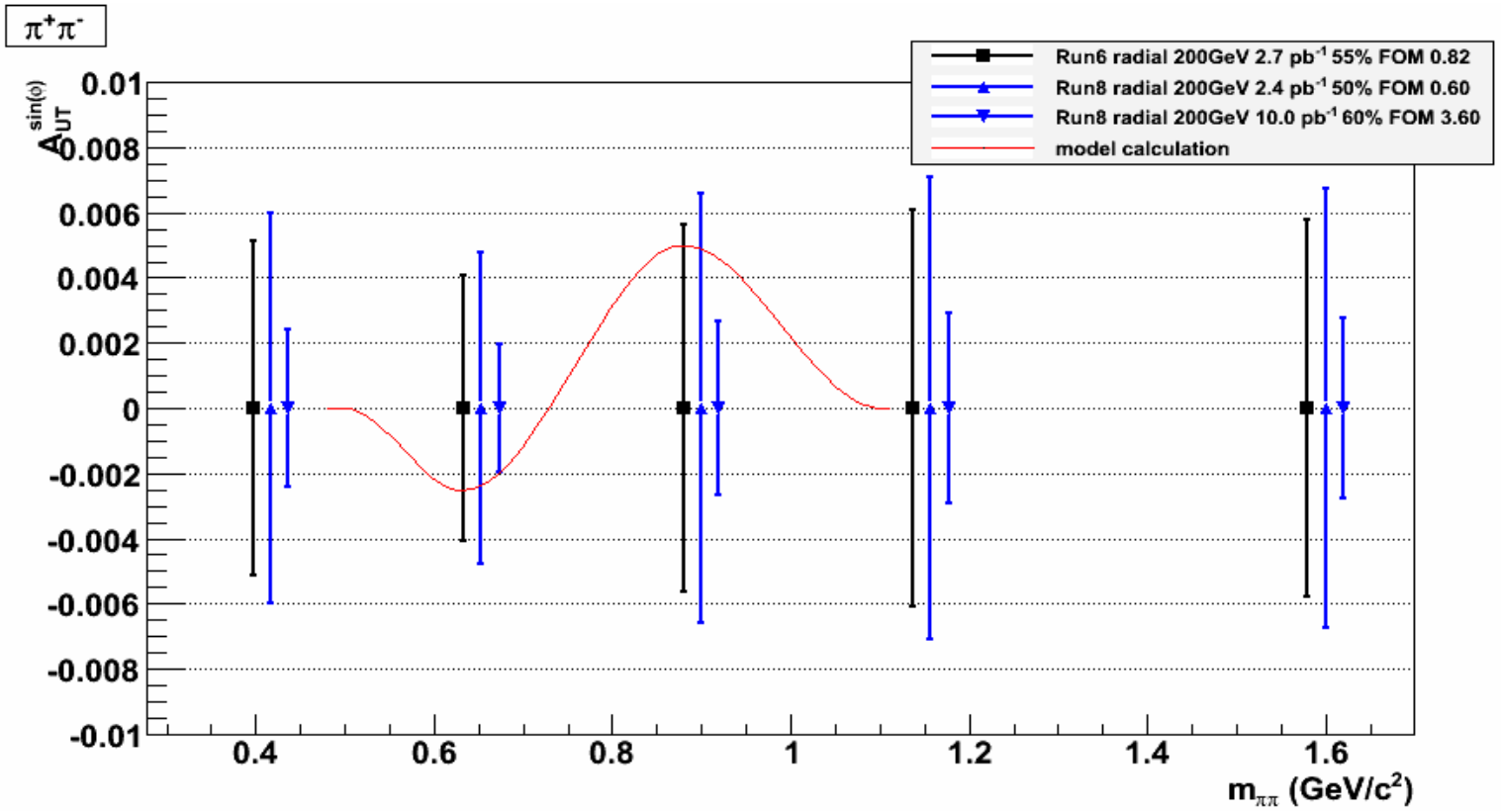
Run-8 polarized p+p

- 71 pb^{-1} recorded (167 delivered)

  to measure ΔG (aim to follow RHIC Spin Plan)

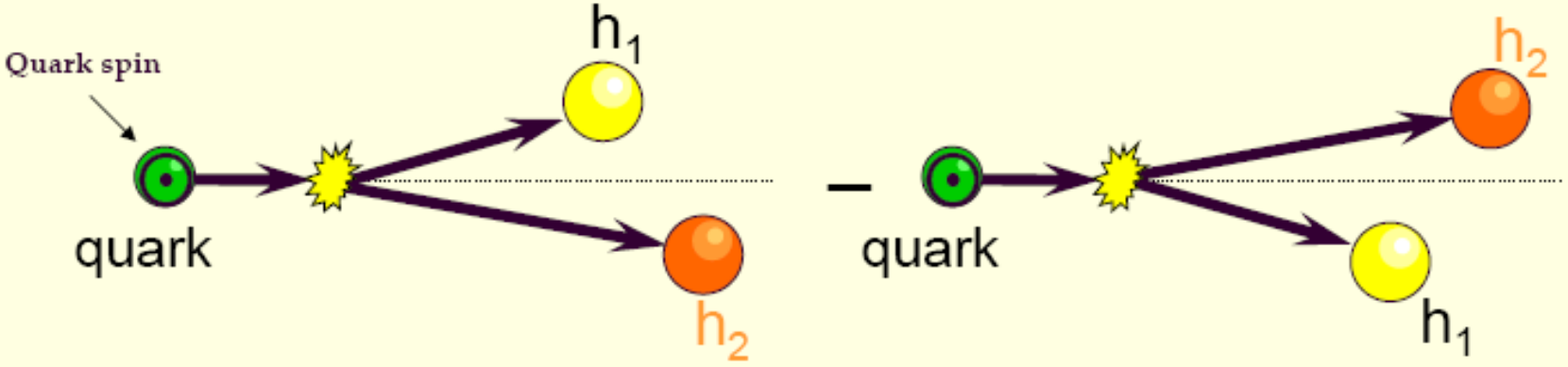



$\pi^+\pi^-$
$A_{UT}^{\sin(\phi)}$
0.01
0.008
0.006
0.004
0.002
0
-0.002
-0.004
-0.006
-0.008
-0.01
0.4
0.6
0.8
1
1.2
1.4
1.6
$m_{\pi\pi}$ (GeV/c^2)
Run6 radial 200GeV 2.7 pb^{-1} 55% FOM 0.82
Run8 radial 200GeV 2.4 pb^{-1} 50% FOM 0.60
Run8 radial 200GeV 10.0 pb^{-1} 60% FOM 3.60
model calculation

Comparison of IFF and Collins FF

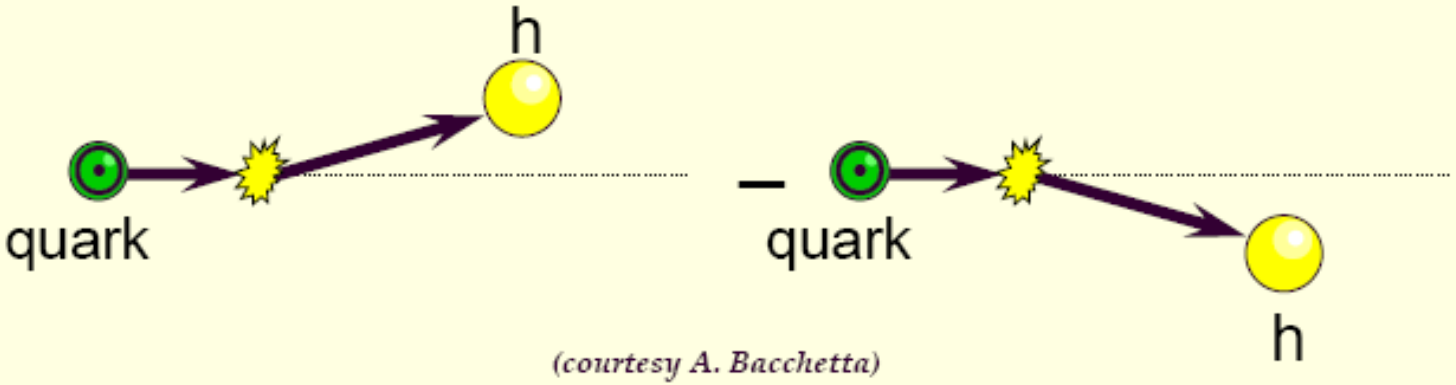
Interference fragmentation function $H_1^{\sphericalangle}(z, M_{\pi\pi}^2)$

J. Collins S.Heppelmann, G. Ladinsky, Nuclear Physics B, 420 (1994) 565
R. Jaffe, X. Jin, J. Tang, Physical Review Letters, 80 (1998) 1166



Collins fragmentation function $H_1^{\perp}$

J. C. Collins, Nucl. Phys. B396, (1993) 161

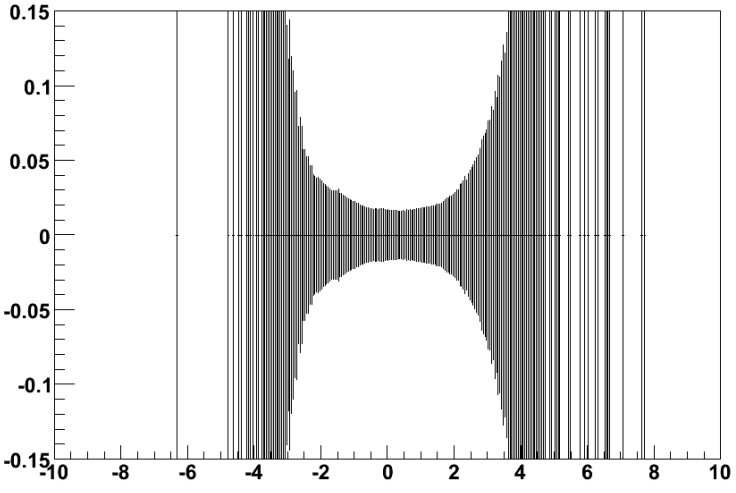


(courtesy A. Bacchetta)

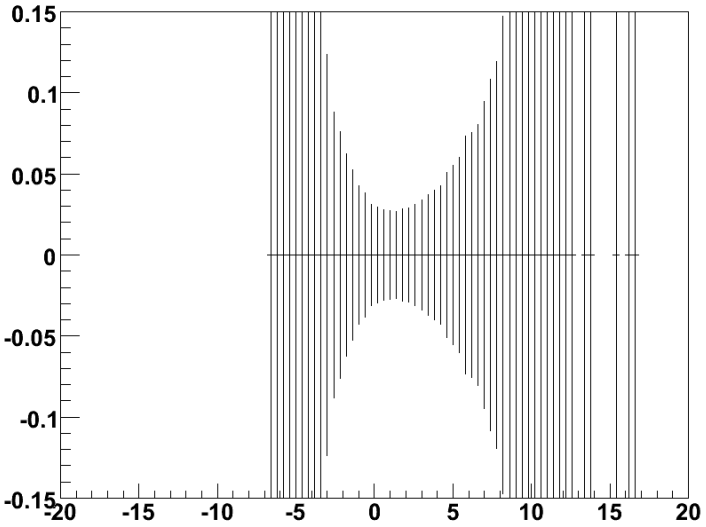
√s=200 GeV: Sivers

- Central-Central correlations
  - Plots show projected errors on raw qty asymmetry
  - Errors assume combining Run-6 and Run-8

2-particle correlations
qty raw asymmetry



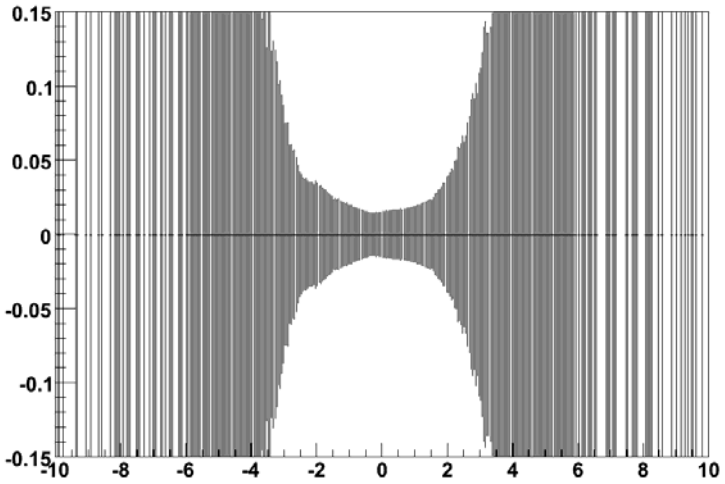
dijet correlations
qty raw asymmetry



√s=200 GeV: Sivers

- Central-Muon correlations
  - Errors assume combining Run-6 and Run-8
  - No enhancement assumed for 1H trigger
    - Needs further study, could be significant

2-particle correlations
qty raw asymmetry



dijet correlations
qty raw asymmetry