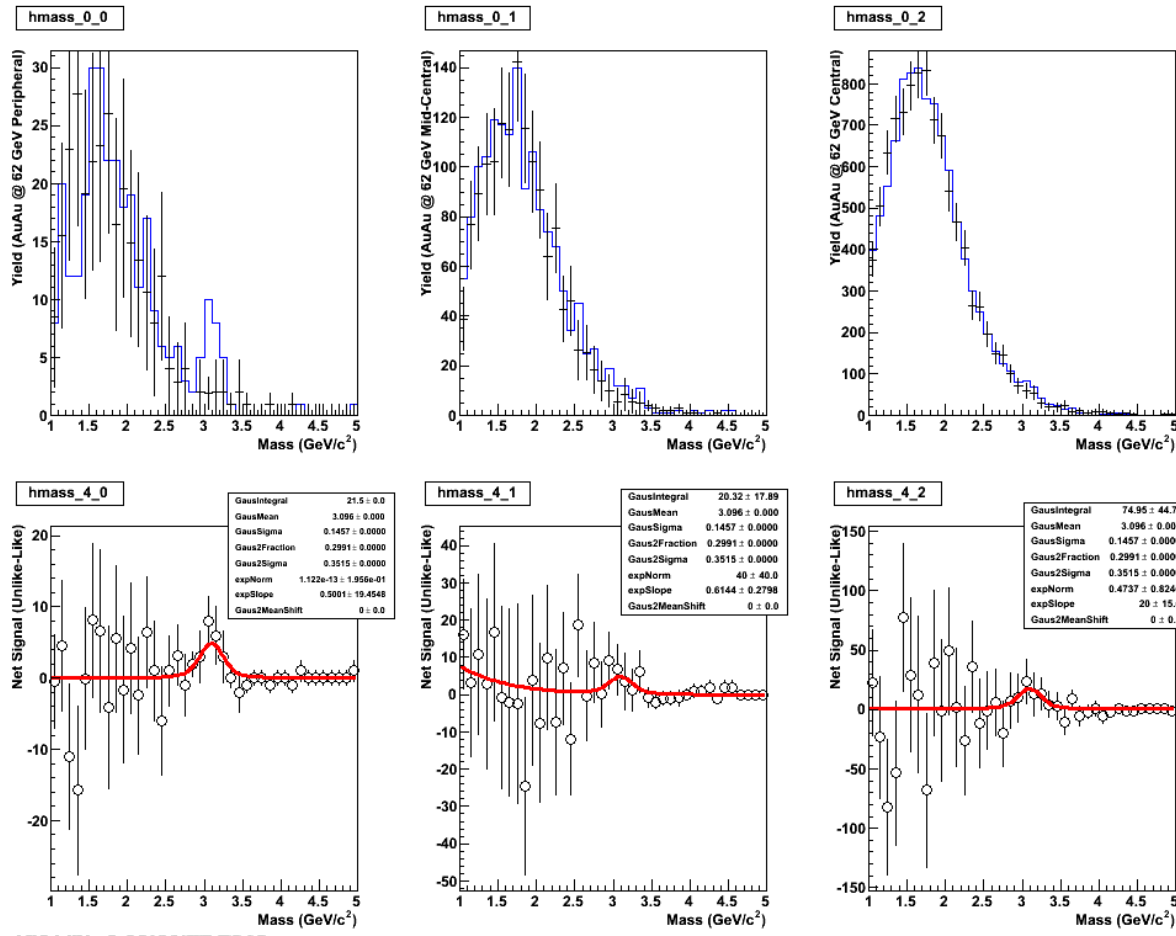# Dilepton Measurement at 39 GeV

Stefan Bathe for PHENIX
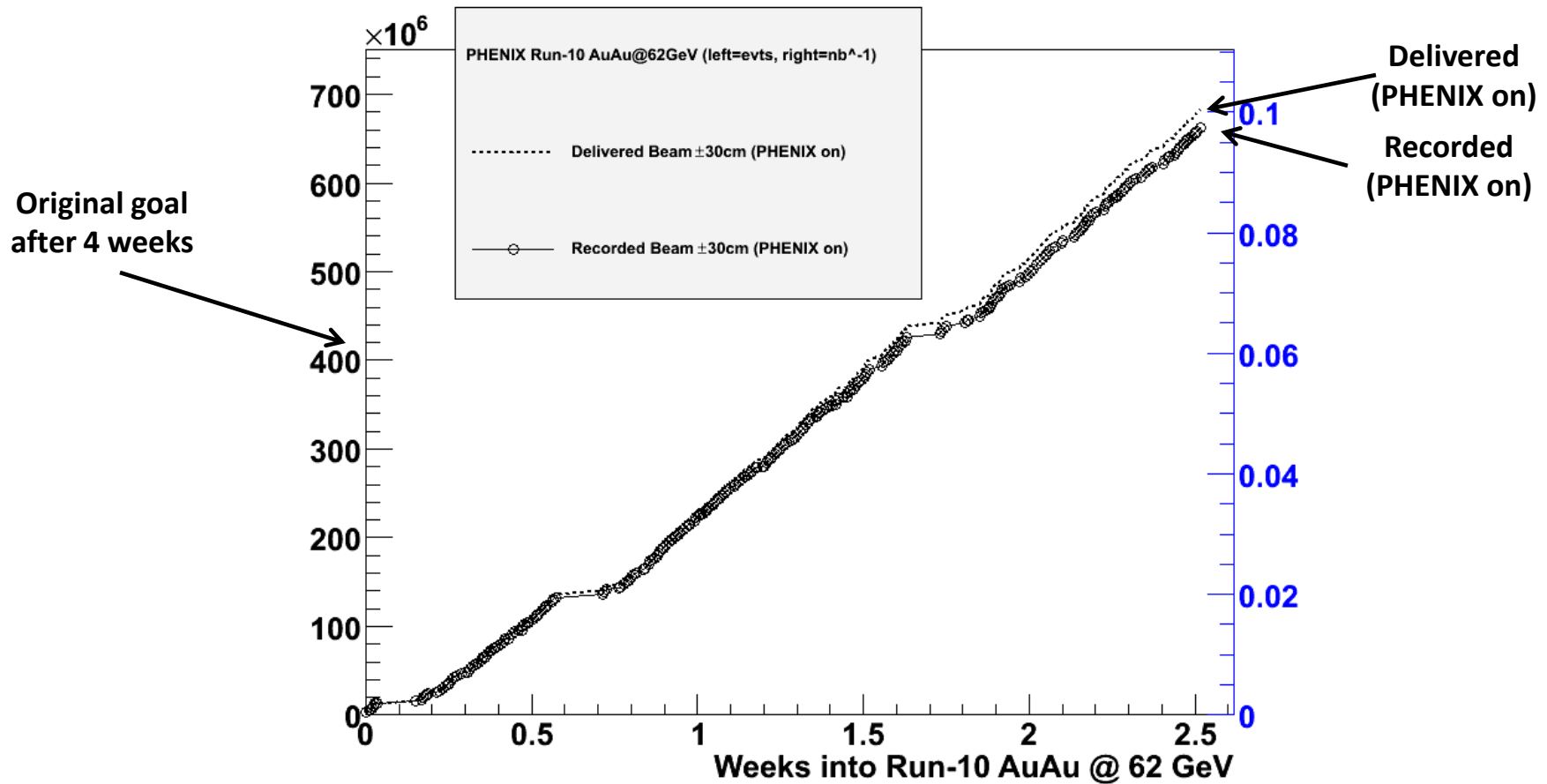
RHIC Machine-Experiment Meeting

4/06/2010

First Glimpse at J/ψ Peaks from 62 GeV

Peak visible from about 25 % of statistics

- Encouragement that with increased data set (700 M instead of 400 M events) we can not only do dilepton measurement with HBD, but also J/ψ measurement (as promised last week)

Excellent Performance @ 62 GeV

- Performance 2.6 x better than expected
  - 660 M events in 2.5 weeks (exp.: 400 M in 4 weeks)

Recorded events at 39 GeV

- 2.6 x better performance makes--previously not possible--dilepton measurement possible at 39 GeV
  - Adding one week of running time to 39 GeV run increases running time from 1.5 to 2.5 weeks
  - 660 M minimum bias events (< 30 cm) recorded at 62 GeV in 2.5 weeks
  - Translates into 280 M events at 39 GeV (< 30 cm); 200 M (< 20 cm)
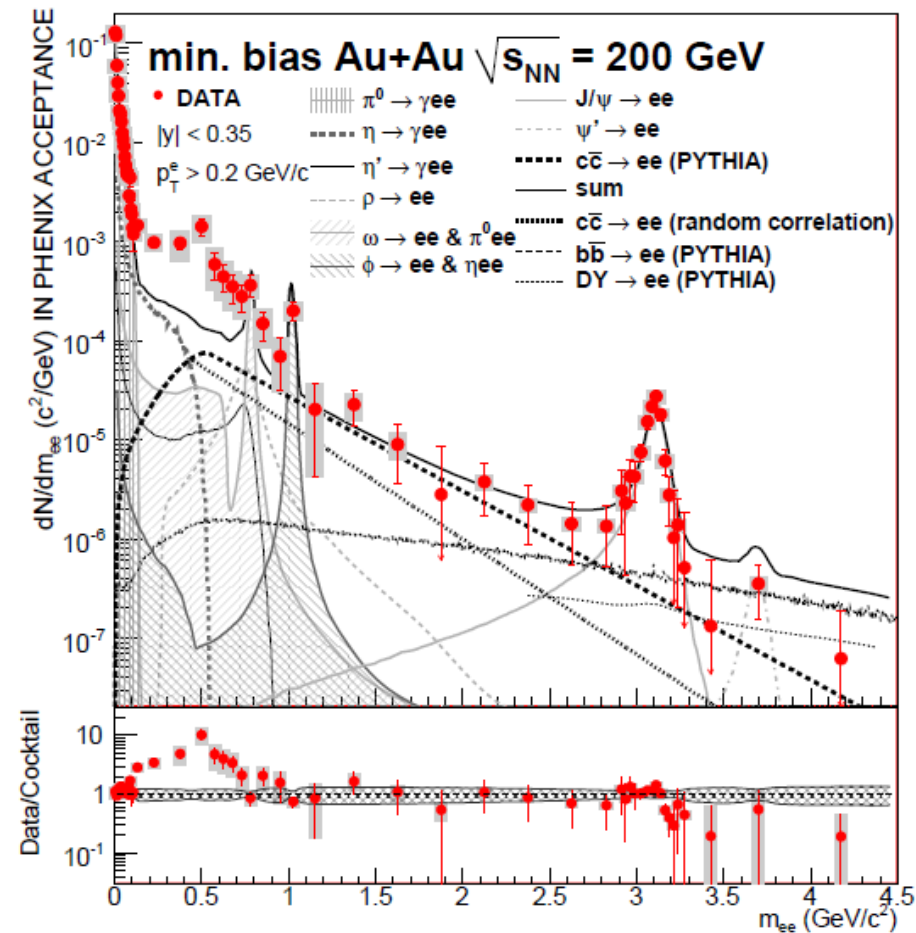 - Note: previous estimate was 50 M in 1.5 weeks

Scaling from Run-4 Results

Done Well

- **Use Raw data from Run-4.**
- **Scale by events recorded (200/1500).**
- **Scale by multiplicity ratio:**
  - **Signal x 0.46**
  - **Background x 0.46^2**
- **Account for HBD modifications:**
  - **20X reduced Background**
  - **0.86^2 reduction of signal.**
- **Propagate Errors:**
  - **Counting Statistics.**
  - **Precision of background normalization.**
- **Precision of background normalization (sqrt(s) dependence) not simple**
- **Compare to Run-4 Result**

Not accounted for

- **Open and closed charm should scale differently than with total multiplicity.**
  - **MAKES LIFE EASIER**
- **Change to +/- Field in HBD:**
  - **Lower minimum electron p_T**
  - **Lower minimum pair m_T**
  - **MAKES LIFE TOUGHER**
- **Calculations only for minimum bias.**

Run 4 AuAu Results

min. bias Au+Au $\sqrt{s_{NN}} = 200$ GeV
- DATA
- $|y| < 0.35$
- $p_T^e > 0.2$ GeV/c

$\pi^0 \to \gamma ee$
$\eta \to \gamma ee$
$\eta' \to \gamma ee$
$\rho \to ee$
$\omega \to ee$ & $\pi^0 ee$
$\phi \to ee$ & ηee
$J/\psi \to ee$
$\psi' \to ee$
$c\bar{c} \to ee$ (PYTHIA)
sum
$c\bar{c} \to ee$ (random correlation)
$b\bar{b} \to ee$ (PYTHIA)
DY $\to ee$ (PYTHIA)

- Run-4 AuAu minimum bias show a striking excess in the low mass regime.
  - x4.7 ± 0.4(stat) ± 1.5(syst)
- Predict 39 GeV expectation by scaling excess w/ two assumptions:
  - Run-4 signal/multiplicity/evt
  - 1/3 of Run-4 signal in 200MeV/c^2 <m_{ee}< 1 GeV/c^2
- for σ_{syst}: background norm. uncertainty scales with like-sign yield ($\rightarrow$ HBD lowers both background & background estimator)

Ratio of Expected Uncertainties

Uncertainty Ratio -- 39 GeV running w/ 200 Million Events
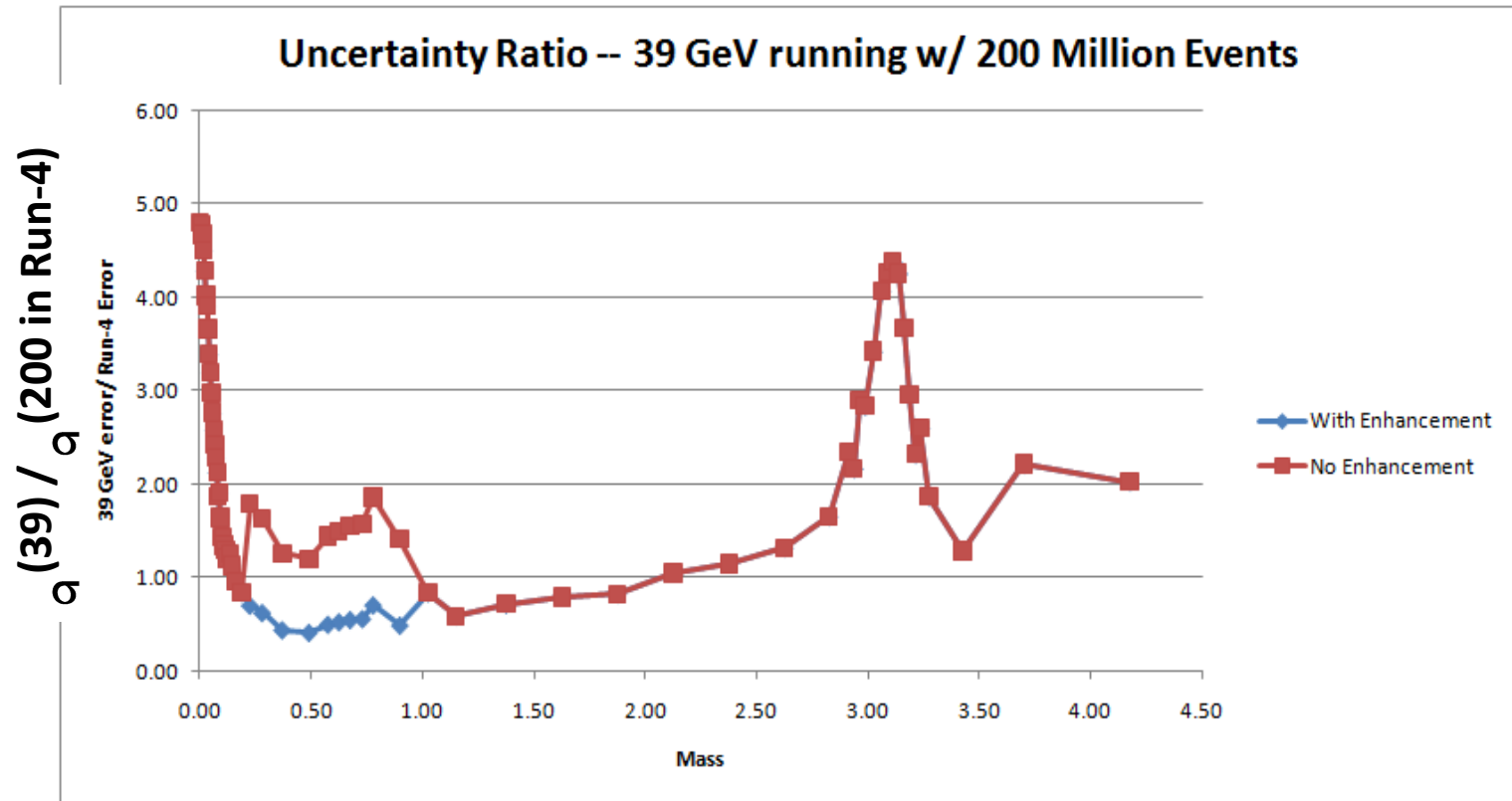
- Statistical & systematic errors combined in quadrature
- If the enhancement persists to 39 GeV, we measure it w/ 2X smaller errors than Run-4.
- If the enhancement does not persist, we will still get a statistically significant measurement.

Expected mass distribution
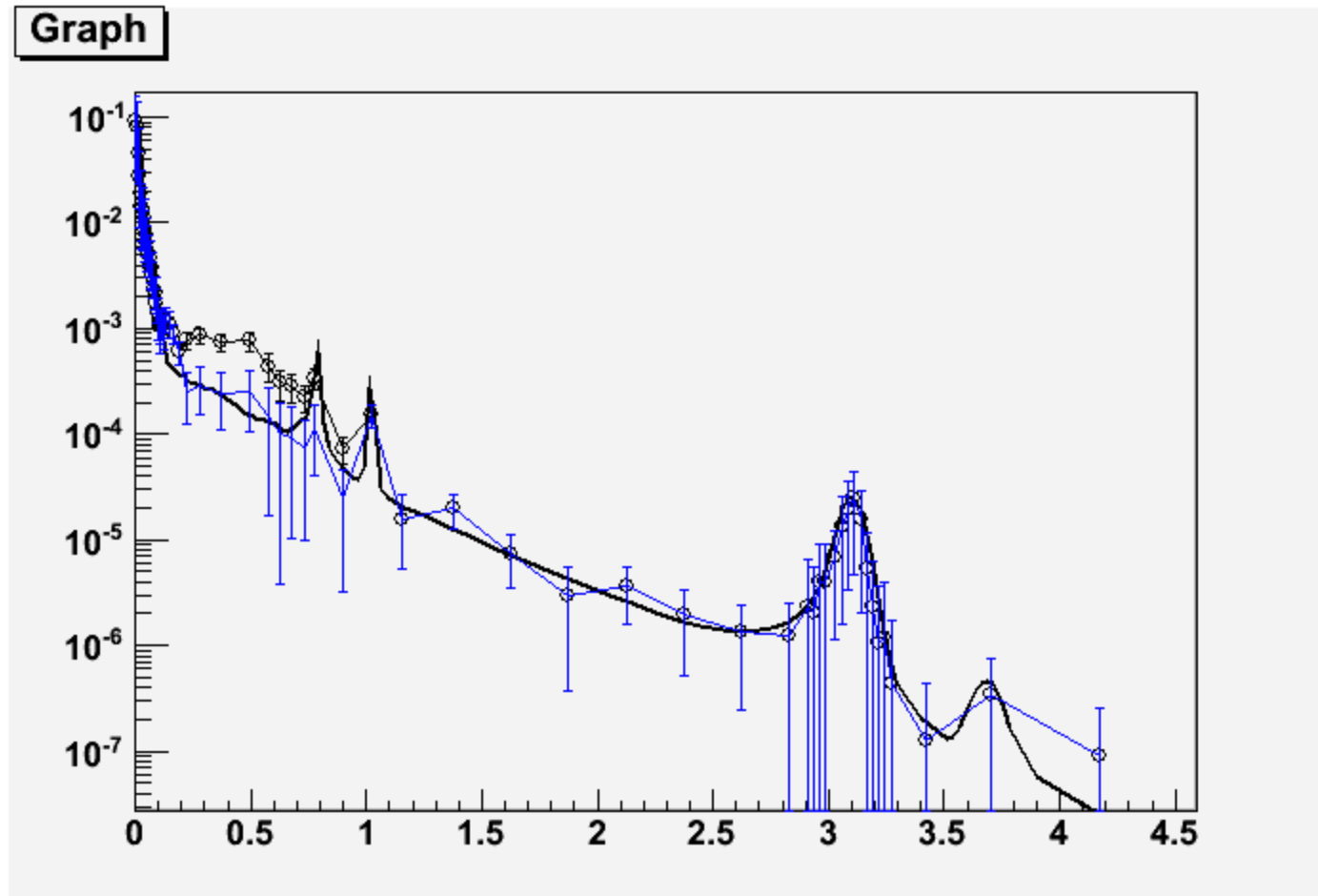
- BLACK—Spectrum if enhancement persists.
- BLUE—Spectrum with 1/3 of full energy enhancement.

Summary

- With 200M events in ± 20cm vertex cut
  - Requires 280M* events recorded inside 30cm
  - Anticipated collection time is 2.5 weeks
- Run-4 result 200 GeV Au+Au
  - Excess over cocktail: x4.7 ± 0.4(stat) ± 1.5(syst)
    - σ_{tot} ± 1.55, so have a 3σ measurement
- If excess is unchanged at 39 GeV
  - Measured excess x4.7 ± 0.77(total); 6 σ result
- If excess is 1/3 of that at 200 GeV
  - Measured excess x1.57 ± 0.77(total)

*NB: BUP request was 400M