Subtracting the combinatorial background

- Using $\mu^+\mu^+$ and $\mu^-\mu^-$ pairs or a recombination method

  Hypothesizes, advantages, disadvantages…
- What is used by:

  - other experiments

  - within PHENIX
- Simulation and data (first attempt…)
- Outlook

Using $\mu^+\mu^+$ and $\mu^-\mu^-$ pairs

- Hypothesizes:

  H1: Muons from a pair are not physically correlated

  H2: No correlation between meson + and – multiplicities

  H3: Multiplicities follow a Poisson distribution

- Experimental constraint:

  $Acc^{\mu+\mu-}(M_0) = Acc^{\mu+\mu+}(M_0) = Acc^{\mu-\mu-}(M_0)$ → $N^{\mu+\mu+} / N^{\mu-\mu-}$

- $N^{\mu+\mu-}(Bgr) = 2\,(N^{\mu+\mu+}\, N^{\mu-\mu-})^{½} \approx N^{\mu+\mu+} + N^{\mu-\mu-}$

  $N^{\mu+\mu-}(Sgl) = N^{\mu+\mu-} - N^{\mu+\mu-}(Bgr)$

  } for A-A

Using $\mu^+\mu^+$ and $\mu^-\mu^-$ pairs in p-p, p-A…

Small multiplicities → H2 (no correlation between mesons + and mesons -) not right:

$N^{\mu+\mu-}(Bgr) = 2\ R\ (N^{\mu+\mu+}\ N^{\mu-\mu-})^{½}$, $R>1$

R estimated using MC simulation

Recombination method

- Hypothesis: muon cinematic distributions from pairs identical with distributions if measure muons individually
- Condition: combination between muons from same Δz_{vertex} and Δb class of events
- Advantages:

  - high statistics

  - do not need $Acc^{\mu^+} = Acc^{\mu^-}$
- Difficulties:

  - Bias introduced by cuts (deep…)

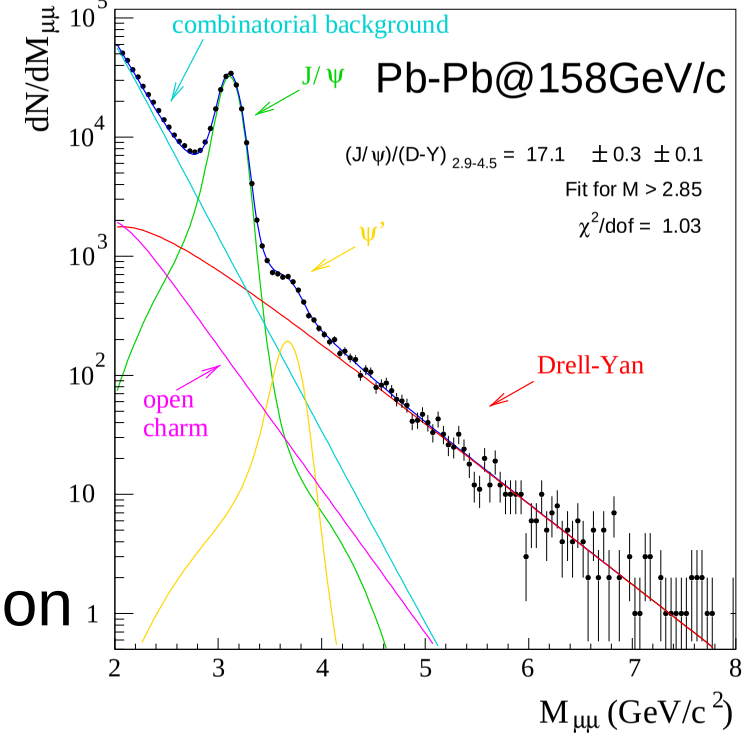
  - Uncertainty calculation

Experiments measuring μ's or e's

- HELIOS/3 (CERN/SPS) – μ's: recombination method and $R \equiv N^{\mu^+\mu^-}(Bgd)/2(N^{\mu^+\mu^+}N^{\mu^-\mu^-})^{½}$ determined by VENUS
- NA38/NA50 (CERN/SPS) – μ's:

  - Φ, ρ, ω, J/ψ, ψ' studies:

    $2(N^{\mu^+\mu^+}N^{\mu^-\mu^-})^{½}$



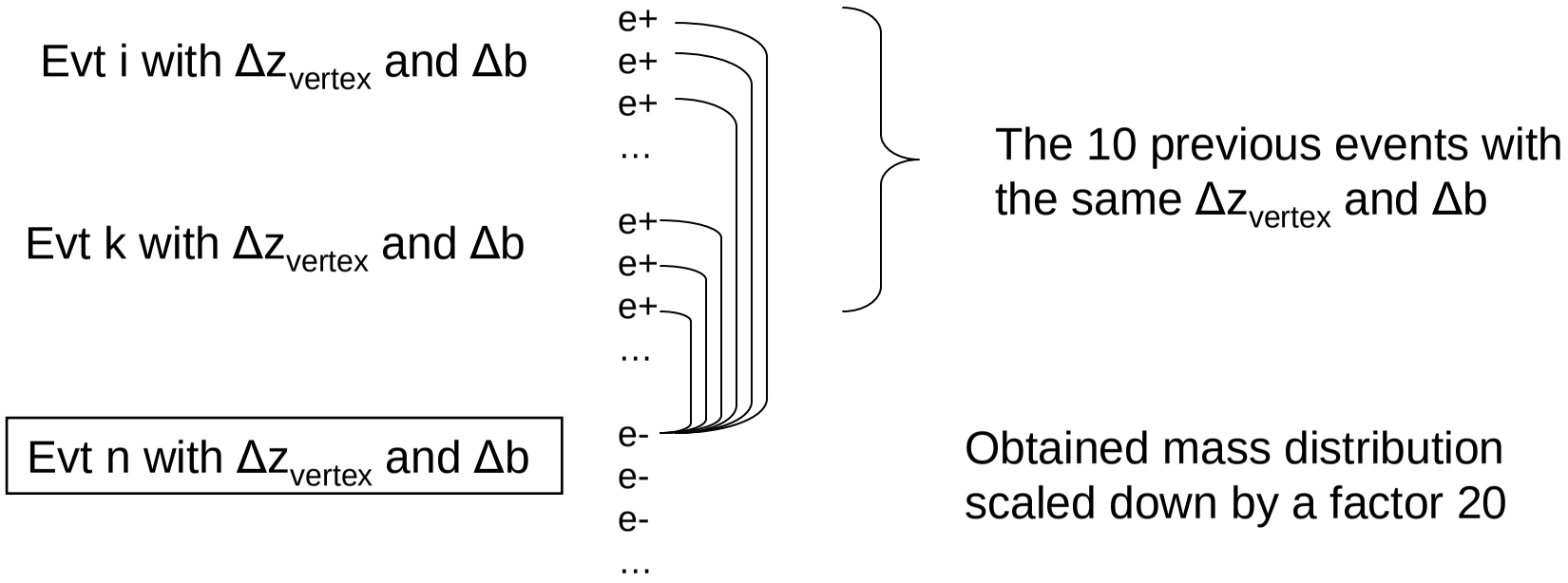
  - Intermediate masses: recombination method and R from VENUS

- CERES/NA45 (CERN/SPS) – e's: $N^{e^+e^+} + N^{e^-e^-}$
- E866 (Fermilab) – μ's: recombination method

Experiments measuring μ's or e's in HIC

- PHENIX – Central arms - e's: 2 recombination methods

  - Yasuyuki Akiba: 40 Δz_{vertex} bins and 6 centrality bins

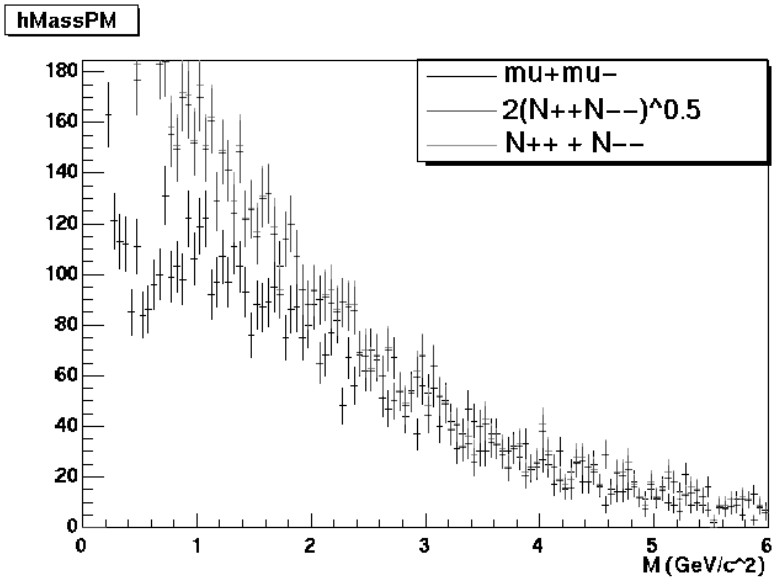


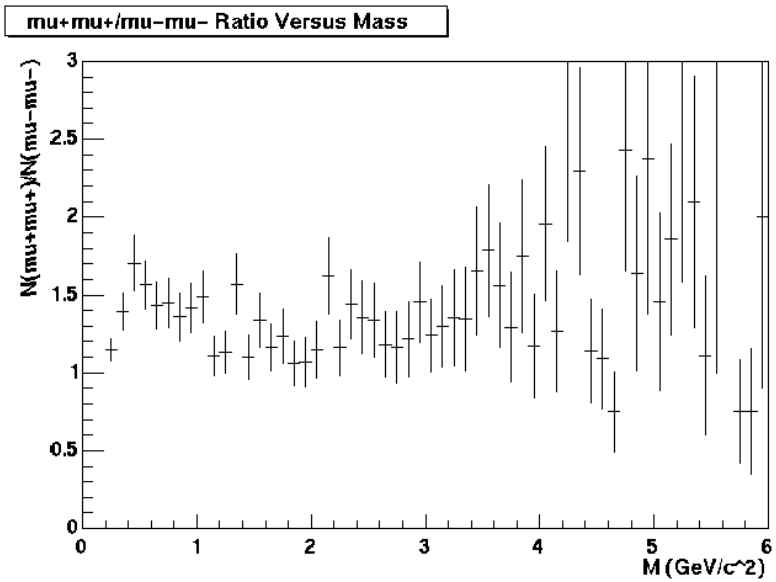
- Felix Matathias: for each event, keep only one e+ or e- and put it in the event "pool" (Δzvertex,Δb). When reach a predefined depth, start combining.

Au-Au: mass spectra

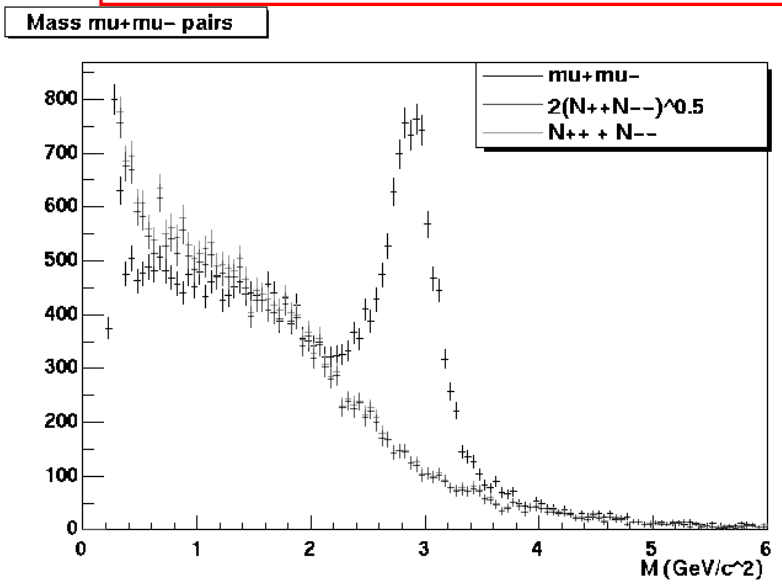
No ghost

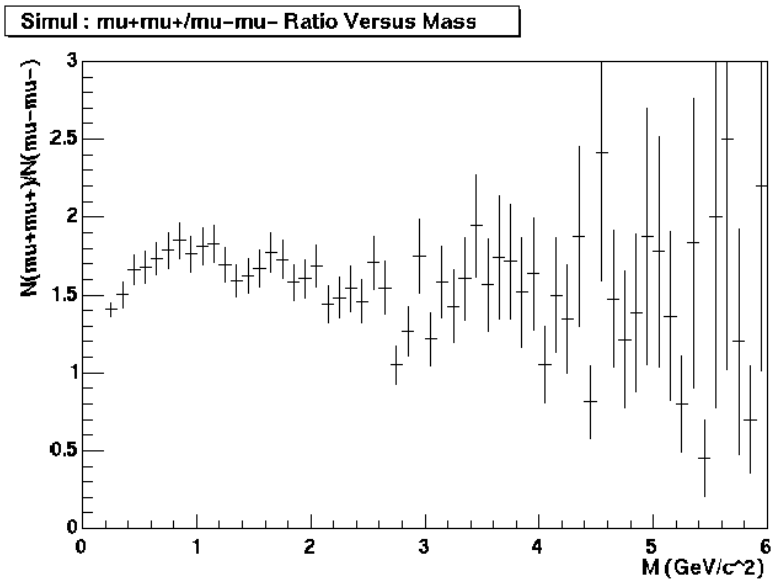
Real Data (before Sept 17th)





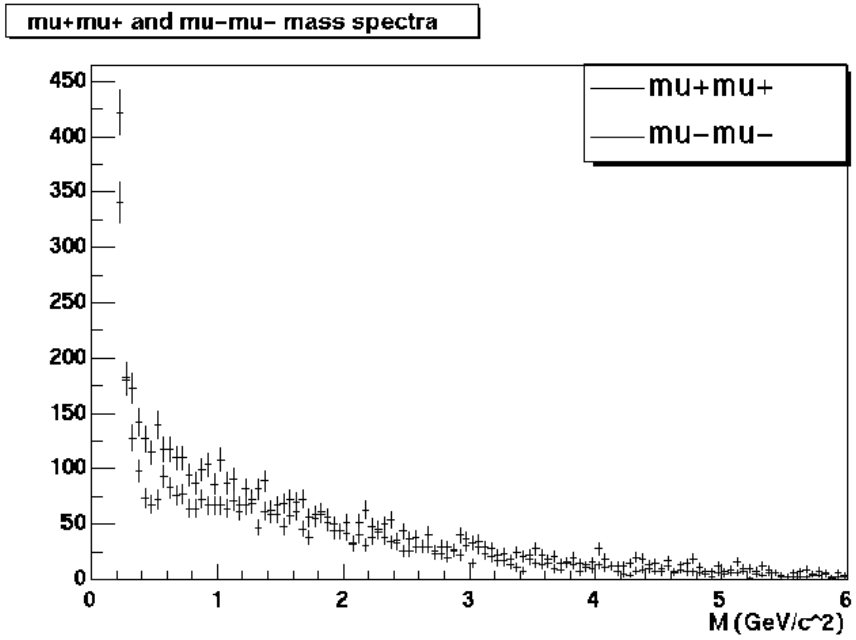
Simulation Central + J/ψ (MDC)





Au-Au: mass spectra

Real Data (before Sept 17th)



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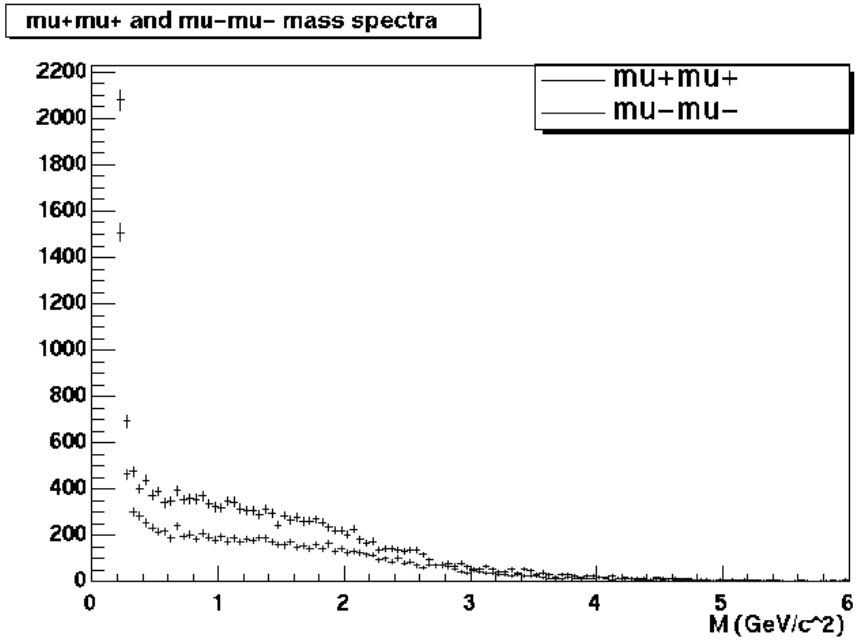
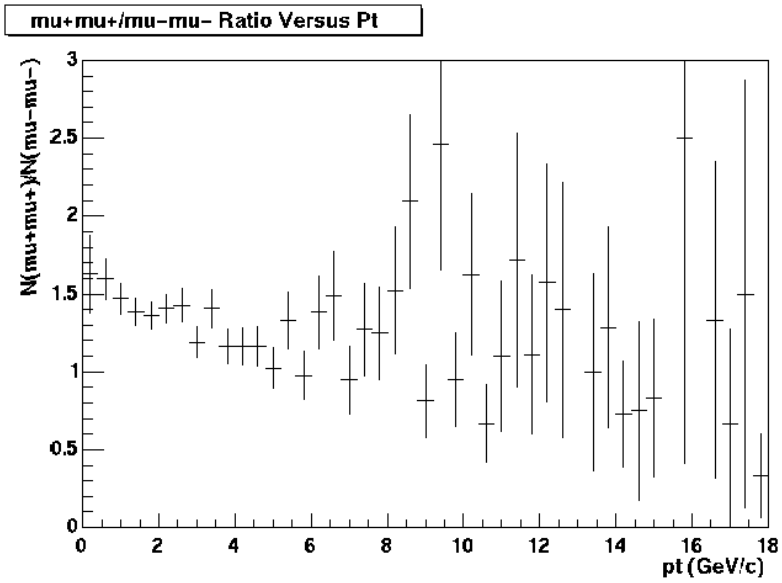
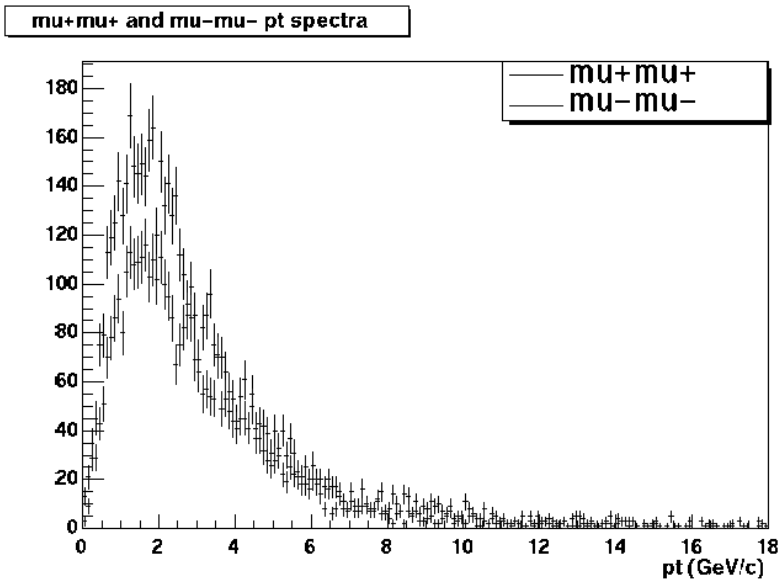


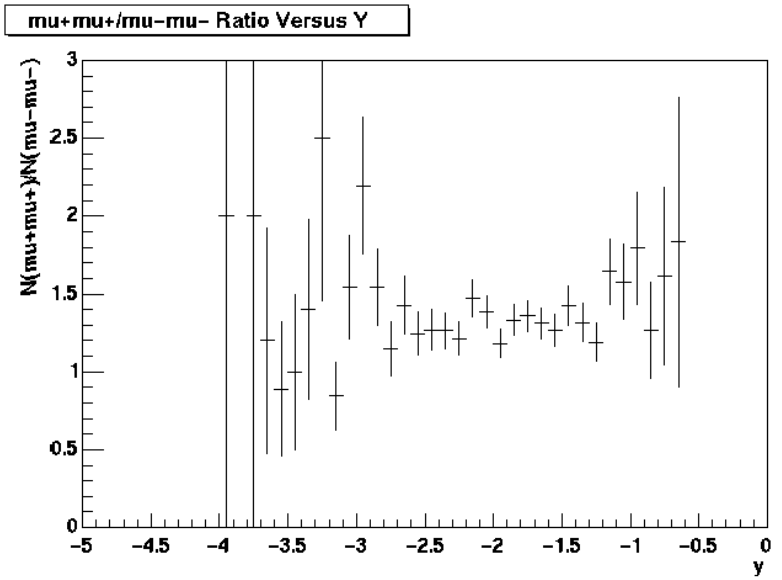
Au-Au: p_T and y spectra

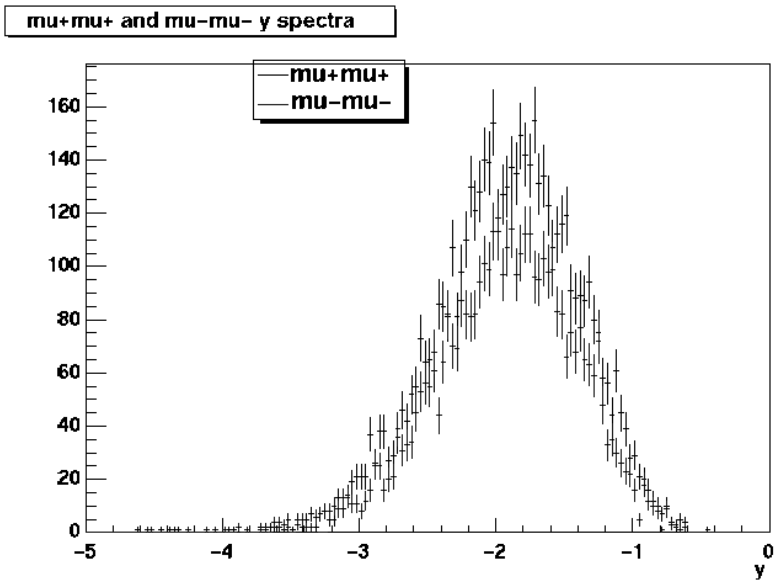
p_T





y





Outlook

- Data with the correct value of B
- Simulations with the last changes (shielding, reconstruction chain, new code…)
- Effect of the dead channels and the inefficiencies
- Effect of the polarity of the magnetic field
- More statistics for data and data w/ shielding

References

Recombination method and R calculation in NA38/NA50:

- "Etude de la production du J/ψ dans les réactions p-Cu, p-U, O-U et S-U à 200 GeV par nucléon" PhD thesis S. Papillon, Paris-7 university (March 1991), IPNO-T.91.03
- "Estimation of the combinatorial background in dimuon spectra using recombination of muons, and associated error" S. Constantinescu, S. Dita, D. Jouan (1996), IPNO-DRE-96-01
- "Intermediate mass dimuons in ultrarelativistic proton-nucleus and nucleus-nucleus collisions at the CERN-SPS" PhD thesis Cristina Soave, Tesi di Dottorato di Ricerca, Università Degli Studi Di Torino, April 1998. http://na50.web.cern.ch/NA50/theses.html

Recombination method and R calculation in HELIOS 3:

- HELIOS 3 collaboration: Eur. Phys. J.C:13(2000) n03 p433

Recombination methods in PHENIX central arms – e's:

- Y. Akiba: https://www.phenix.bnl.gov:8080/phenix/WWW/p/draft/akiba/01.01/AN_PART2.pdf
- F. Matathias: http://www.phenix.bnl.gov/phenix/WWW/p/lists/phenix-heavy-l/recent/msg00240.html

Limit of the methods estimating the combinatorial background:

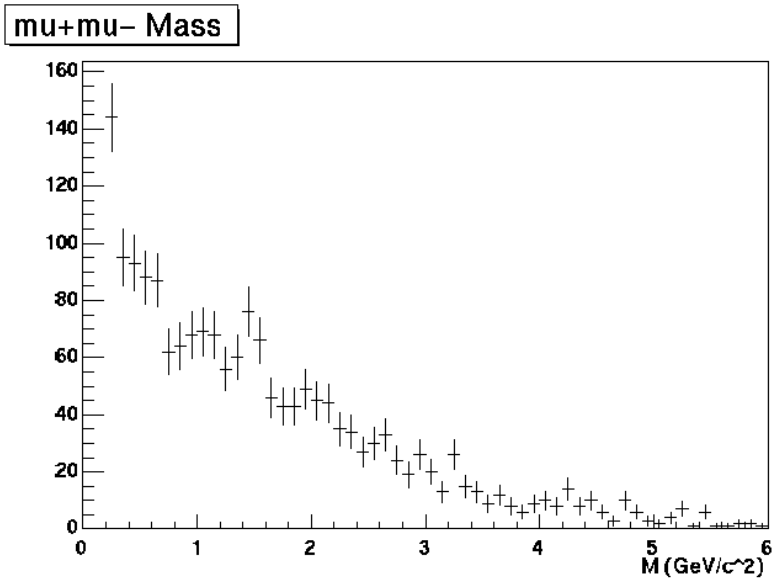
- M. Gaździcki and M. I. Gorenstein hep-ph/0003319

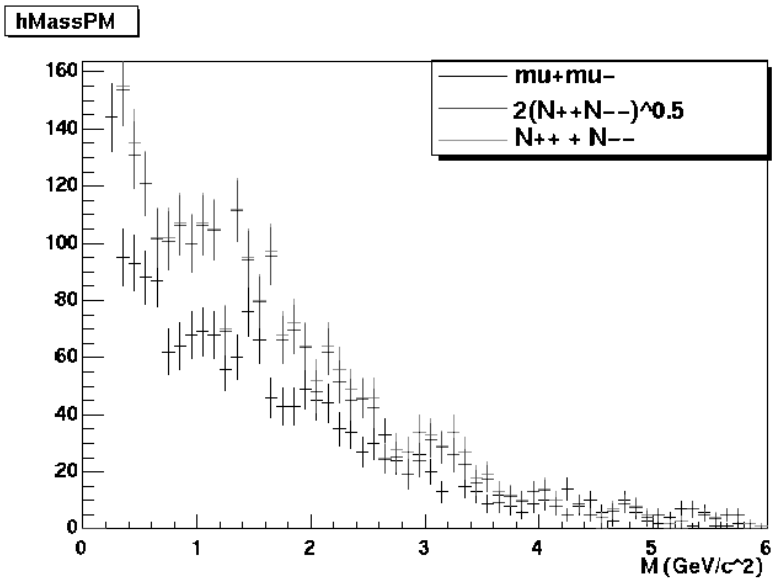
Combinatorial background in ALICE:

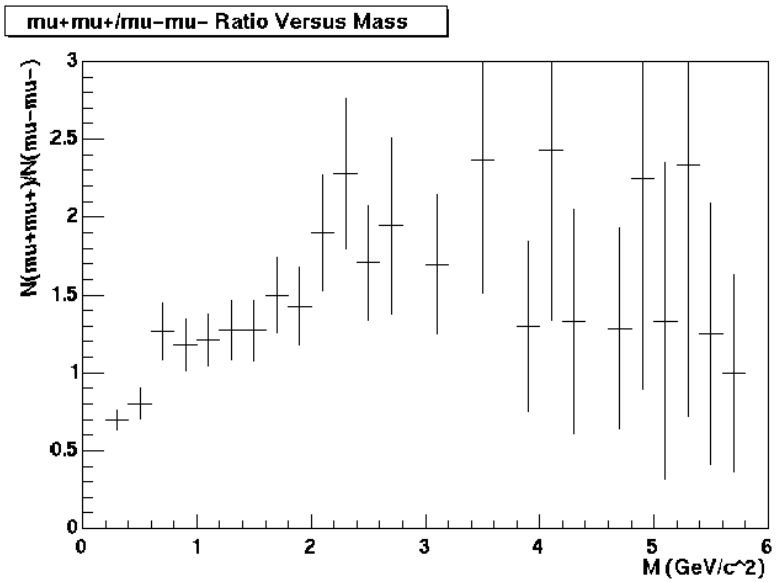
- P. Crochet and P. Braun-Munzinger nucl-ex/0106008

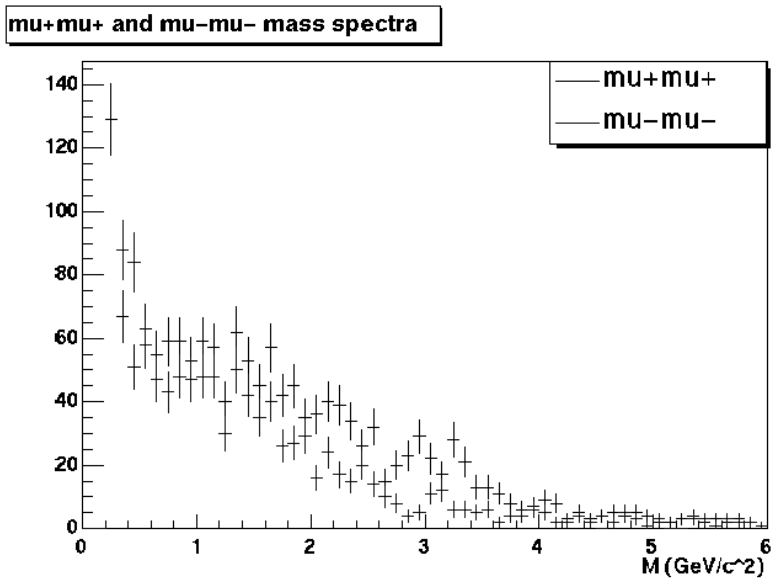
p-p: mass spectra

Hiroki's DST's - No ghost



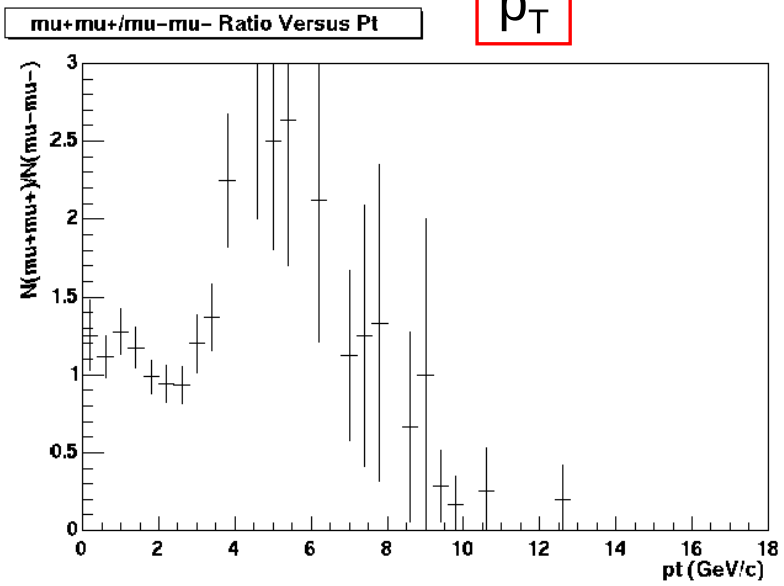
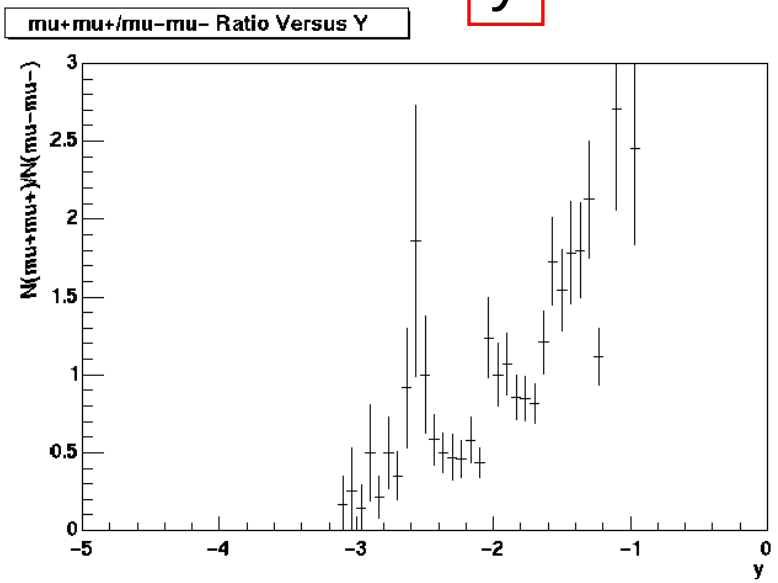
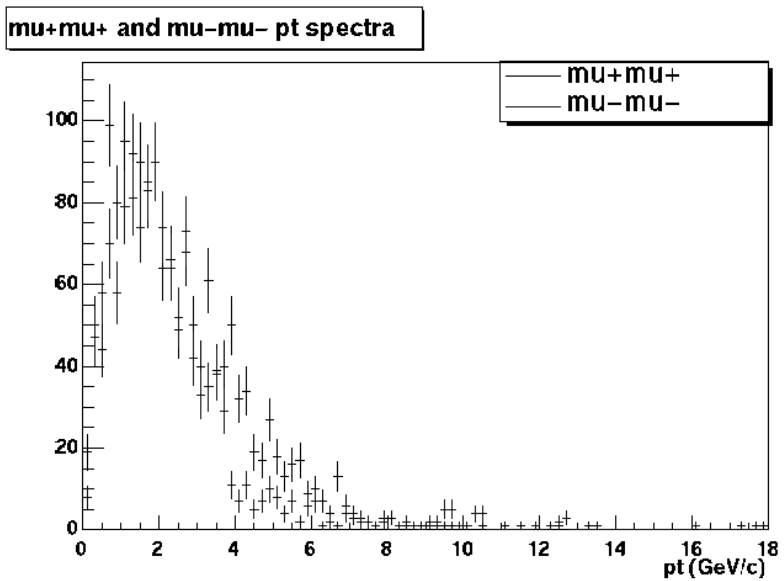
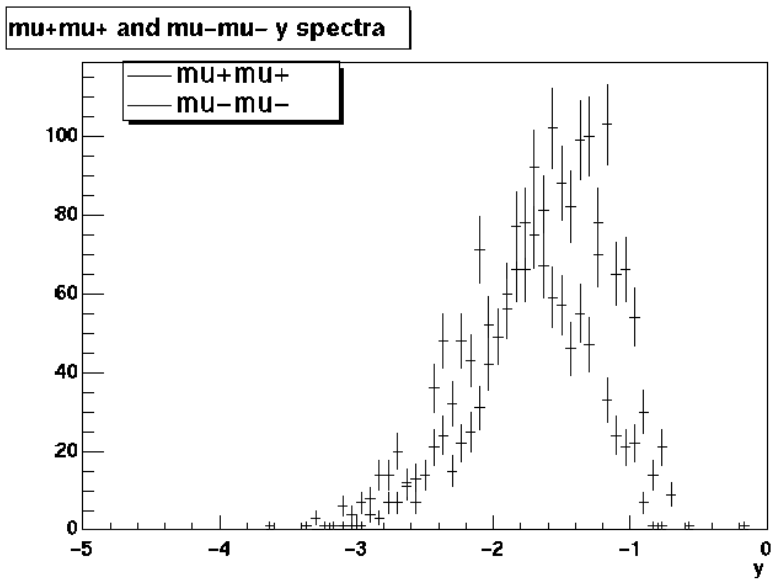






p-p: p_T and y spectra

p_T



y