Baryon and Antibaryon Production in Hadron - Hadron and Hadron - Nucleus Collisions at 158 GeV/c

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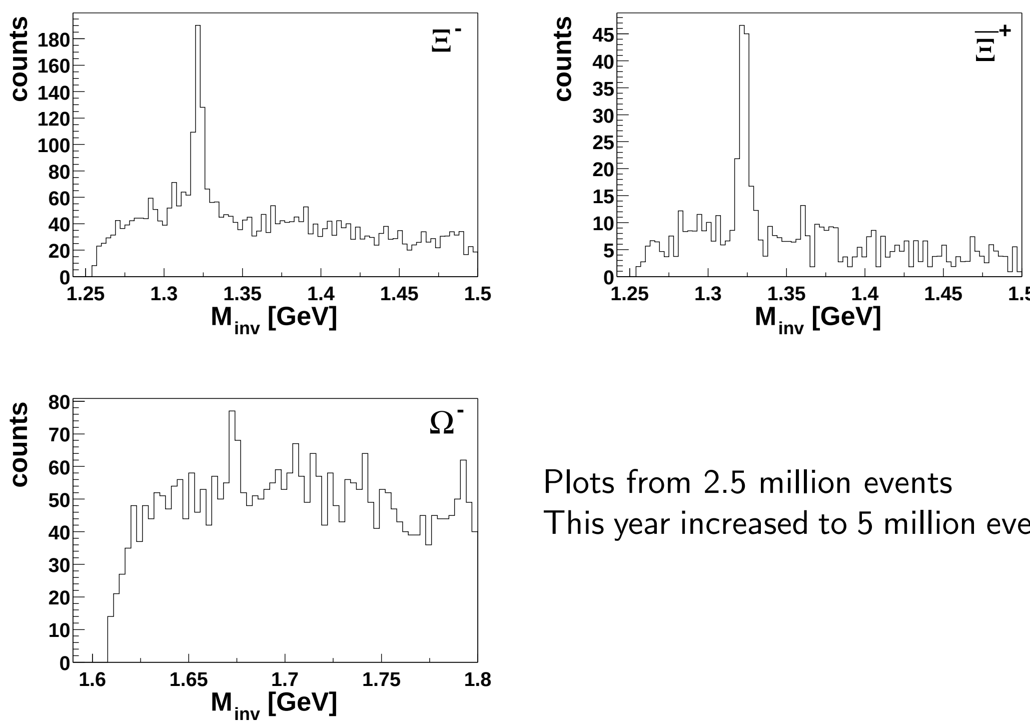
net baryon density vs stopping

- How to measure it?
- is it enough to measure protons, antiprotons?
- is it enough to look at midrapidity?
- how does it depend on strangeness content?
- special issue: Ω
- from p - p to p - A to A - A: evolution or a jump?

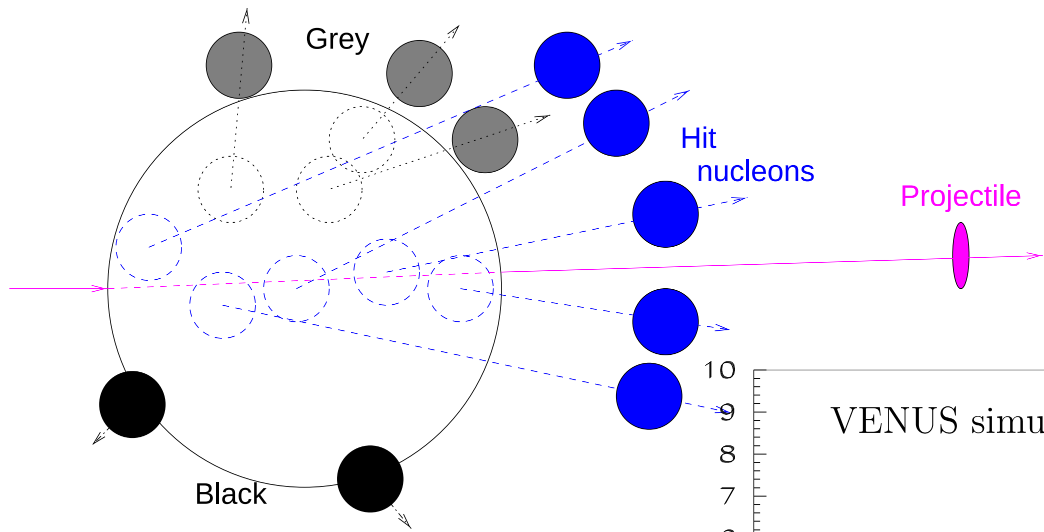
NA49 data

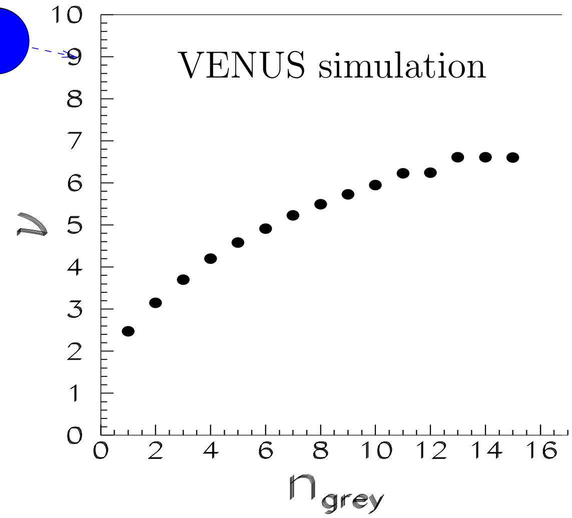
Measurements of (almost) all charged hadrons
Identification of (almost) all of them (dE/dx, ToF)
Coverage of (almost) full forward CM hemisphere
Collisions: p - p, n - p, p - Pb, Pb - Pb
Controlled centrality
Quality of data:

Ξ and Ω mass spectra in pp collisions

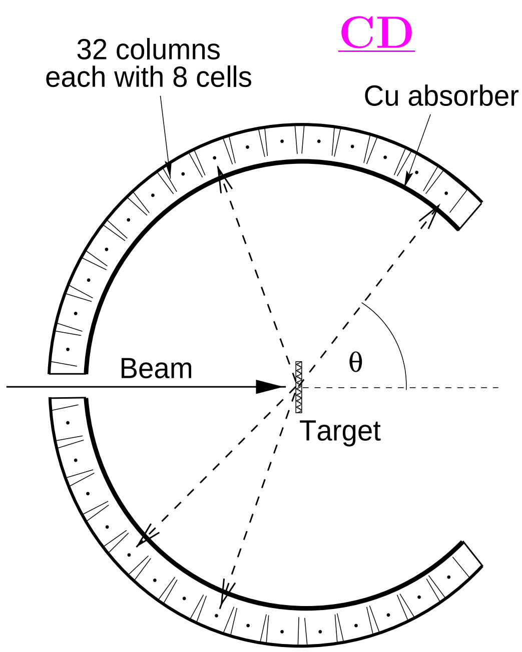


Plots from 2.5 million events
This year increased to 5 million events

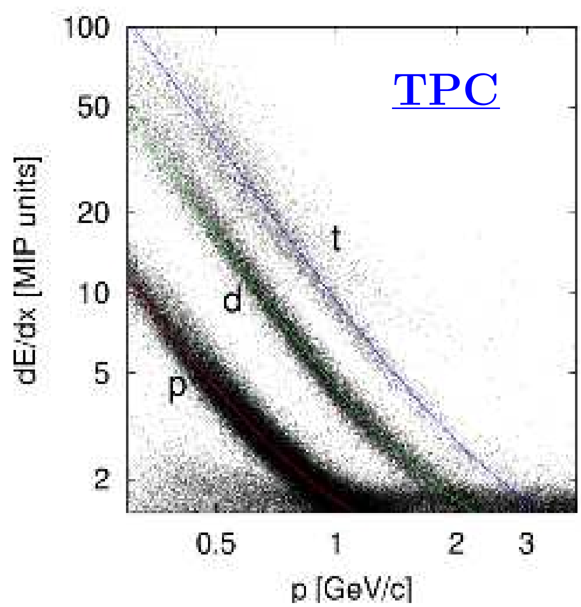




- grey: 0.15 < p < 1.0 GeV/c
- black: p < 0.15 GeV/c



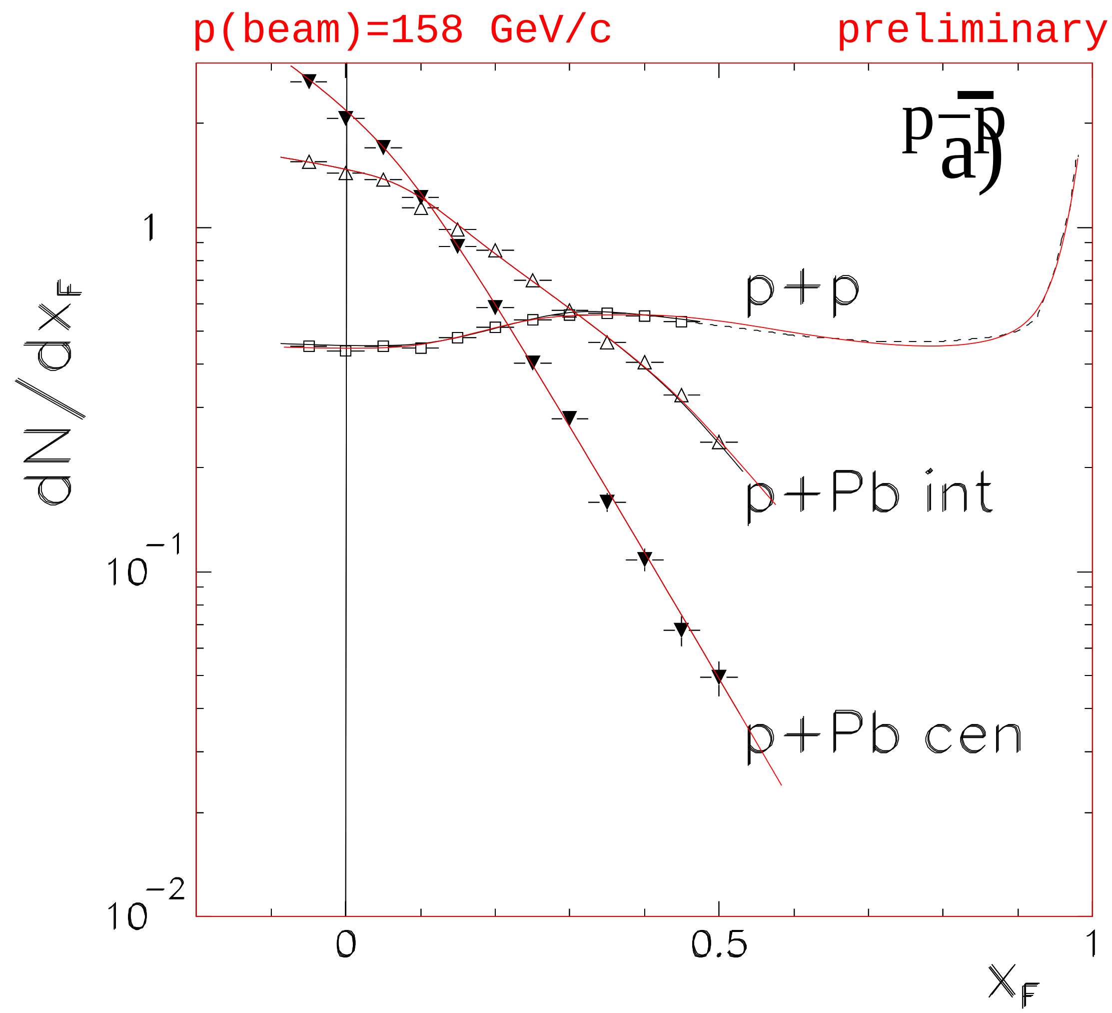
- Cu absorber 200 μ eliminates black protons
- Charge amplitude cut at 3·MIP rejects fast particles



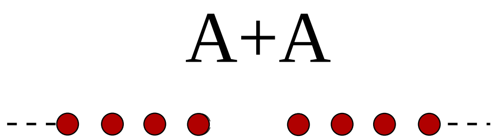
Slow particles, cut on dE/dx takes pions and electrons out

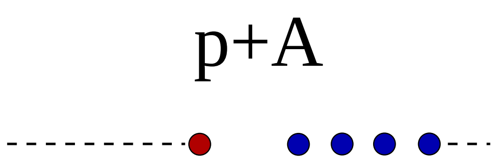
net proton density

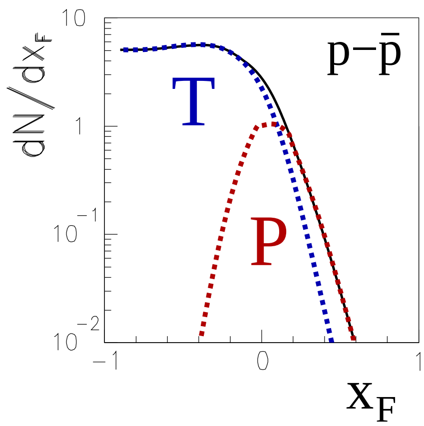
Measure and identify protons, antiprotons
net protons from pp, pPb different centralities:



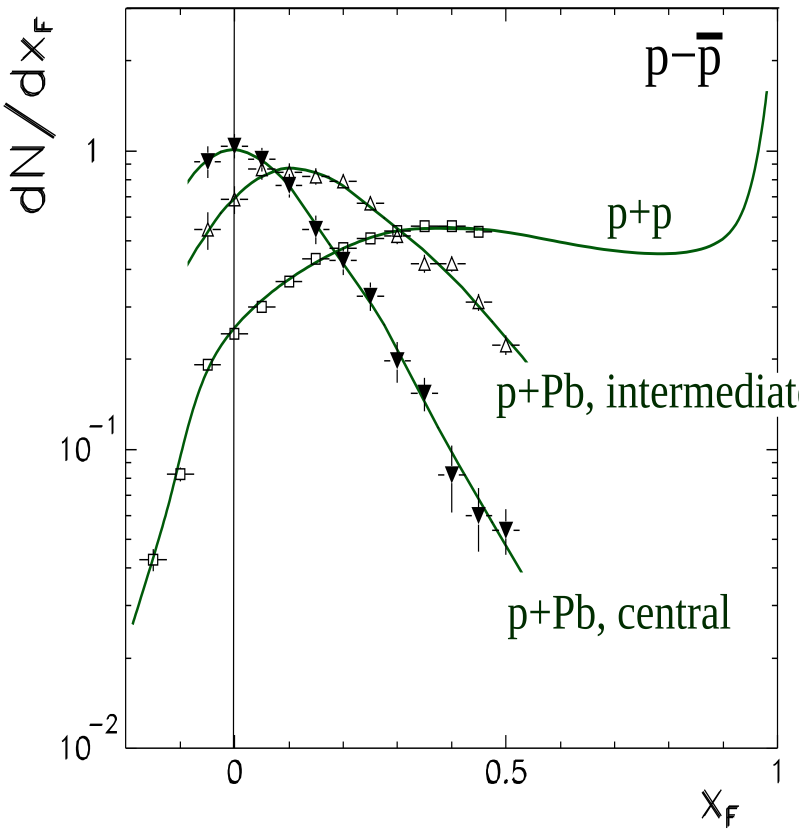
How to compare spectra from pp, pA, AA?



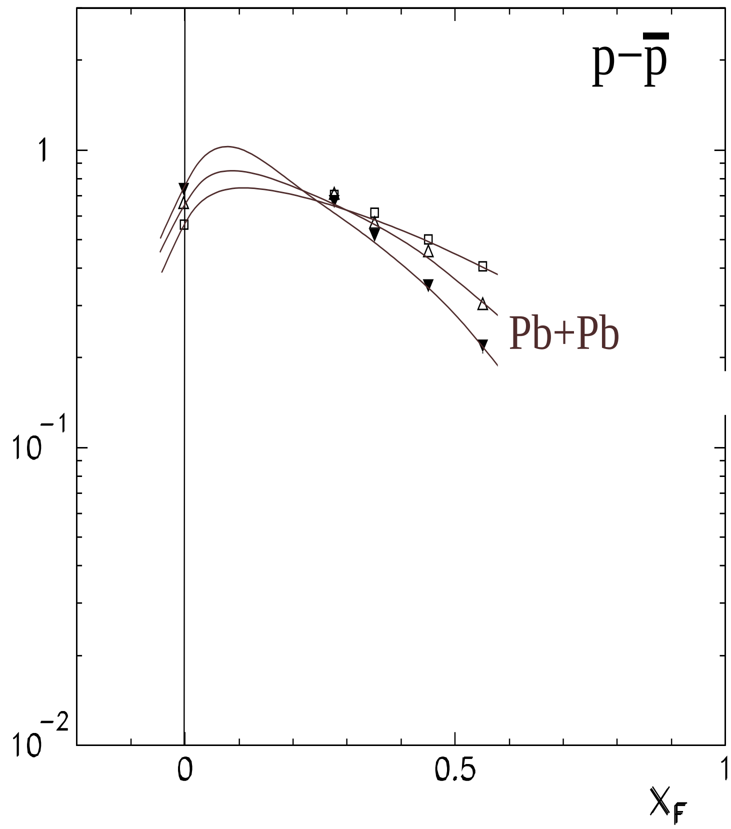




Separate projectile component
incident nucleon struck ν times
and target component - ν collisions



evolution of projectile component with centrality in p - Pb

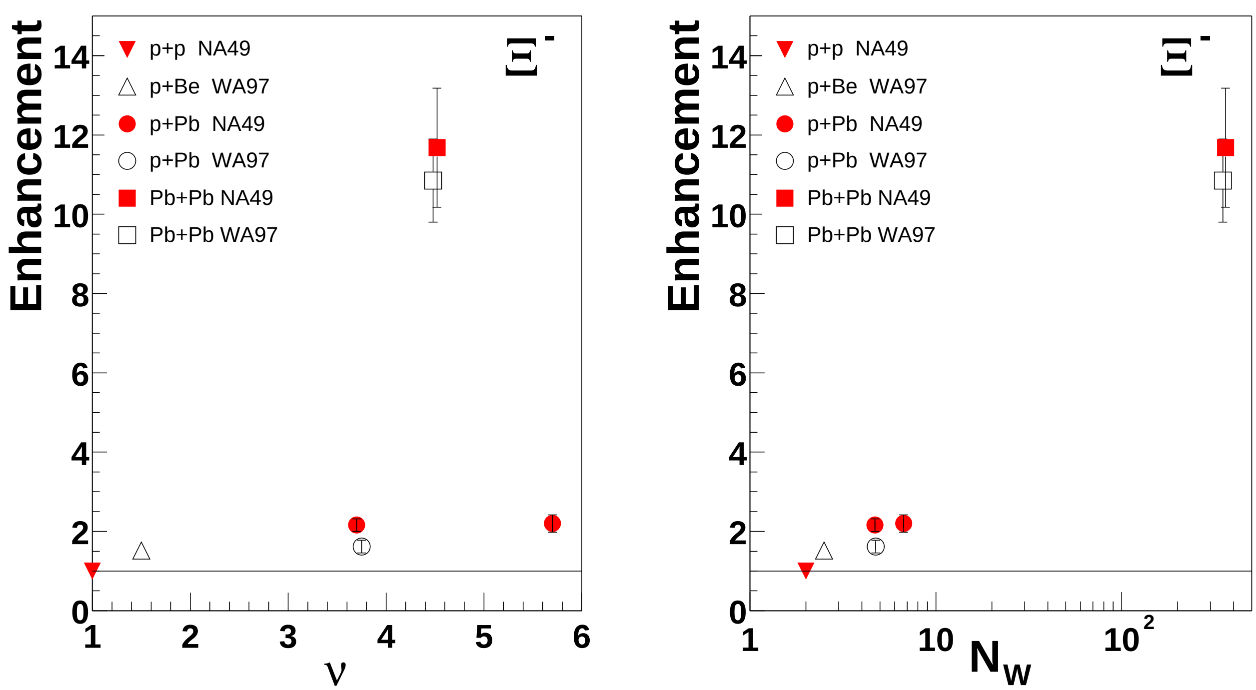


...and the same for Pb - Pb

Thus the longitudinal spectra of net protons follow a continuous evolution

strange baryons

Everybody knows:
strange particles enhanced in central AA
enhancement hierarchy:
more strange - more enhanced
strangeness also enhanced in p - A
more so with increasing centrality
illustration: midrapidity yields of Ξ as a fncn of the number of wounded nucleons, or number of collisions
enhancement = yield per participant normalized to proton-proton

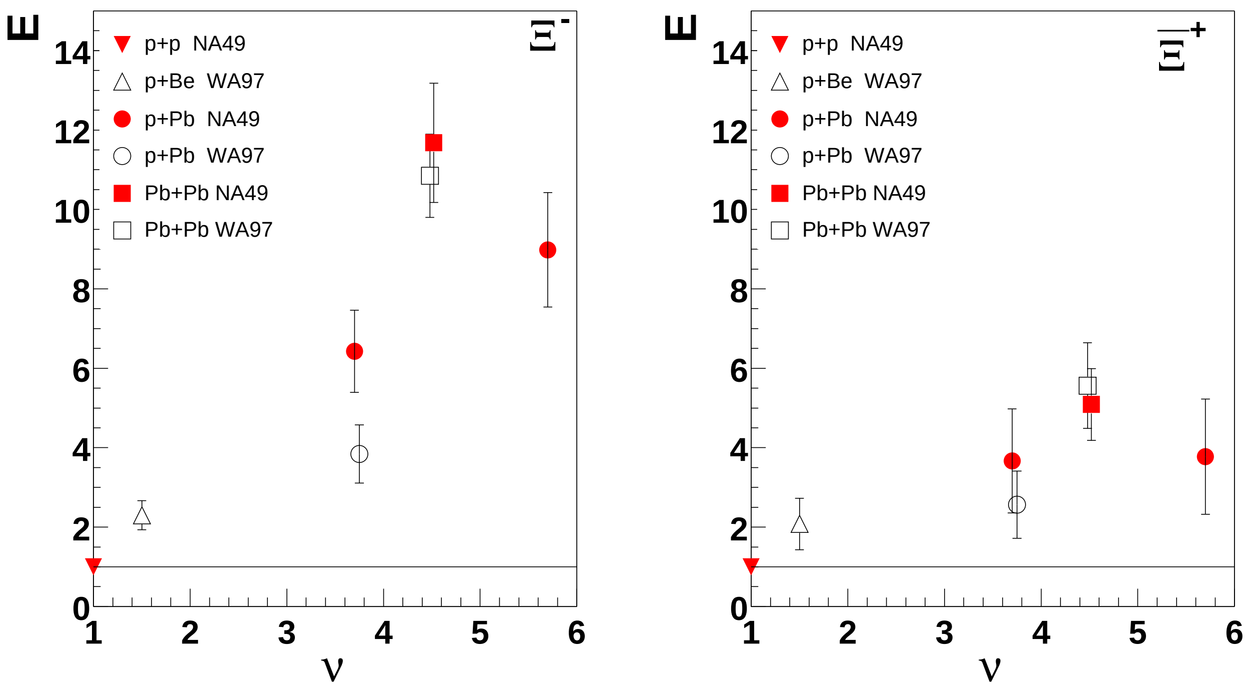


Again - how to compare p - A, A - A?

Suppose at midrapidity we have half of target contribution (ν collisions) and half of projectile contribution (one nucleon struck ν times)

Then define enhancement E:

$$dN/dy_{(pA)} = [\nu/2 + 1 * E/2] dN/dy_{(pp)}$$

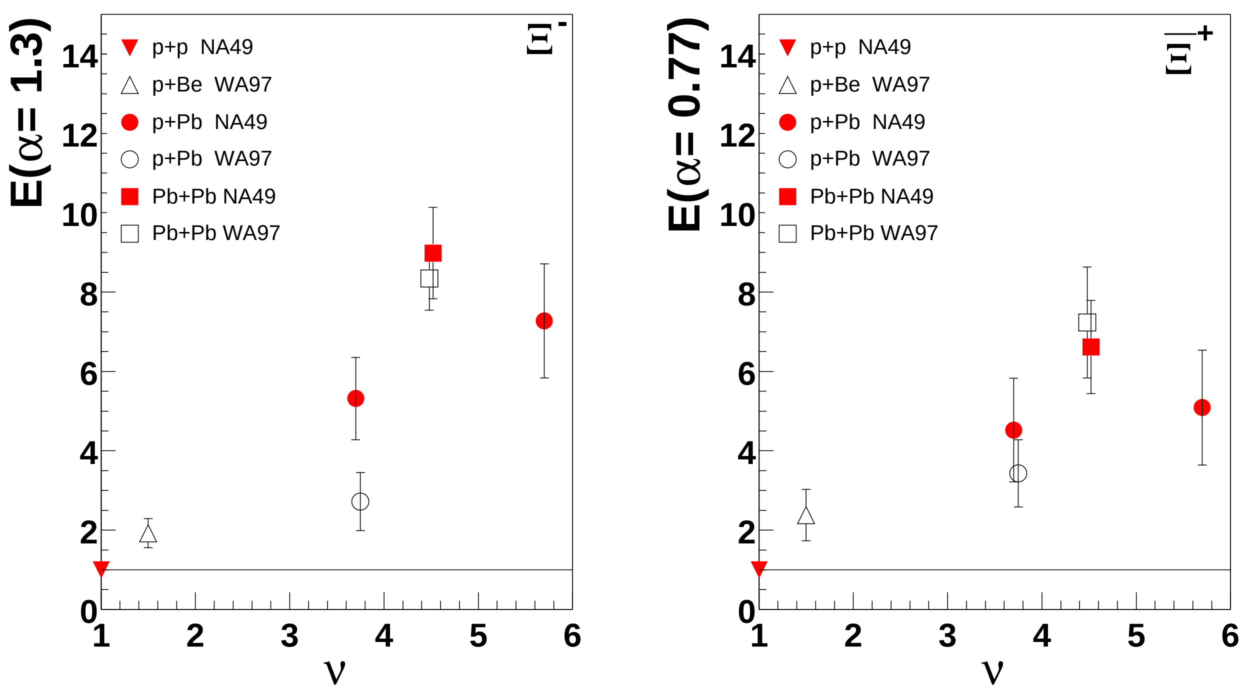


Now the enhancement in Pb - Pb similar to that in p - Pb

Notice: Ξ more enhanced than $\bar{\Xi}$

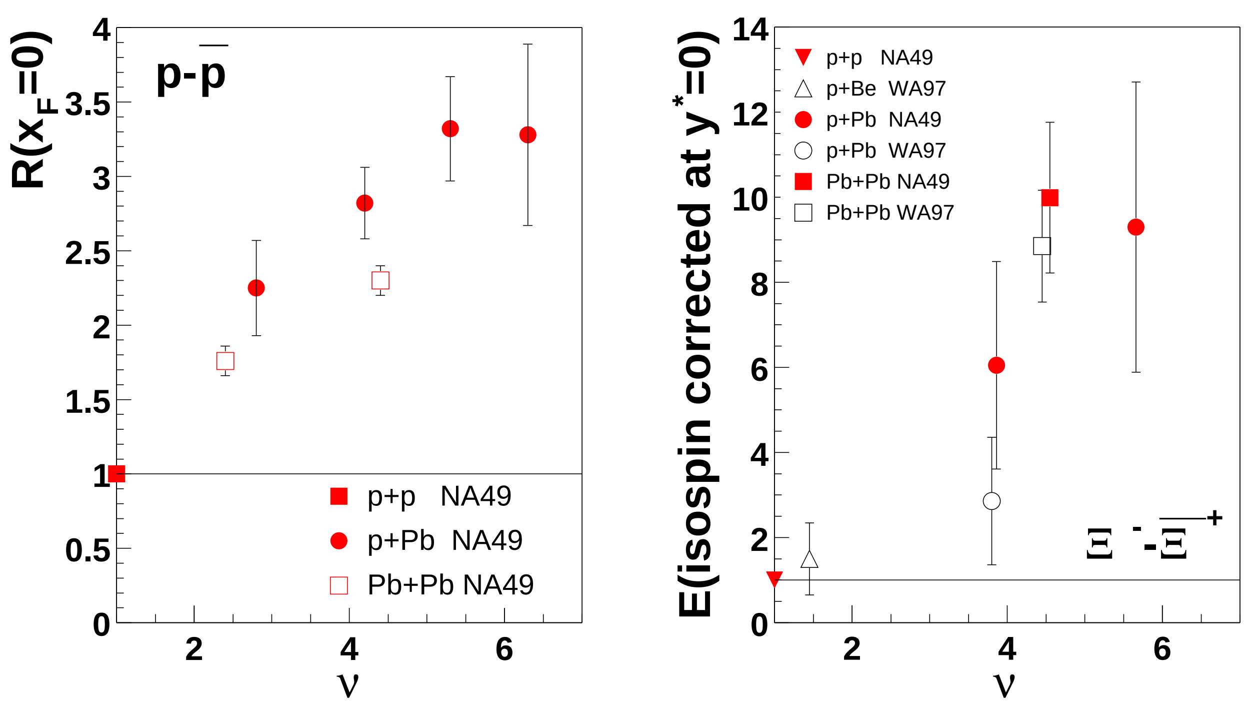
Isospin effects

Comparing pp, pA, AA:
remember that Pb contains 60% neutrons
in n - p collisions more antiprotons produced at midrapidity than in pp
can expect similar effect for Ξ
enhancement factor modified by I-spin ($E \rightarrow \alpha * E$)

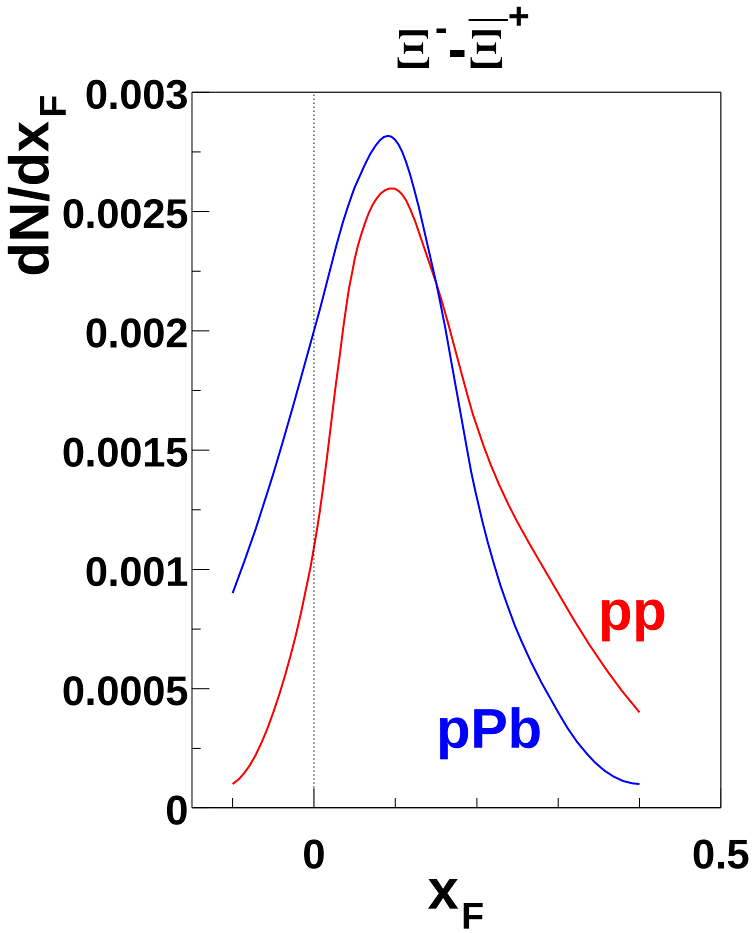


Now the enhancement for $\Xi, \bar{\Xi}$ comparable

Net strange baryon density:
an interplay of $B - \bar{B}$ enhancements
and stopping



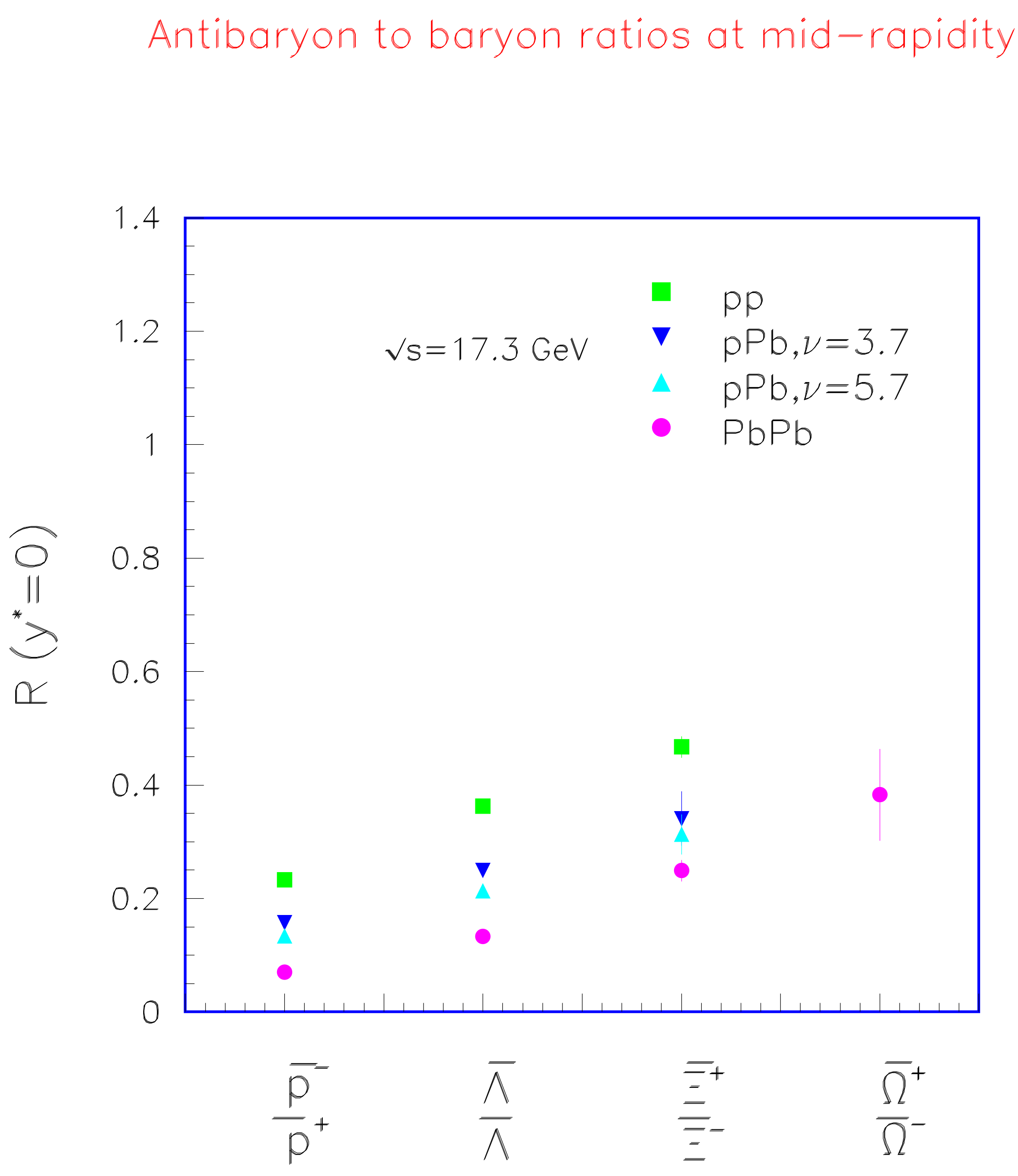
net protons (midrapidity) projectile component
and same for net Ξ



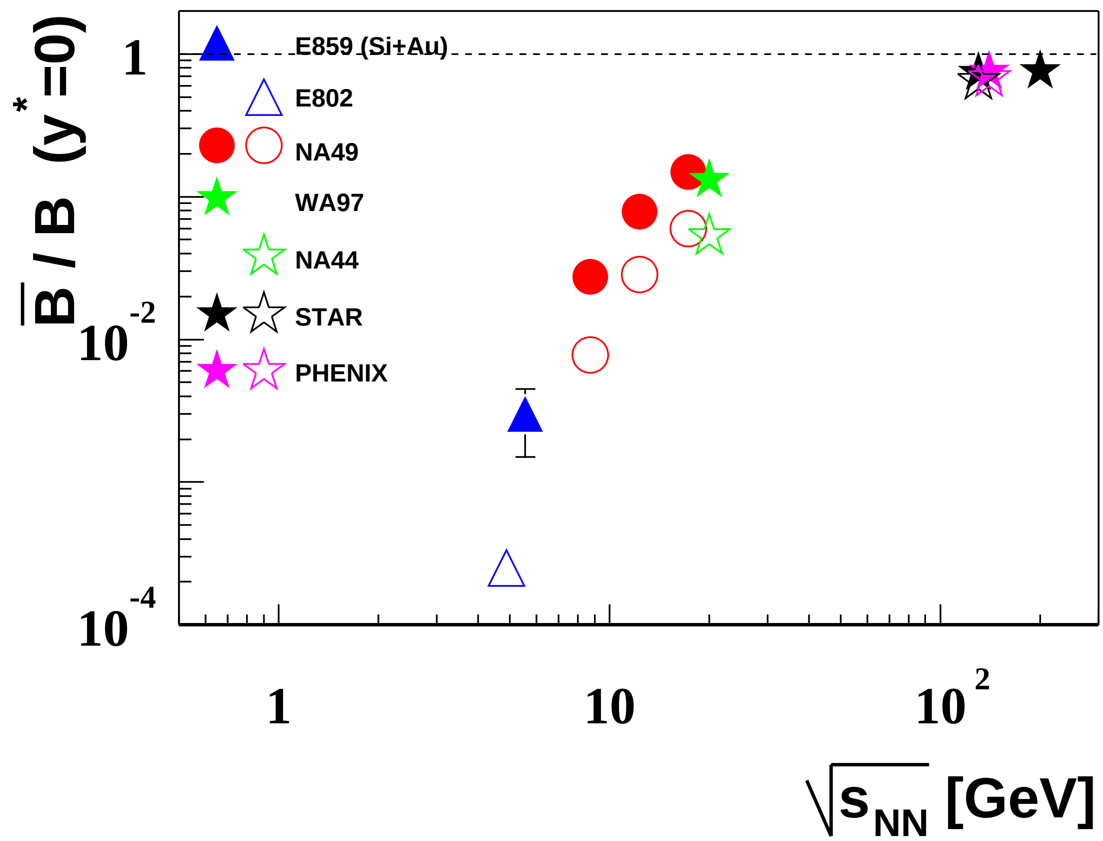
cartoon

Antibaryon/Baryon

All the above bears upon 'true' $B, \bar{B}$ ratios:



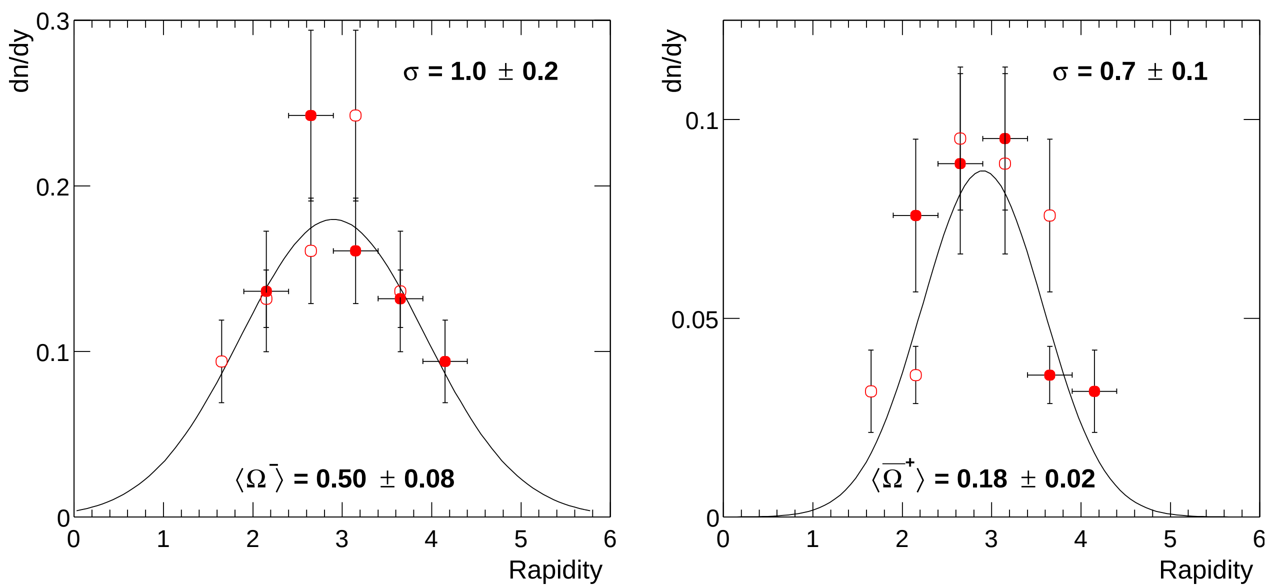
How are we approaching a baryon-free region:



filled symbols: $\bar{\Lambda}/\Lambda$, open - $\bar{p}/p$ (A - A only)

Ω *and* $\bar{\Omega}$

Ratio of $\bar{\Omega}/\Omega$ in pp important for models (statistical vs strings)
NA49 has Ω from 2.5 mln pp, upper limit for $\bar{\Omega}$
At present, upper limit (95%confidence level)
$\bar{\Omega}/\Omega$ =0.5
Have doubled statistics to 5 mln pp, more precise ratio soon
And here is our Ω, $\bar{\Omega}$ from Pb - Pb 20%central:



$$\bar{\Omega}/\Omega \simeq 0.32$$

Data at 40 GeV soon to come

Summary

- net proton spectra gradually evolve from pp thru pPb and PbPb
  - stopping
- strange baryon enhancement in pPb (projectile part) comparable to that in PbPb
- comparing pp, pA, AA: take care of I-spin
- 'net baryons': interplay of enhancements and stopping
- $\bar{\Omega}/\Omega$ vs models?