First results on strange baryon production from the NA57 experiment

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CERN

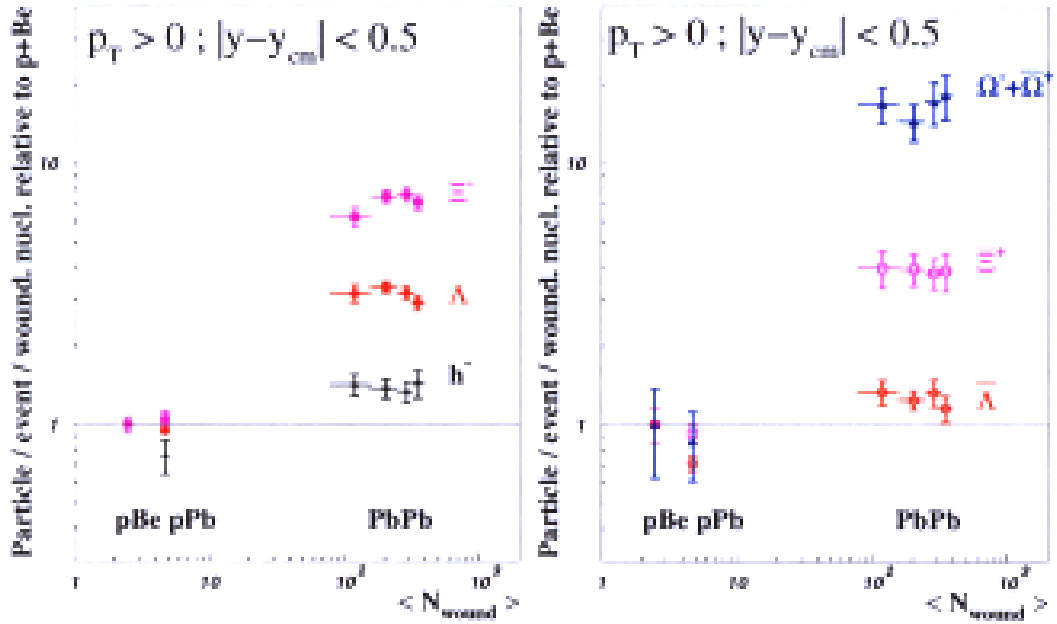
- Motivation
- Status
- Results
- Conclusions

List of institutes

- Dipartimento I.A. di Fisica dell'Università e del Politecnico di Bari and Sezione INFN, Bari, Italy
- Fysisk institutt, Universitetet i Bergen, Bergen, Norway
- Høgskolen i Bergen, Bergen, Norway
- School of Physics and Astronomy, University of Birmingham, Birmingham, UK
- Comenius University, Bratislava, Slovakia
- Dipartimento di Fisica dell'Università and Sezione INFN, Catania, Italy
- CERN, European Laboratory for Particle Physics, Geneva, Switzerland
- Institute of Experimental Physics SAS, Kosice, Slovakia
- P.J. Safárik University, Kosice, Slovakia
- Fysisk institutt, Universitetet i Oslo, Oslo, Norway
- Dipartimento di Fisica dell'Università and Sezione INFN, Padua, Italy
- Collège de France and IN2P3, Paris, France
- Institute of Physics, Academy of Sciences of the Czech Republic, Prague, Czech Republic
- Dipartimento di Fisica dell'Università "La Sapienza" and Sezione INFN, Rome, Italy
- Dipartimento di Fisica dell'Università "E.R. Caianiello" and Sezione INFN, Salerno, Italy
- State University of St. Petersburg, St. Petersburg, Russia
- Insitut de Recherches Subatomiques, IN2P3/ULP, Strasbourg, France
- Utrecht University and NIKHEF, Utrecht, The Netherlands

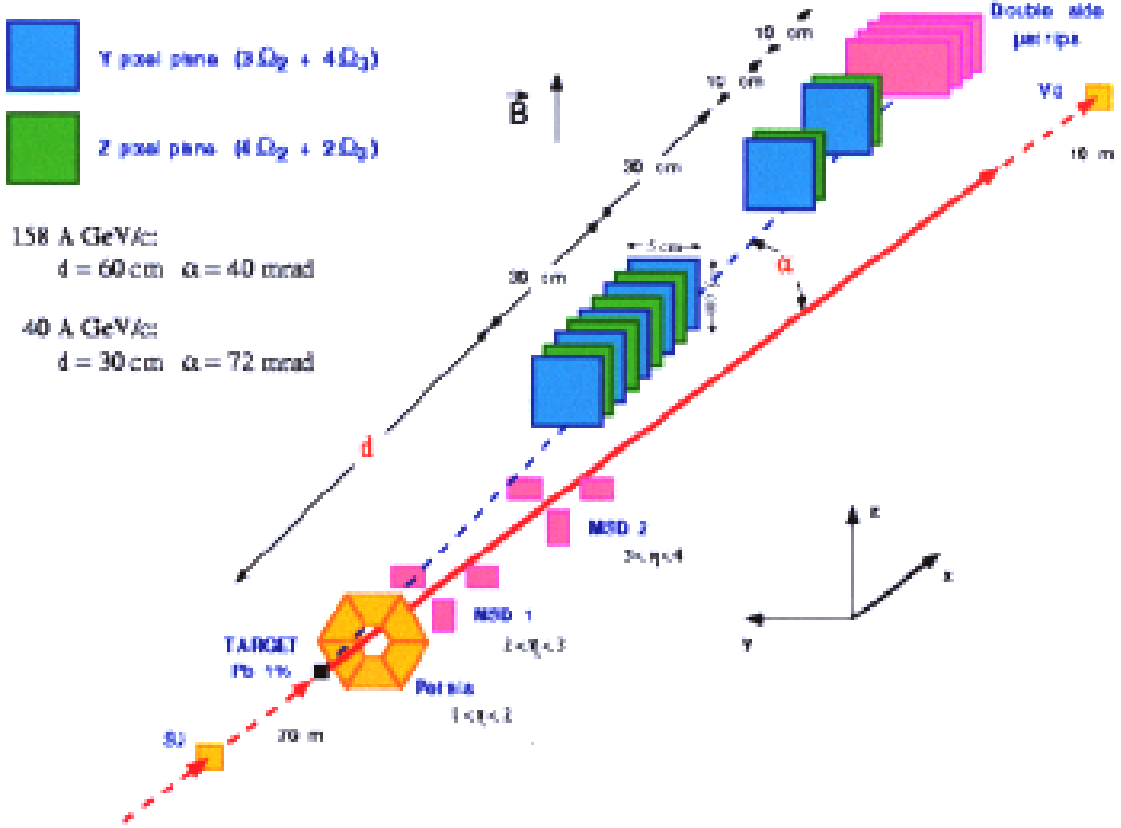
- strangeness enhancement in Pb+Pb w.r.t. p+A increases with strangeness (QGP prediction)
- Enhancement ~saturated for N_{wound}>100

WA97
160 A GeV/c



- NA57: search for the onset of the enhancements
  - Lower beam momentum from 160 to 40 A GeV/c
  - Extend centrality range down to $N_{wound} \simeq 50$

The NA57 experiment



- Changes w.r.t. WA97:
  - New spectrometer
    - Different magnet
    - Only pixels for tracking (~1M channels)
  - New DAQ, data structure
  - Significant changes in alignment, track finding and event reconstruction software

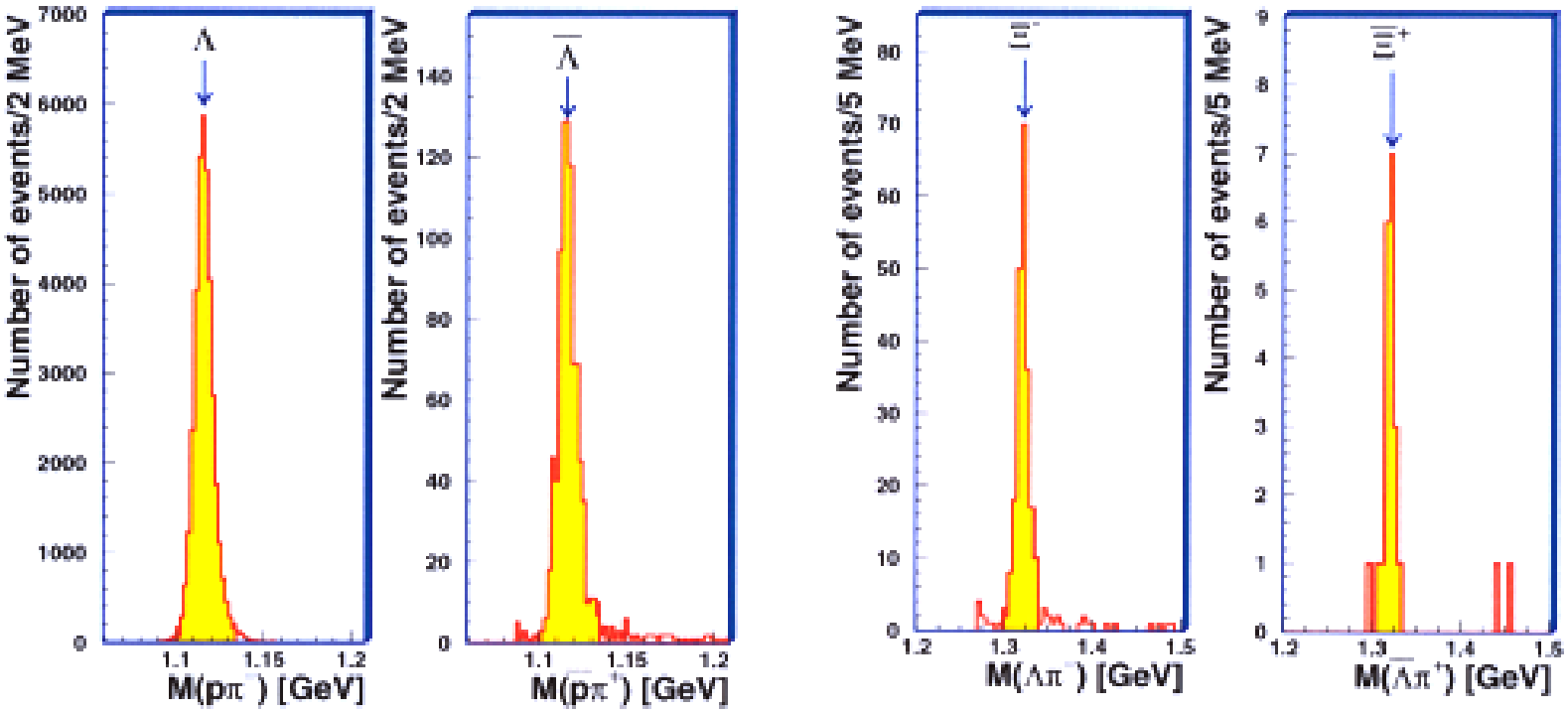
NA57 results at QM2001

(Preliminary samples)

- 40 A GeV/c:
  - Pb+Pb:
    $\bar{\Lambda}/\Lambda$ and $\bar{\Xi}^+/\Xi^-$ ratios (uncorrected)
  - p+Be:
    $\bar{\Lambda}/\Lambda$ ratio (uncorrected)
- 160 A GeV/c
  - Pb+Pb in extended centrality range:
    Ξ^- and $\bar{\Xi}^+$ yields and m_T spectra (corrected)

Λ and Ξ @ 40 A GeV/c

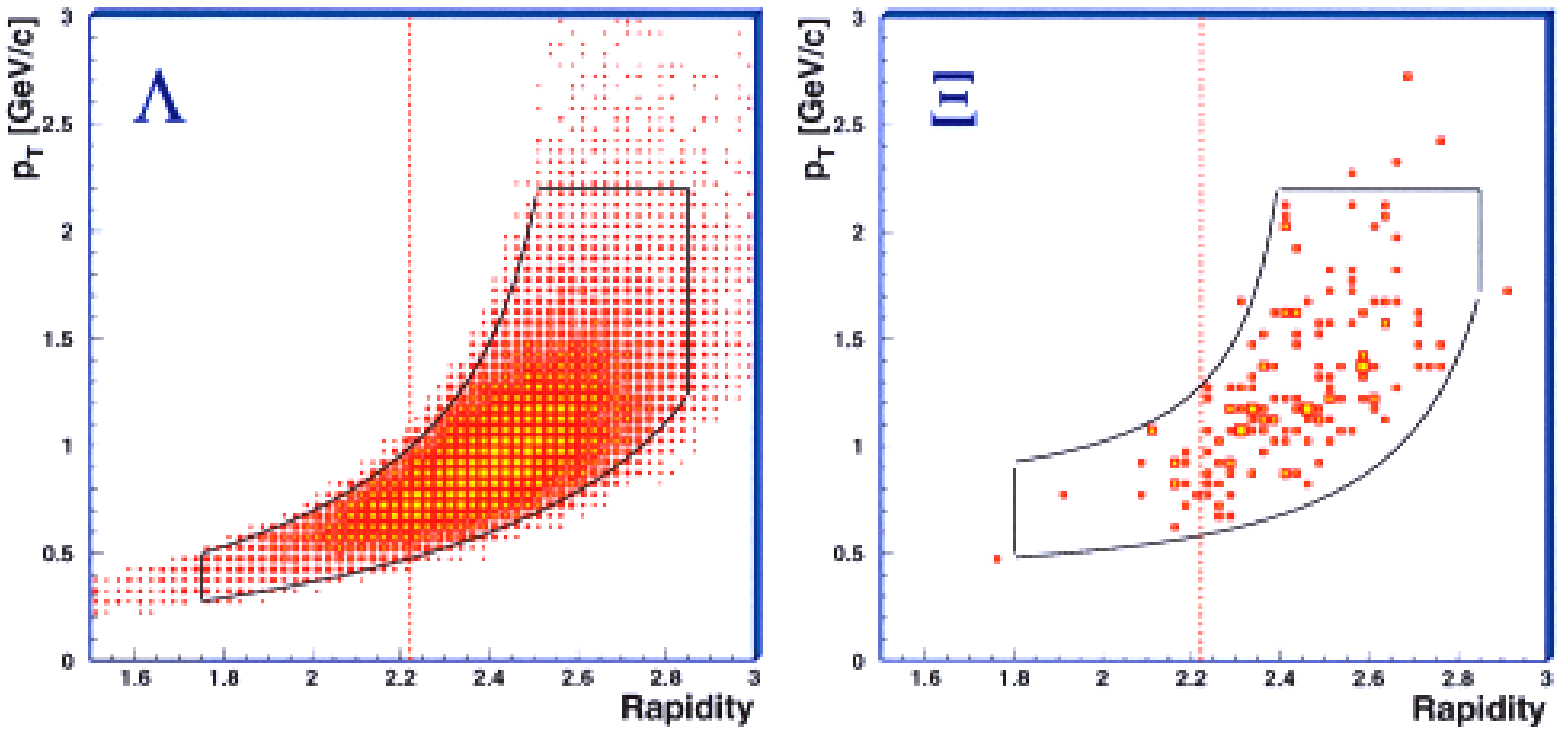
Pb+Pb sample



- Most central ~20% of the total cross section

- Acceptance windows:

Pb+Pb sample



- Similar acceptance for p+Be

$\bar{Y}/Y$ ratios

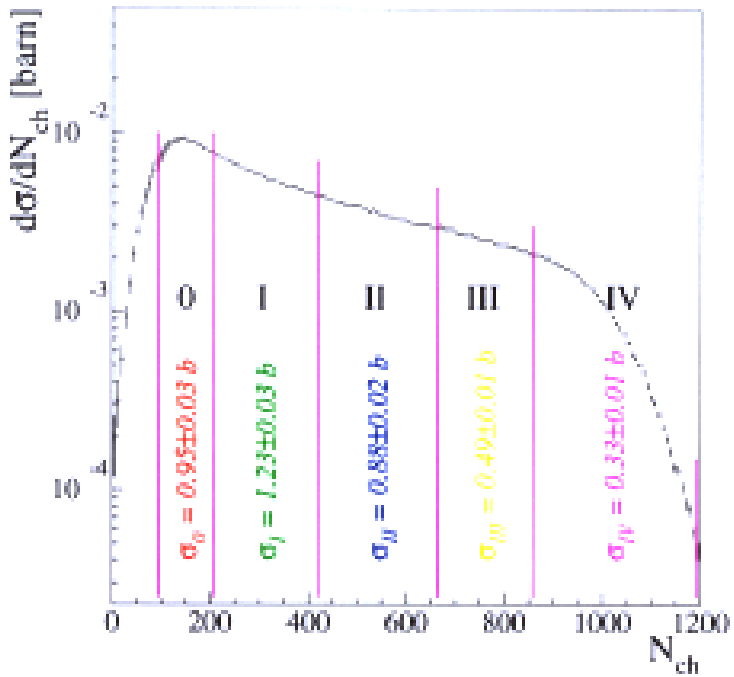
NA57 WA97	Pb+Pb		p+Be	
	40AGeV/c	160 A GeV/c	40 A GeV/c	160 A GeV/c
$\bar{\Lambda}/\Lambda$	0.023±0.001	0.133±0.007	0.059±0.007	0.332±0.008
$\bar{\Xi}^+/\Xi^-$	0.080±0.025	0.249±0.019	—	0.45±0.07

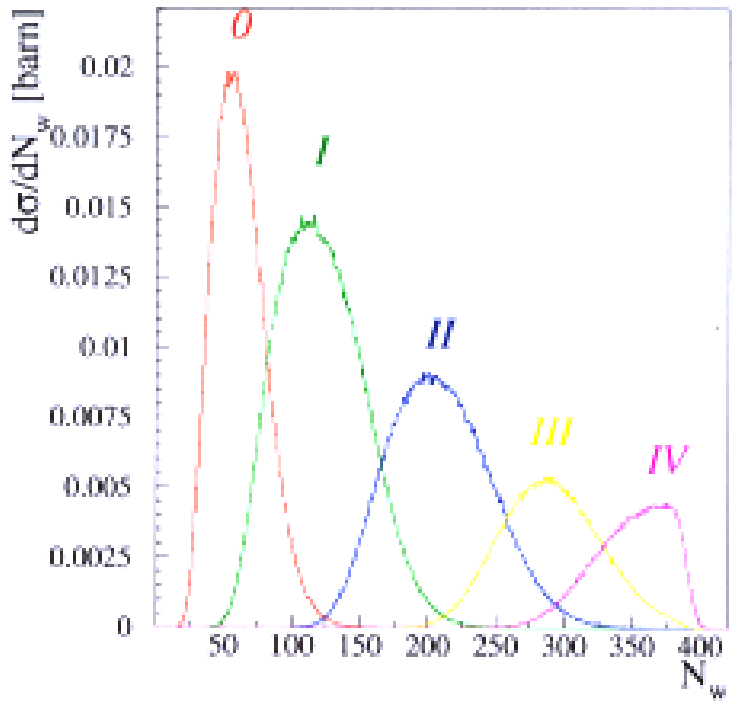
- 160→40 A GeV/c:
  - Pb+Pb: $\bar{\Lambda}/\Lambda$ decreases by a factor ~6
    $\bar{\Xi}^+/\Xi^-$ decreases by a factor ~3
  - same reduction for $\bar{\Lambda}/\Lambda$ in p+Be
- Interpretation:
  - Baryon density larger at 40 A GeV/c
  - $\bar{Y}$ suppressed due to higher threshold ($\bar{\Xi}^+/\Xi^-$ in p+Be?)
  - Look at absolute yields & enhancements

Pb+Pb @ 160 A GeV/c

- 1998 run:
  - Event reconstruction completed
  - Acceptance and efficiency corrections in progress
- Analysis started with Ξ^- & $\bar{\Xi}^+$:
  - Statistics large enough to study the centrality dependence down to $N_{wound} \simeq 50$
- 2000 run:
  - Statistics $\simeq$ 1998 run
  - Event reconstruction in progress

Centrality

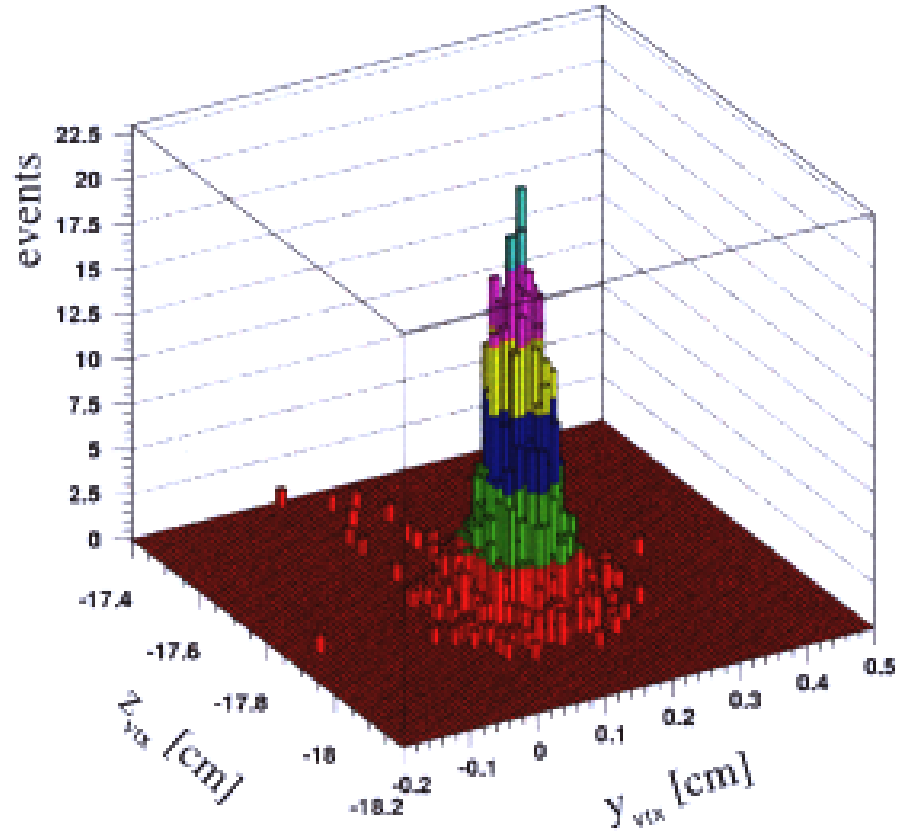




- Centrality selection → charged part. multiplicity (MSD)
- N_{wound} from Xsections for each class (Glauber model)
  - In WA97 N_{wound} from WNM (δN_{wound} at most 3%)
- NA57: most peripheral bin → $\langle N_{wound} \rangle = 62$

Primary vertex definition

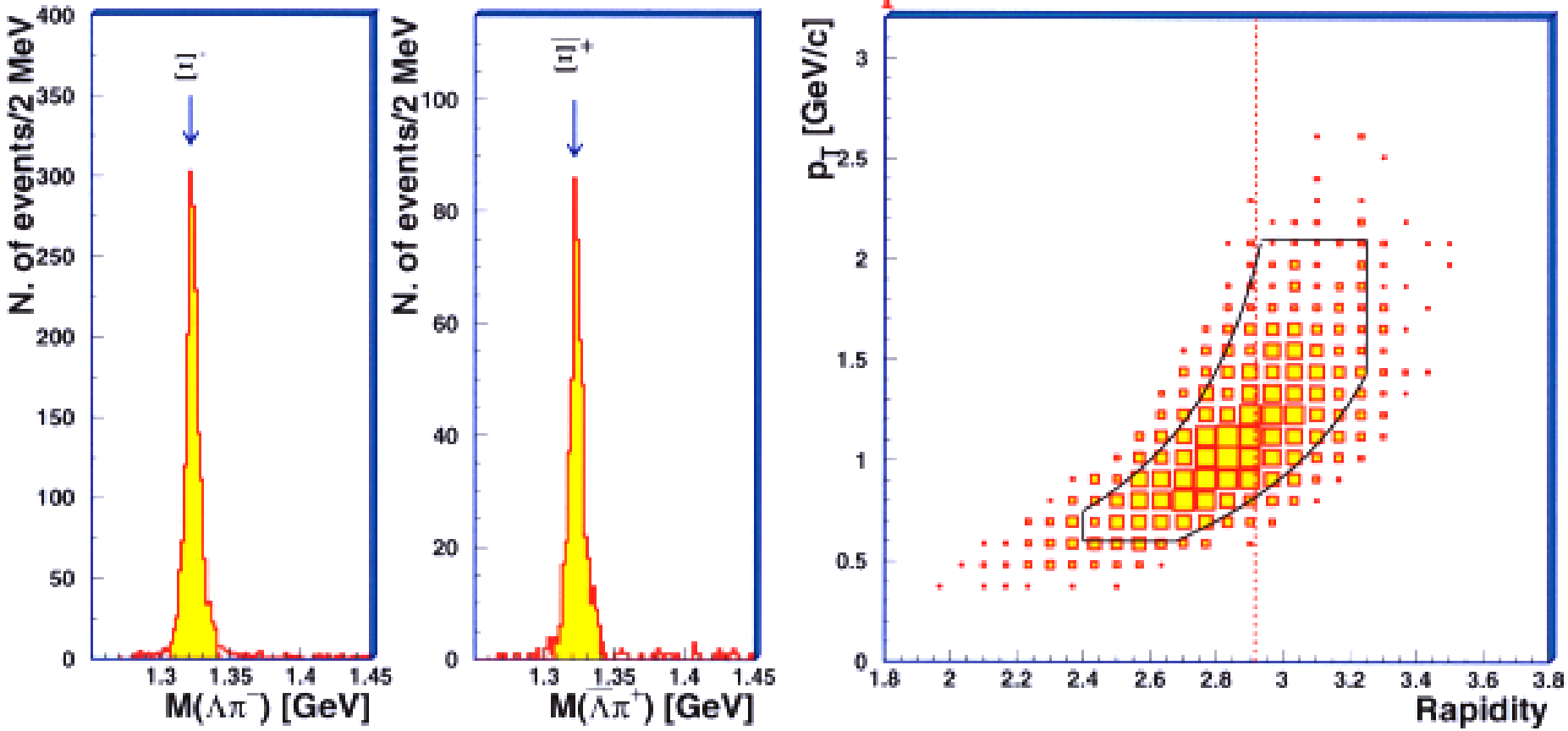
- WA97:
  ev–by–ev vertex estimated using track impacts on target plane
- NA57:
  - ev–by–ev vtx not efficient for low–mult. events
  - $\sigma_y \simeq 350\ \mu m \quad \sigma_z \simeq 650\ \mu m$
  - average beam position & spread determined for each run (~½h) using high–mult. events



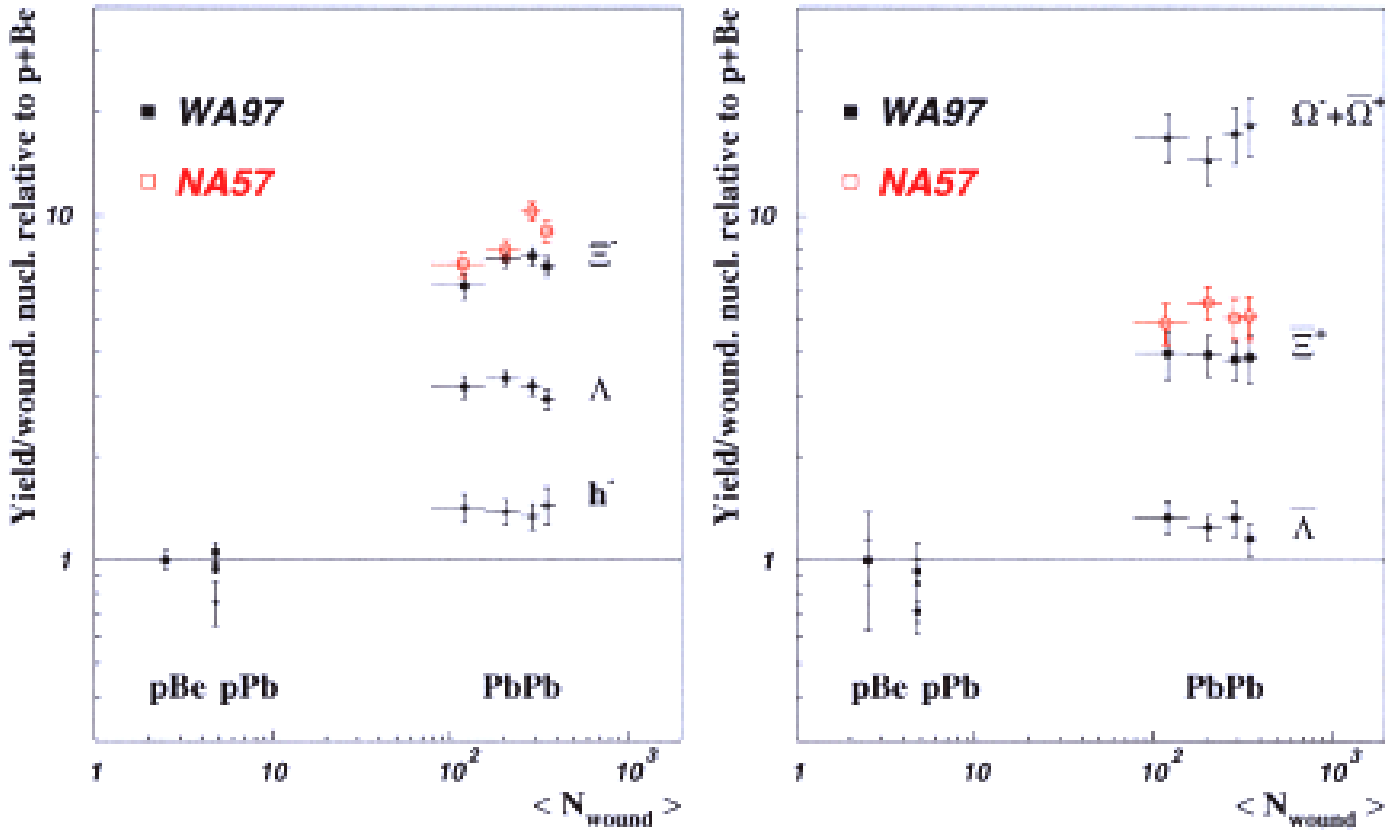
(See poster by K.Fanebust)

Ξ signals Pb+Pb @ 160 A GeV/c

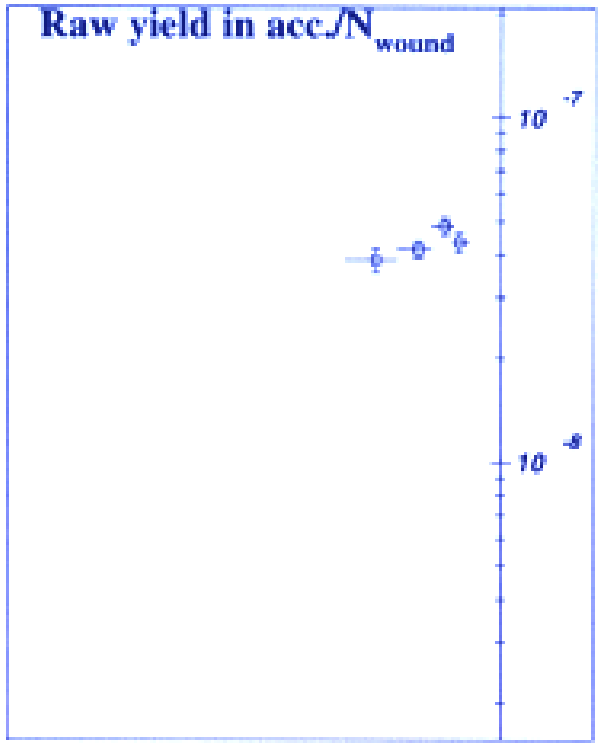
Pb+Pb sample

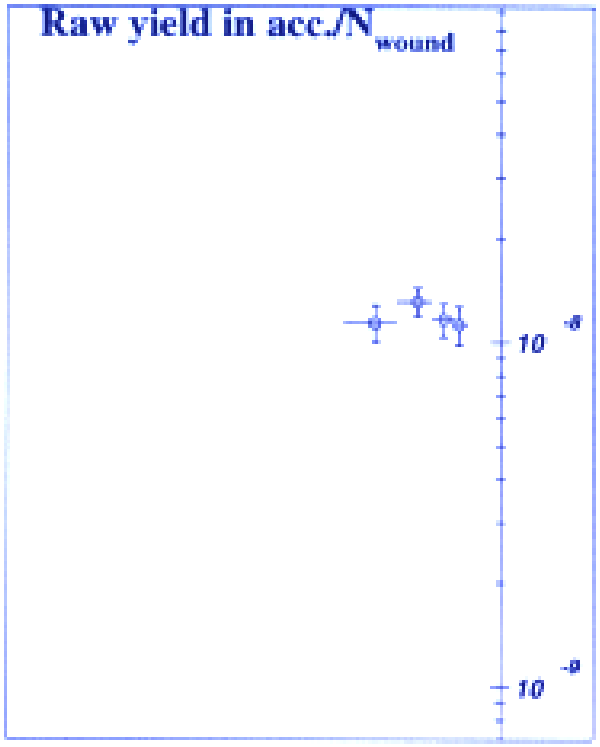


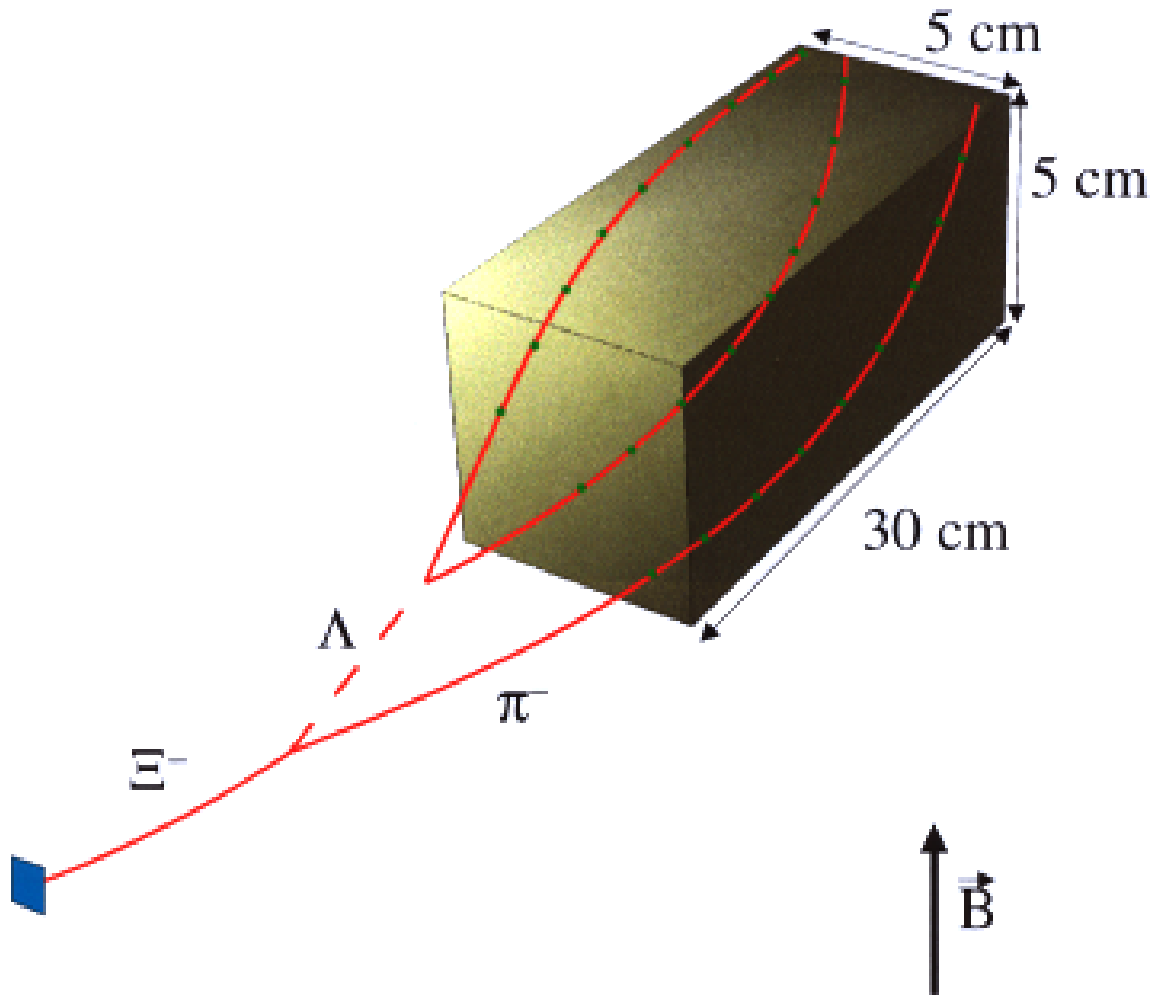
NA57 yields in WA97 centrality range



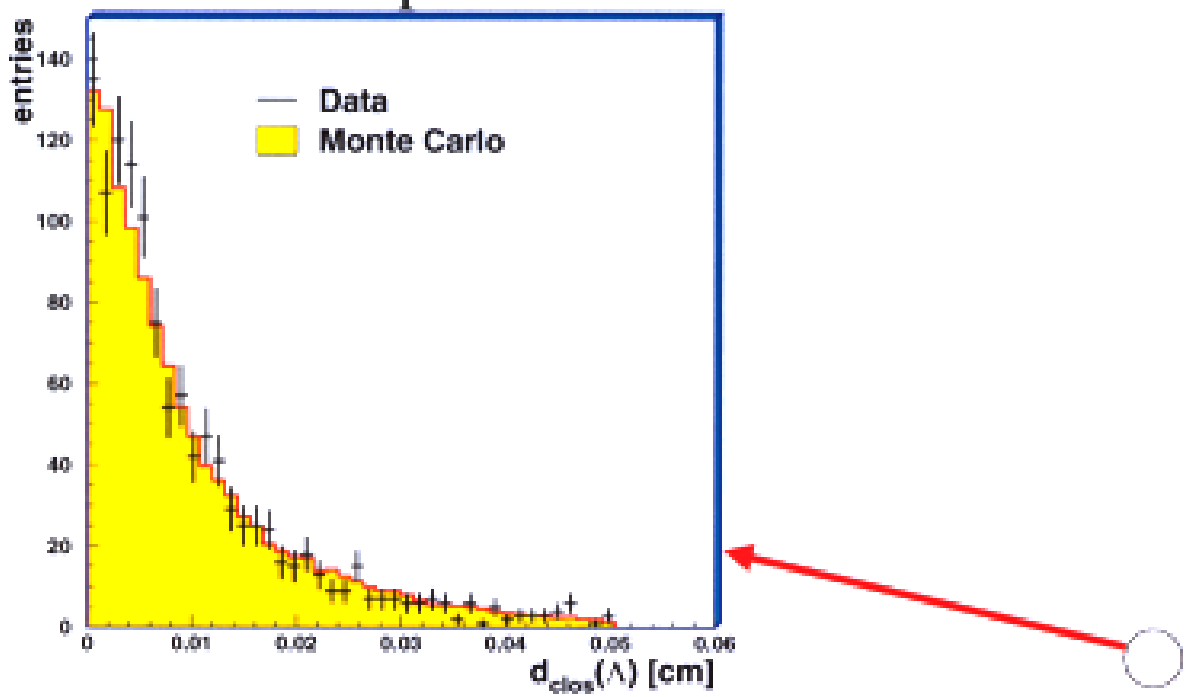
- Ξ^- and $\bar{\Xi}^+$ absolute yields larger by 20–30% w.r.t. WA97 (under study)


Raw yield in acc./N wound
10 -7
10 -8

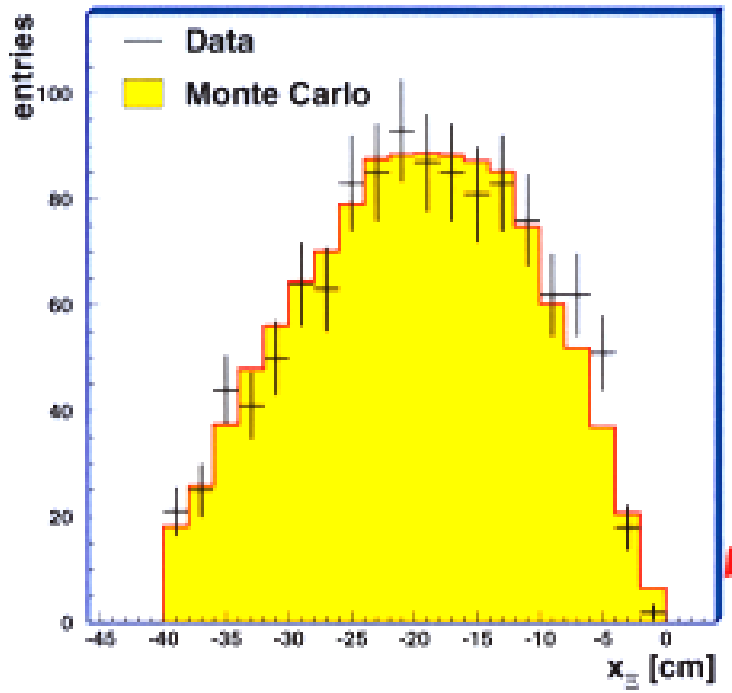

Raw yield in acc./N wound
10 -8
10 -9

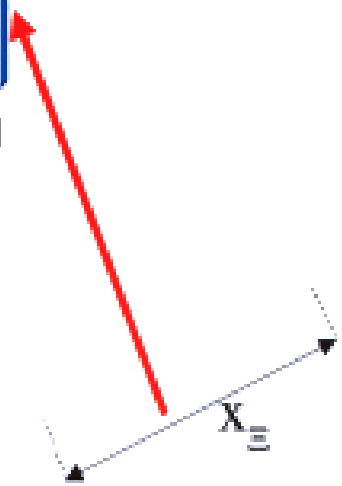

5 cm
5 cm
30 cm
Λ
π⁻
Ξ⁻
B

Closest approach distance in space

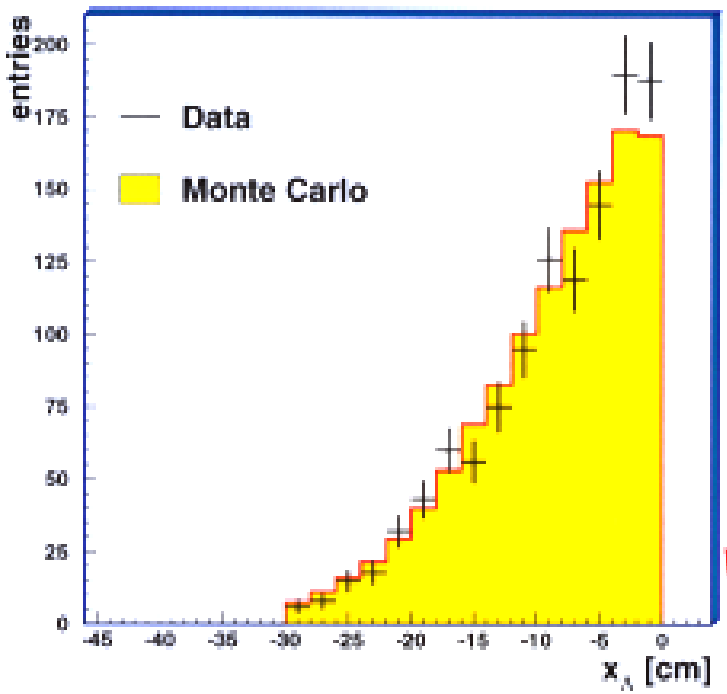


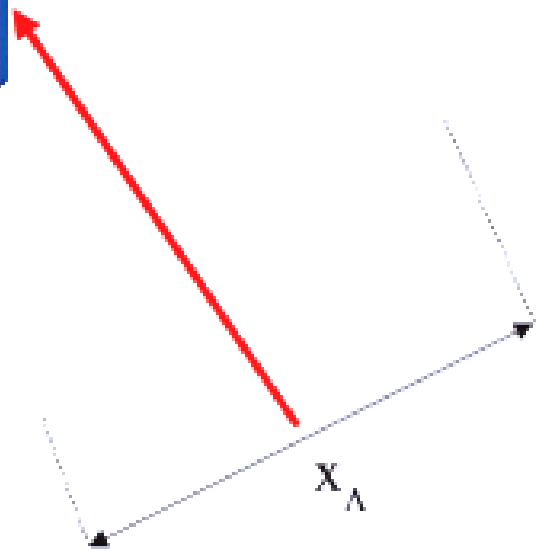
Ξ decay distance



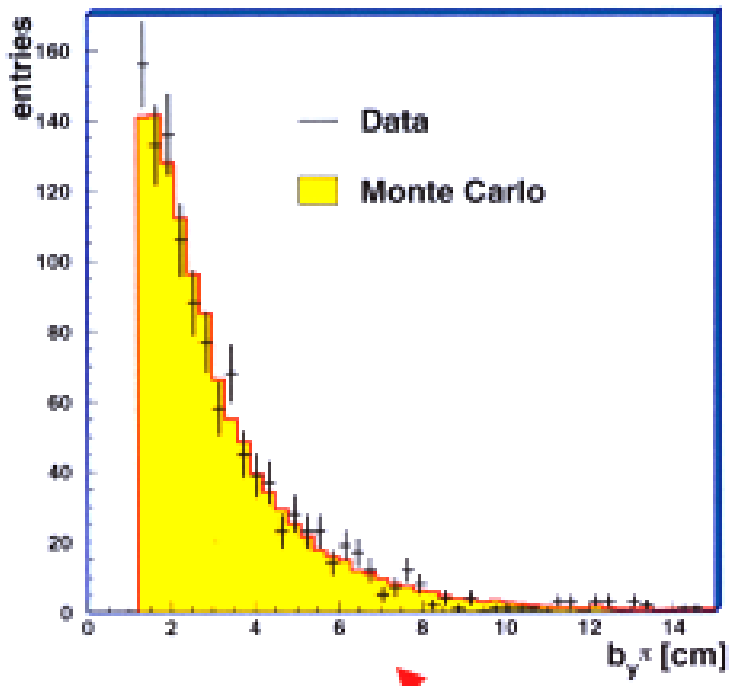


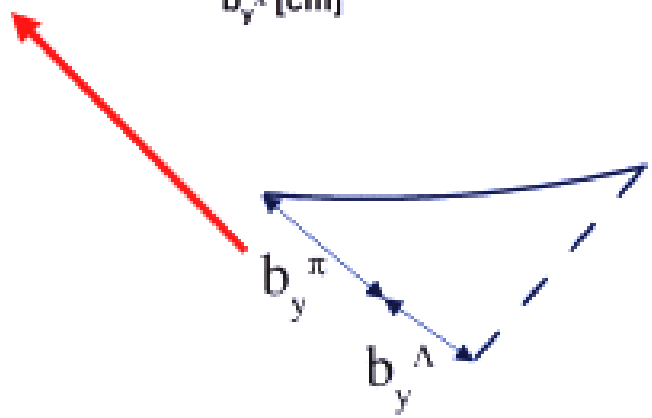
Λ decay distance



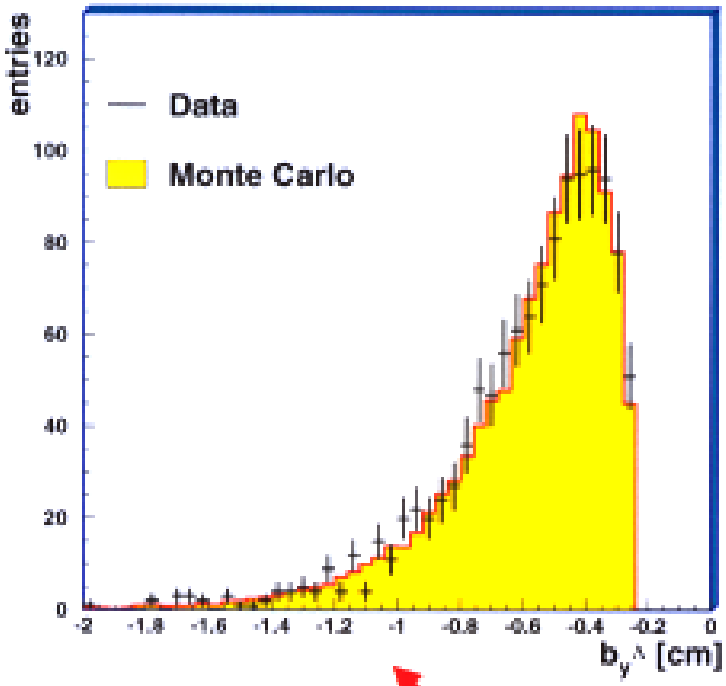


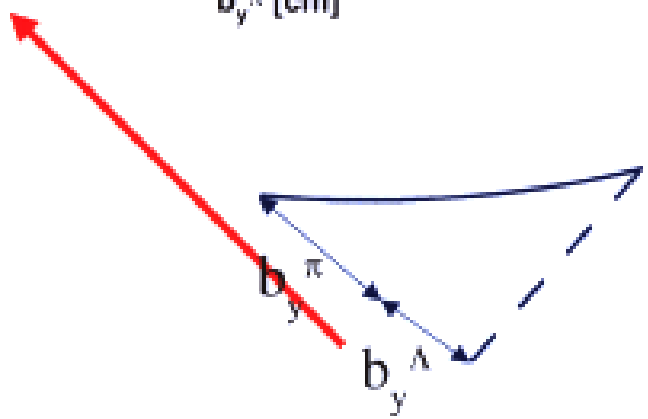
$\pi - \Xi$ impact parameter



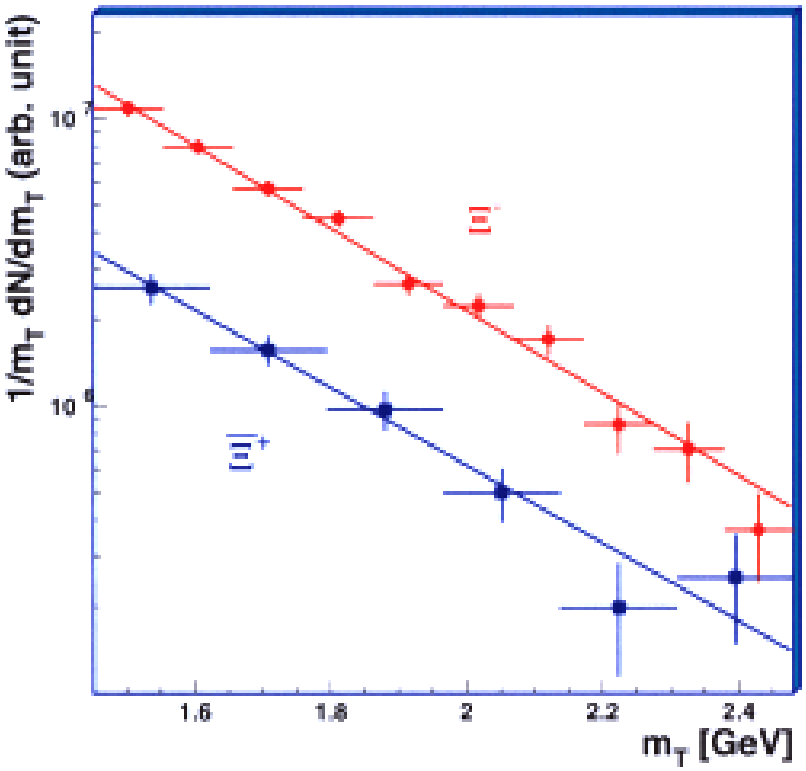


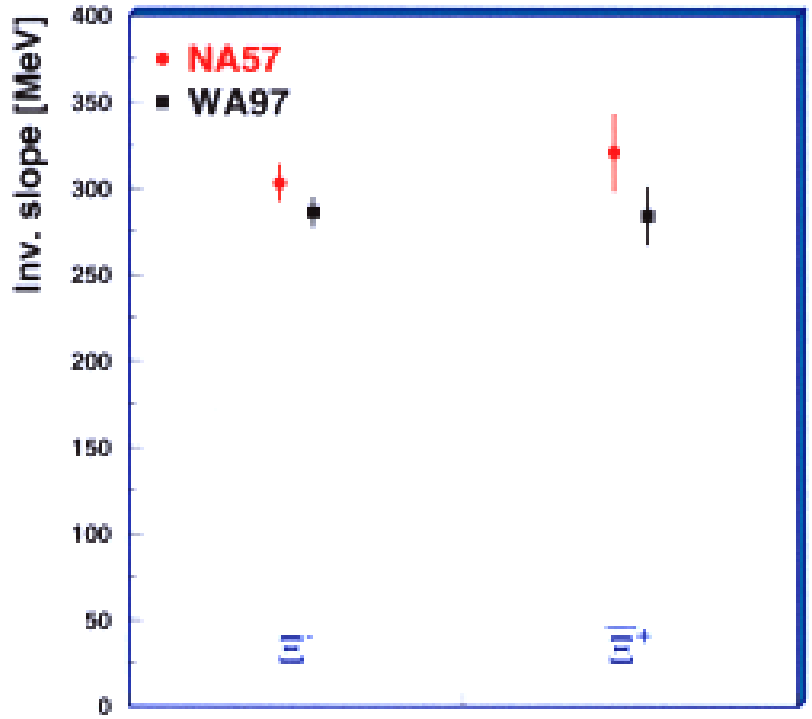
Λ−Ξ impact parameter





m_T spectra

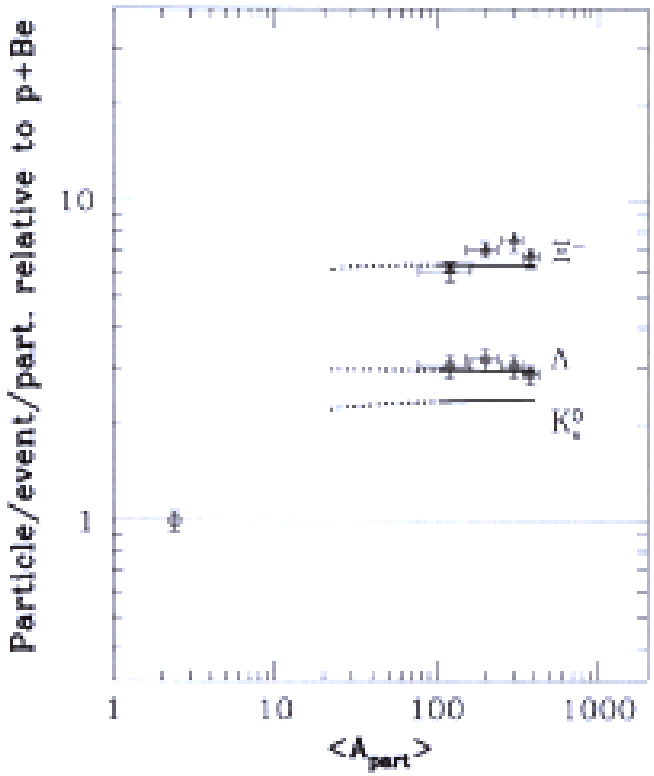


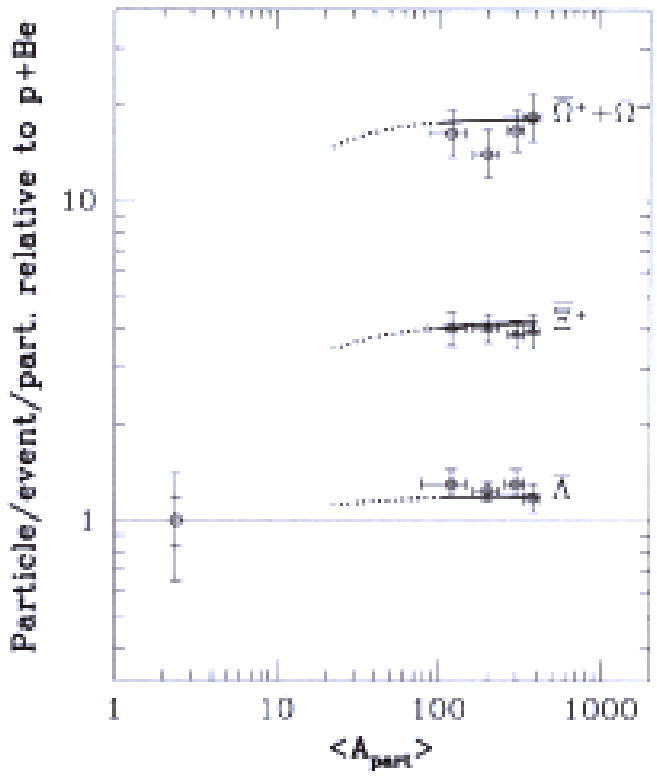


- NA57 inverse slopes compatible with WA97
- No significant variation with centrality

Statistical canonical model

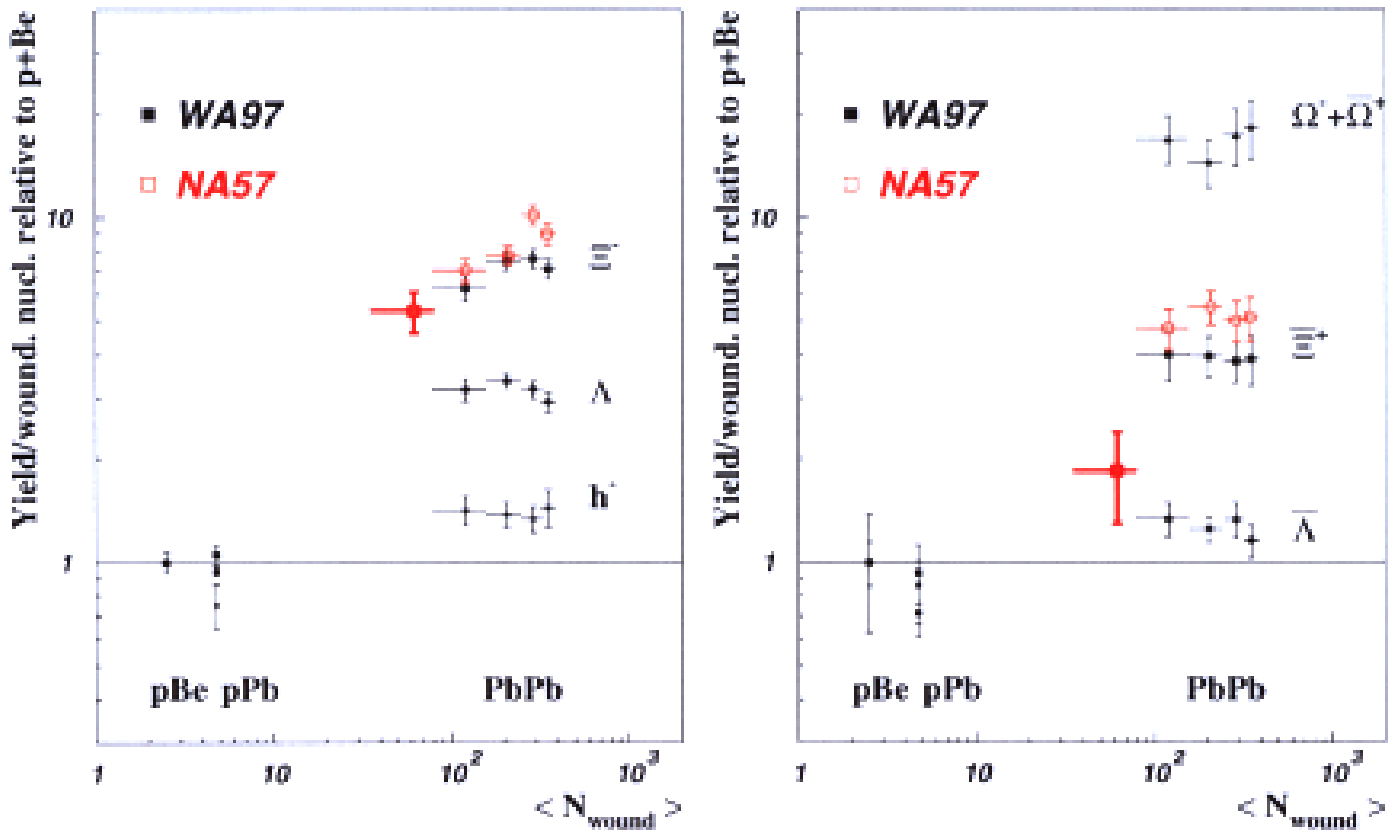
S. Hamieh, K. Redlich and A. Tounsi hep–ph/0006024



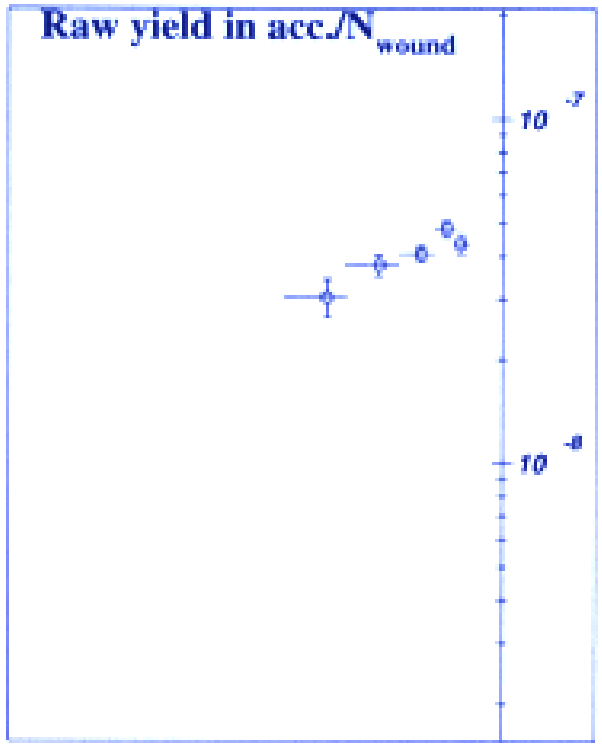


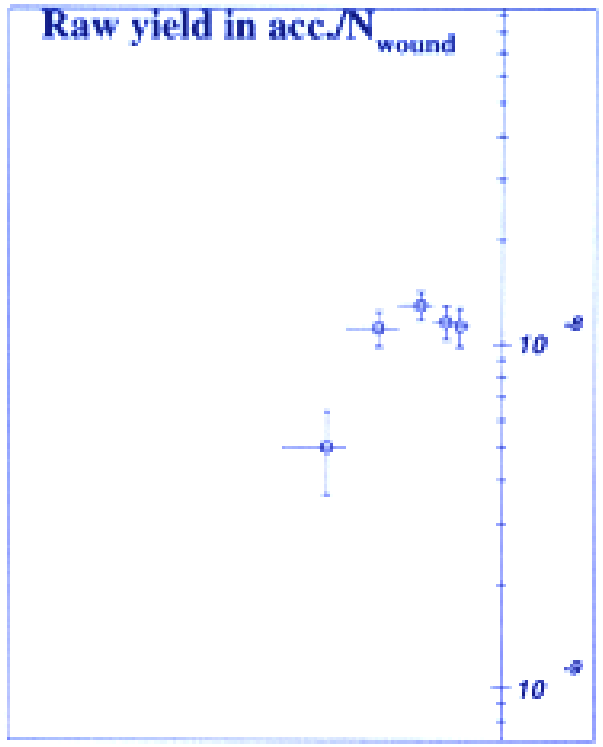
- Reproduces WA97 hyperon data
- Predicts enhancements ~saturated down to N_{wound}=20

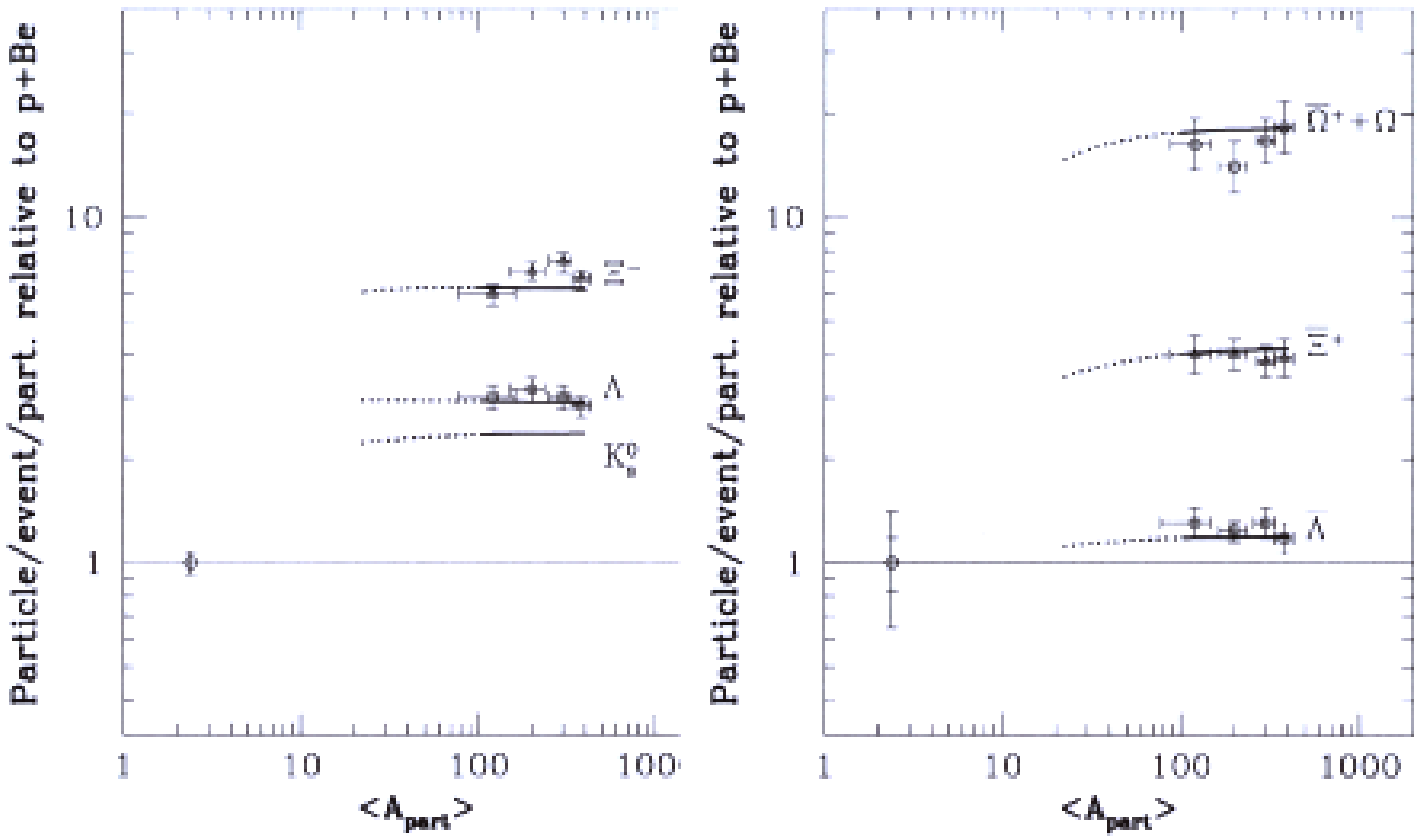
Yields per participant



- Yield per N_{wound} rises from $\langle N_{wound} \rangle = 62 \rightarrow 121$ both for Ξ^- and for $\bar{\Xi}^+$
  - 2.6 for $\bar{\Xi}^+$ (3.5 σ effect)


Raw yield in acc./N$_{wound}$
10^{-7}
10^{-8}


Raw yield in acc./N$_{wound}$
10^{-8}
10^{-9}



Particle/event/part. relative to p+Be
10
1
1
10
100
1000
<A_part>
Ξ⁻
Λ
K⁰s
Ω̄⁺ + Ω⁻
Ξ̄⁺
Λ̄

Conclusions

- 40 A GeV/c:
  - Decrease of $\bar{Y}/Y$ w.r.t. 160 A GeV/c Pb+Pb & p+Be
  - What next: yields Ξ^-, $\bar{\Xi}^+$, Λ, $\bar{\Lambda}$, K^0_s, h^-
- Pb+Pb @ 160 A GeV/c:
  - Ξ yields/participant increase for $\langle N_{wound} \rangle = 62 \rightarrow 121$ both for Ξ^- and $\bar{\Xi}^+$
    - → $\bar{\Xi}^+$ by a factor 2.6 (3.5 σ effect)
  - **QGP onset?**
- More results to come: Ω^-, $\bar{\Omega}^+$, Ξ^-, $\bar{\Xi}^+$, Λ, $\bar{\Lambda}$

Stay tuned!