Hyperon production with Σ^-, π^- and neutrons in WA89

(1993 data)

The most important features of WA89 is the strange quark in the incoming baryon and this shoud be seen in distributions of the outcoming particles.

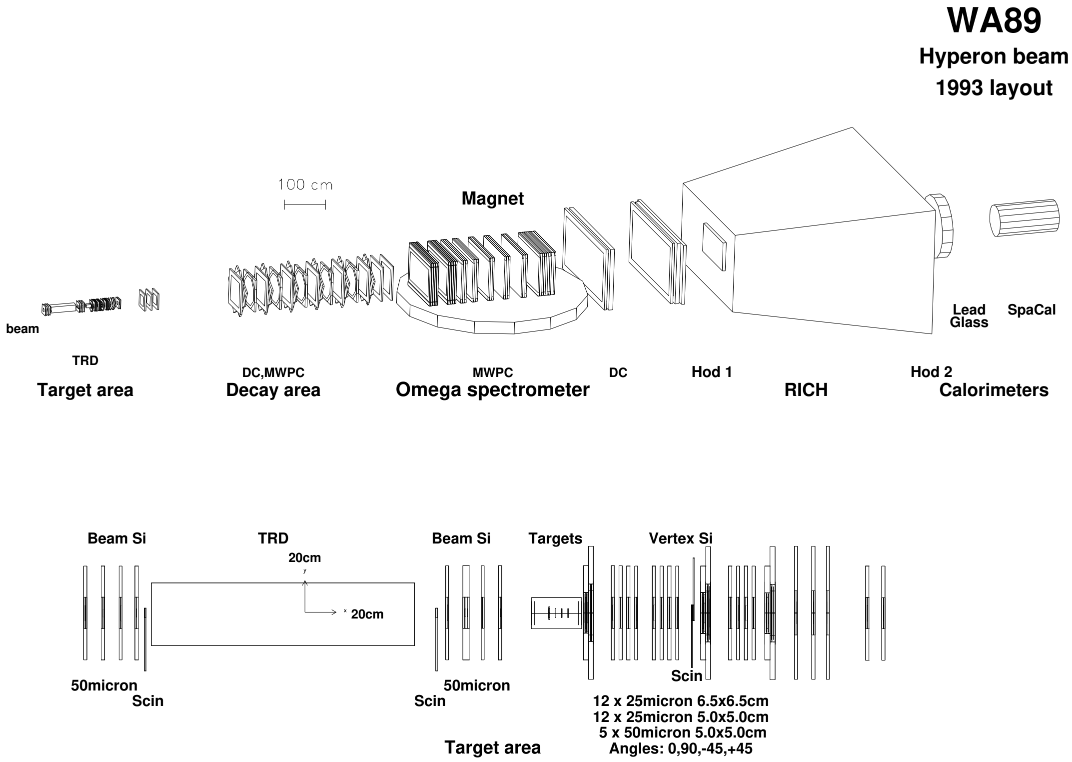
Main goals:

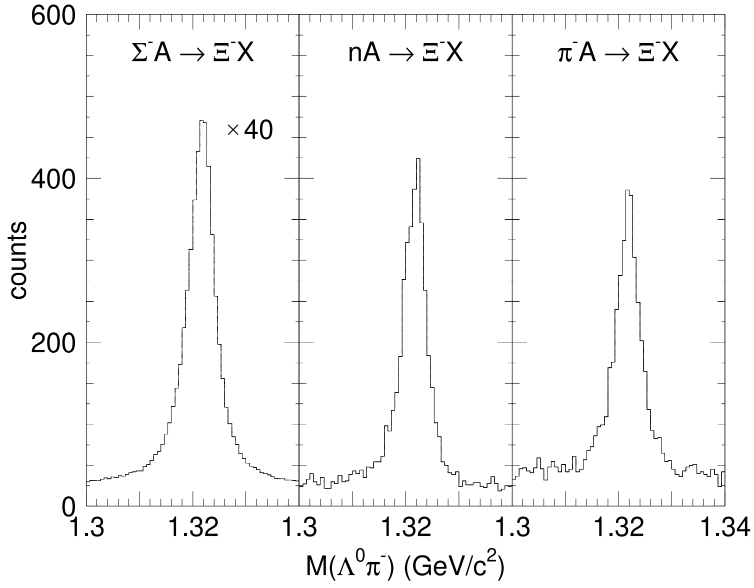
- production and properties of charmed baryons Σ_c,Ξ_c,Ω_c
- search for exotic states (hexaquark H, U(3100))
- Hyperons and hyperon resonance production (V^0 and Ξ).

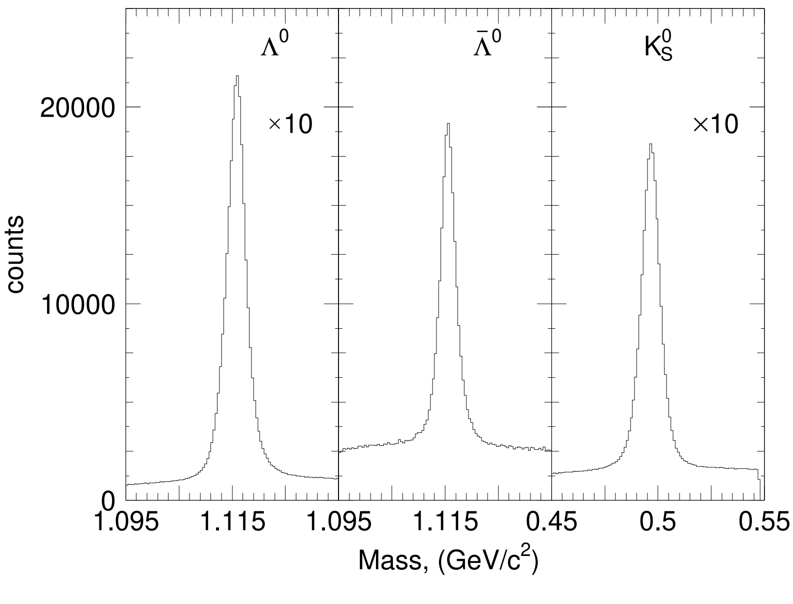
There are two ways to study the production mechanism:

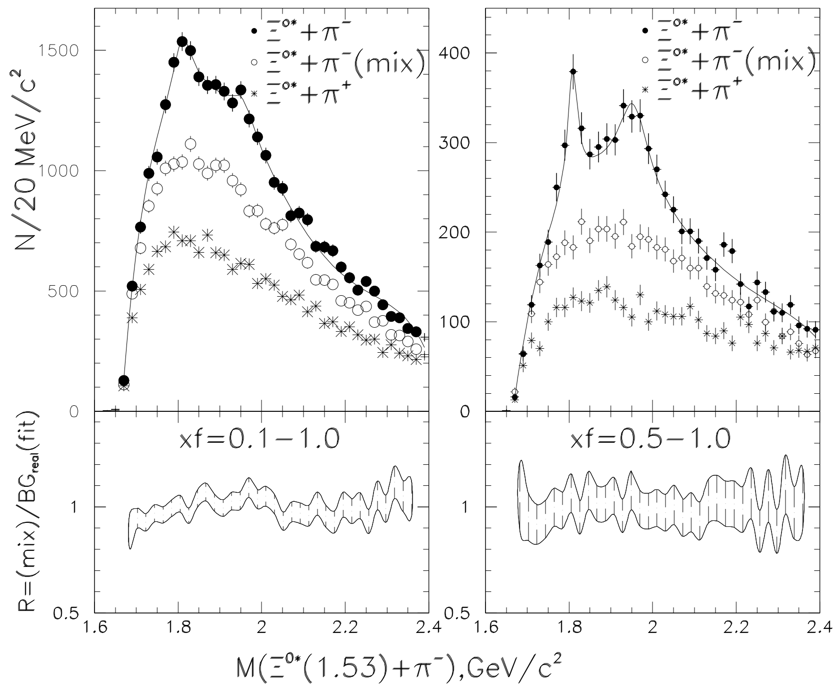
1. by asymmetries (like in the charm asymmetries)
2. production cross sections and x_F distributions for different particles.

Setup of the WA89 experiment in the 1993 run.
The lower part shows an expanded view of the target area.
Beam : Σ^- or π^- at $345 \mathrm{GeV}/c$ with momentum spread about 10%.



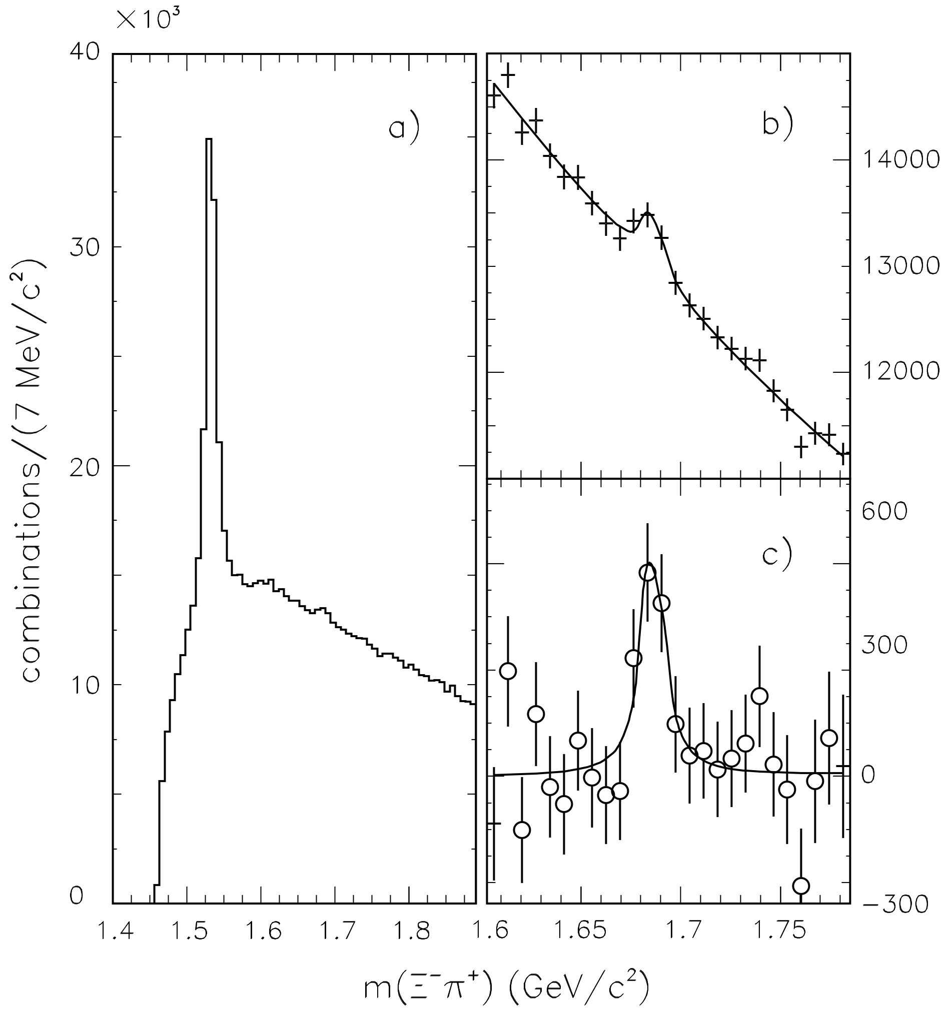

$\Sigma^{-}A \rightarrow \Xi^{-}X$
$nA \rightarrow \Xi^{-}X$
$\pi^{-}A \rightarrow \Xi^{-}X$
$\times 40$
counts
0
200
400
600
1.3
1.32
1.3
1.32
1.3
1.32
1.34
$M(\Lambda^0\pi^-)$ (GeV/c^2)


Λ^0
$\bar{\Lambda}^0$
K^0_S
$\times 10$
$\times 10$
counts
0
10000
20000
1.095
1.115
1.095
1.115
0.45
0.5
0.55
Mass, (GeV/c^2)



$\Xi^{0*}+\pi^-$
$\Xi^{0*}+\pi^-$(mix)
$\Xi^{0*}+\pi^+$
N/20 MeV/c²
R=(mix)/BG$_{real}$(fit)
xf=0.1-1.0
xf=0.5-1.0
M(Ξ^{0*}(1.53)+π^-),GeV/c²

The $\Xi^0_{1690} \rightarrow \Xi^-_{1320}\pi^+$ decay mode.



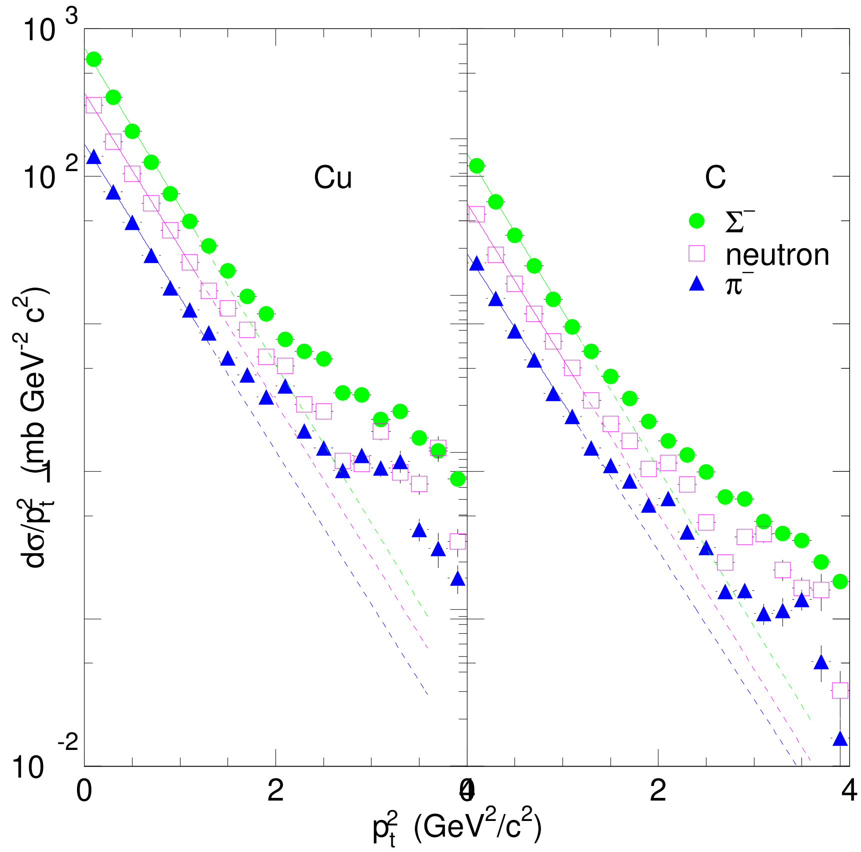
Signal	:	N $= 1400 \pm 300$
Mass	:	$M = 1686 \pm 4$ MeV$/c^2$
Width	:	$\Gamma = 10 \pm 6$ MeV$/c^2$
$\sigma \cdot BR(\Xi^0(1690) \rightarrow \Xi^-\pi^+)$	:	$(6.8 \pm 0.2)\mu b$

cross section per nucleon

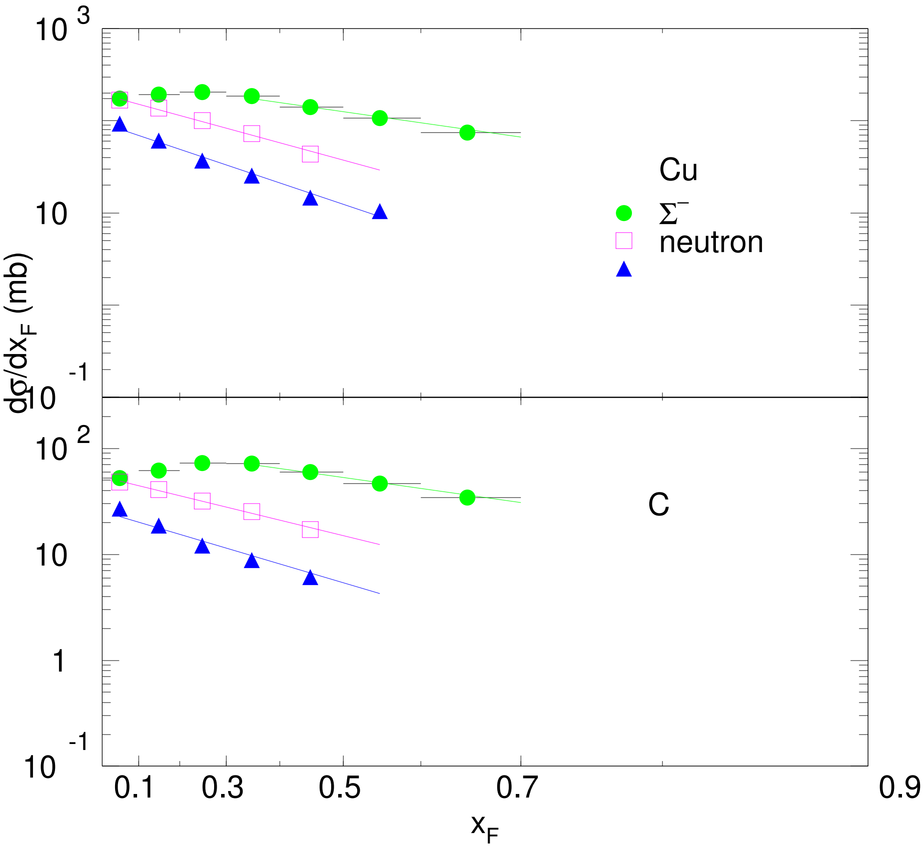
As a point of reference, we parametrized the observed invariant cross sections by a function of the form

$$\frac{d^2\sigma}{dp_t^2 dx_F} = C(1 - x_F)^n \cdot exp(-bp_t^2)$$

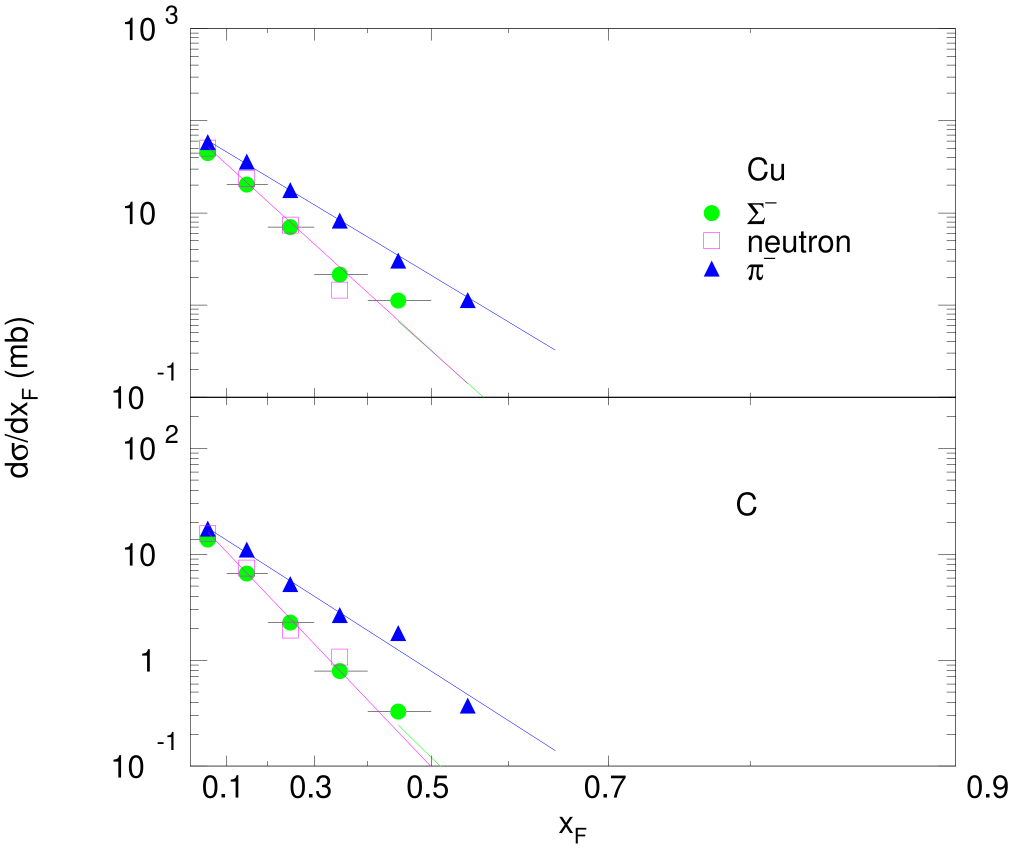
which is based on quark counting rules and phase space arguments. The three parameters C, b, and n were assumed to be independent of p_t and x_F.



The differential production cross section of Λ^0 as a function of p_t^2.



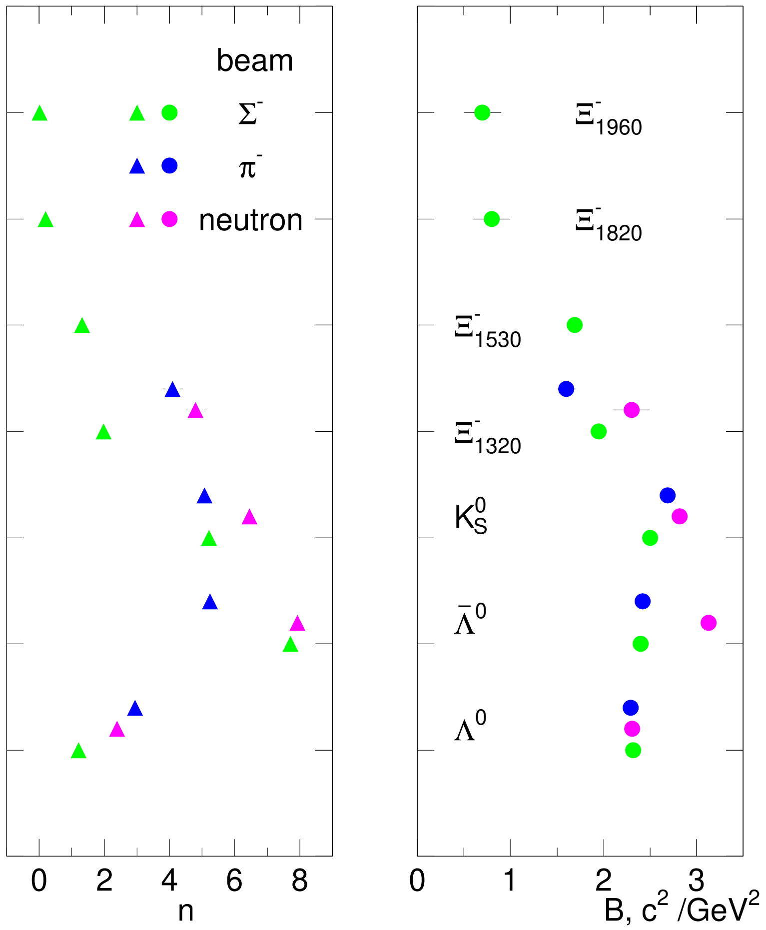
The differential production cross section of Λ^0 as a function of x_F.



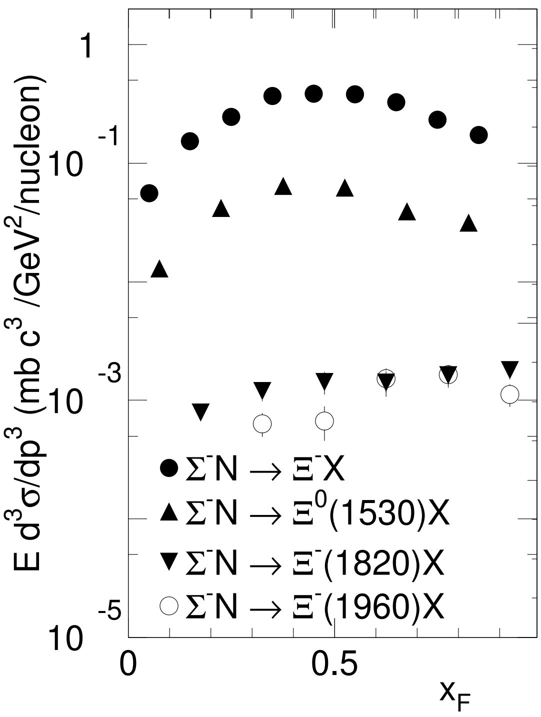
The differential production cross section of $\overline{\Lambda}^0$ as a function of x_F.

The cross section parametrisation:

$$\frac{d^2\sigma}{dp_t^2 dx_F} = C(1 - x_F)^n \cdot exp(-Bp_t^2)$$

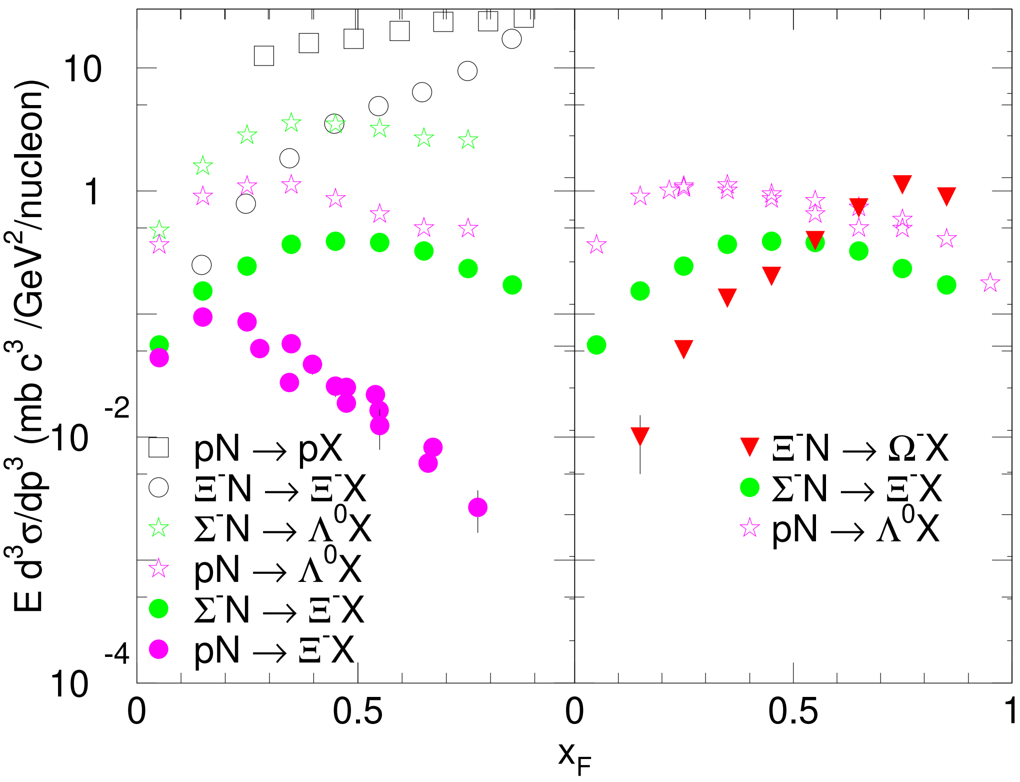


Ξ hyperons production: Ξ^0_{1530}, Ξ^-_{1820}, Ξ^-_{1960}.



The higher exited state - the flatter differential cross section along x_F, and wider p_t^2 distribution.

Hyperons production in different beams : proton/neutron, Σ^- , Ξ^-.



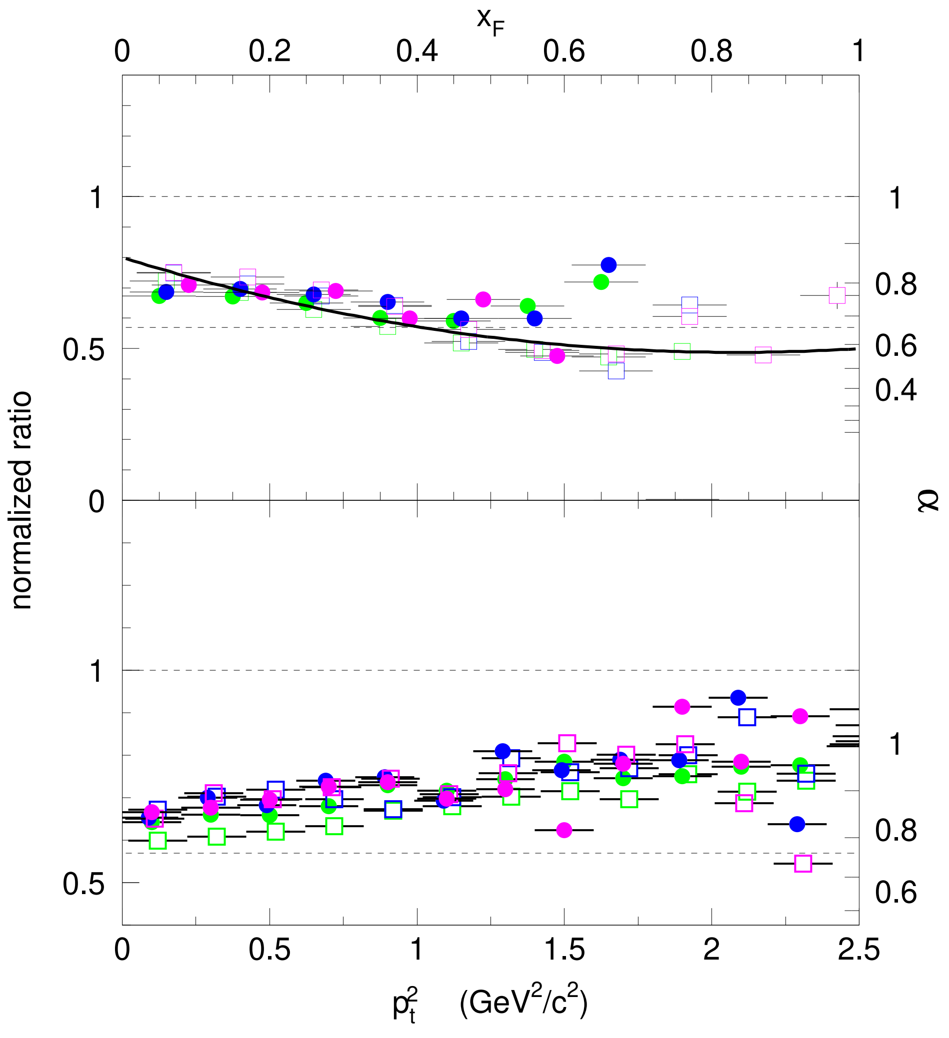
At small x_F cross section does not depend of the beam particle type. At high x_F the cross section depends of how many common quarks have the beam and a product particles.

The A dependence of hyperons production in different beams.

The conventional parametriszation for the A dependence is:

$$\sigma = \sigma_0 \cdot A^{\alpha}$$

The A dependence shows the same decrease of α with x_F as observed in other hadron beam experiments(solid curve) and increase of α with p_t^2. We are seen that α =2/3 favoured over α=1.



CONCLUSION

1. The existence of the $\Xi^0_{1690)}$ was confirmed by observation of a new decay mode. This state is unexplained in relativistic quark potential model and in chiral boson exchange interaction model.

2. It was shown that in the central region the initial strangeness content in the projectile is not relevant for the production of hyperons and all strange quarks contained in the hyperons are produced in the fragmentation process.
   On the other hand, in the projectile fragmentation region the cross sections depend strongly on the overlap of the quark content between the projectile and the produced particle.

3. At p_t values above 1 GeV/c, the cross-section for hyperon production shows a marked increase compared to the usually observed Gaussian behaviour of $d\sigma/dp_t^2$, which indicates that a different production process becomes important.

4. The A-dependence of the hyperon production does not sensitive to the strangeness in the beam particle. It shows the same behavour observed in other hadron beam experiments and α =2/3 favoured over α=1.

5. There is now a wealth of hadroproduction data with variation of strangeness in beam and produced particle.
   A COHERENT DESCRIPTION/PARAMETRIZATION IS STILL MISSING.