Selex (E781) results on Ω_c^0

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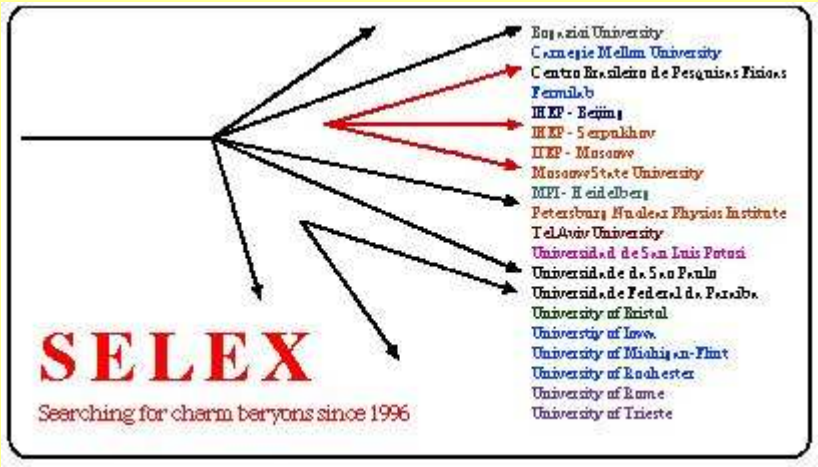
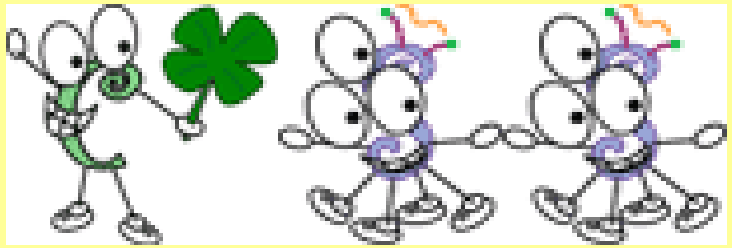
on behalf of Selex





OUTLINE

- Ω_c^0 mass
- Measurement of $(\Omega_c^0 \rightarrow \Omega^-\pi\pi\pi)/(\Omega_c^0 \rightarrow \Omega^-\pi)$ branching ratio
- Ω_c^0 production
- $\tau(\Omega_c^0)$ (preliminary result)
- Conclusions

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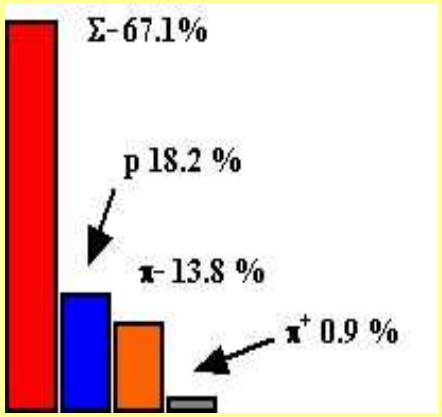
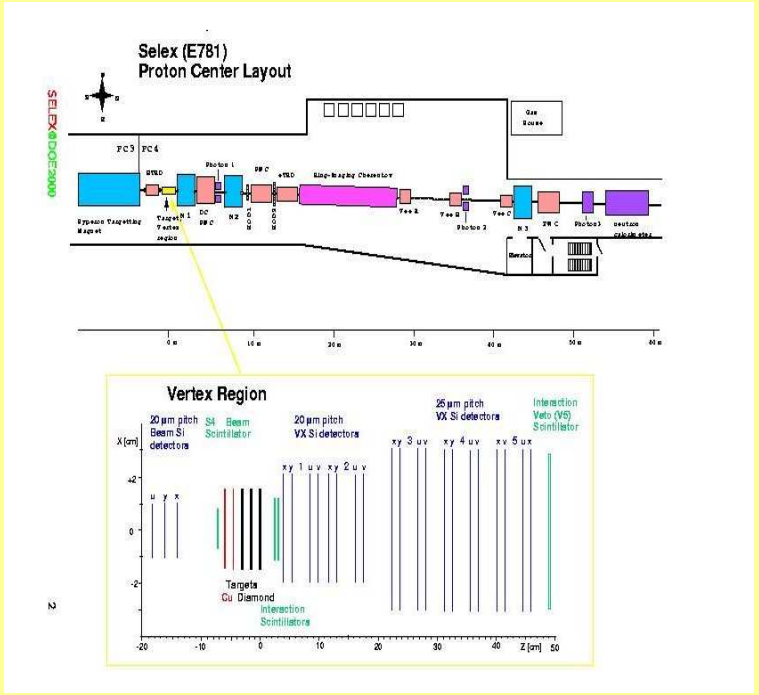
The SELEX spectrometer

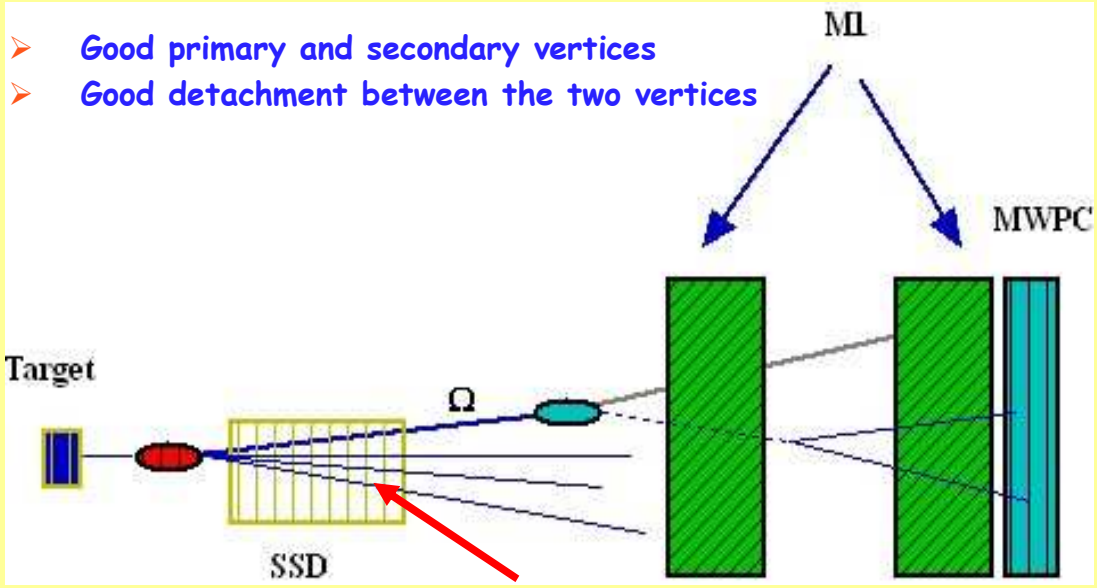
- Segmented target (2Cu and 3C)
- High precision vertex detector σ_{prim}=270μm, σ_{sec}=550μm
- Particle identification: 2σ,K/π separation up to 165 GeV/c
- Typical Lorenz Boost ~100
- 15 billion interactions taken with 600 GeV/c Σ^-/π^- beam and 550 GeV/c p





Hyperon reconstruction $\Sigma^{\pm}$, $\Omega^{\pm}/\Xi^{\pm}$

- Good primary and secondary vertices
- Good detachment between the two vertices



Silicon linked tracks

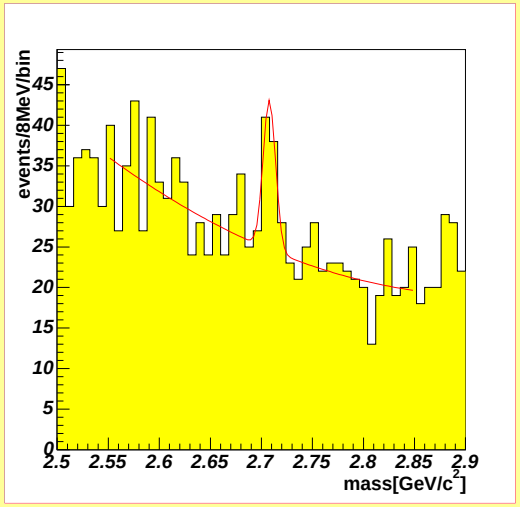
$\Sigma^+ \rightarrow p\pi^0$

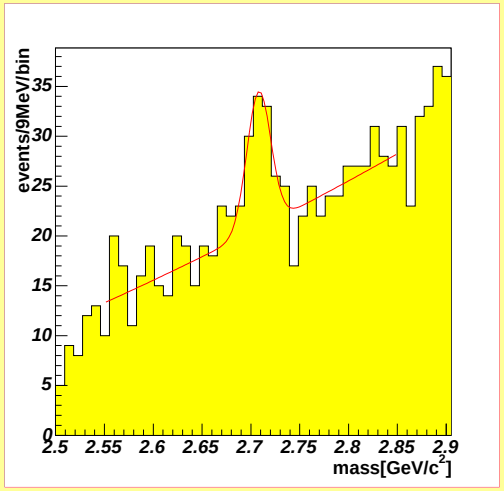
- Hyperon vx (and m1) segment
- Daughter must have m1(m2) segment
- Z_{kink} known $\rightarrow$ $P^2_x=(P^2_{hyperon} - P^2_{daughter})$

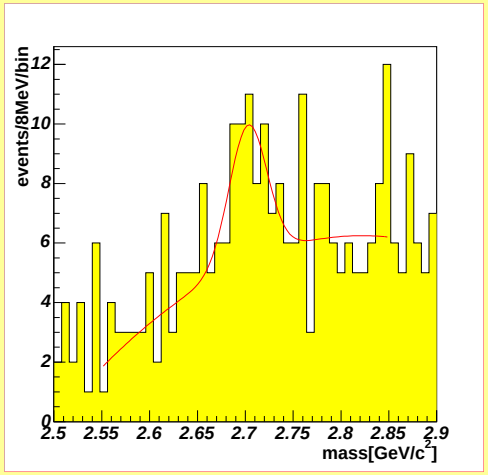
- SSD information are used
- Λ^0 reconstructed only in p,π mode

- ✓ $\Omega^- \rightarrow \Lambda K^-$
- ✓ $\Lambda \rightarrow p\pi$ always reconstructed
- ✓ by at least one of
- ✓ (vx+m1) and/or m2 segments
- ✓ K identified by Cerenkov

Ω_c^0 sample







$\Omega_c^0 \rightarrow \Omega^-\pi$

Signal 35 ±12

$\Omega_c^0 \rightarrow \Omega^-\pi\pi\pi$

signal 44± 14

$\Omega_c^0 \rightarrow \Xi^-K\pi\pi$

signal 28± 12

L/σ>6 ,X^2 <20

transverse distance>2.5σ

Each decay track to Kink

must have t<300μm @kink vertex

Total sample 107 ± 22 evts

S/√B= 6.6 ±1.5

Daughter K prob >π,p

$\Omega_c^0 \rightarrow \Omega^-\pi$:

P_π >12. GeV/c

$\Omega_c^0 \rightarrow \Omega^-\pi\pi\pi$:

$p_{t3\pi}$ >0.35 GeV/c

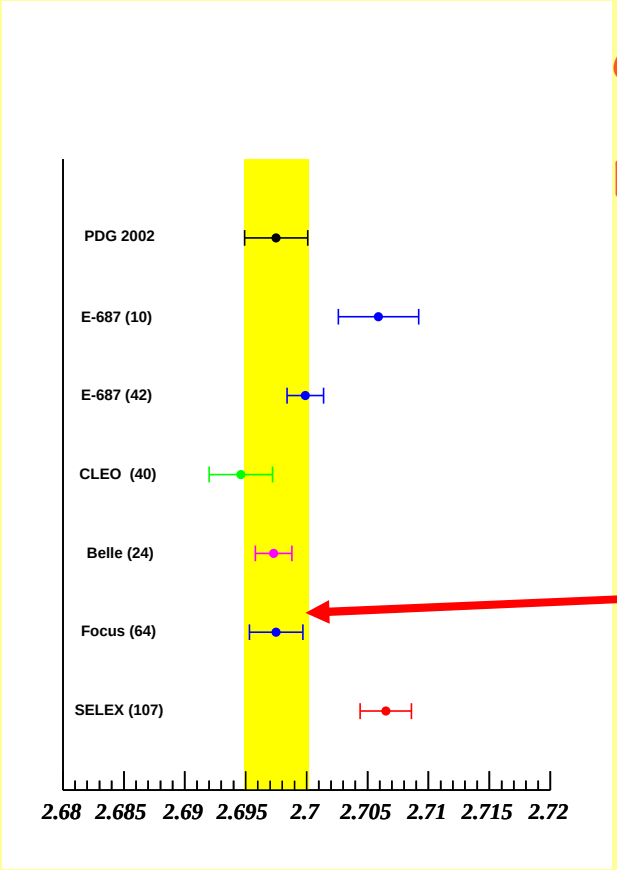
The Ω_c^0 mass

	Mass (MeV/c^2)	Signal	
• $\Omega_c^0 \to \Omega^- \pi\pi\pi$	2708.0 ± 4.5	44 ± 14	used for
• $\Omega_c^0 \to \Omega^- \pi$	2707.1.± 2.4	35 ± 12	lifetime
• $\Omega_c^0 \to \Xi^- K\pi\pi$	2702.8 ± 8.0	28 ± 12	

- No dependence of mass value on momentum is found
- corrected mass value (preliminary):

SELEX	2706.5 ± 2.1+1.2	107 ± 22 events

Ω_c^0 mass summary



- Recent measurements:

FOCUS (PLB 2003) 2697.5 .± 2.2
64±14 $\Omega^-\pi$, Ξ^- $K\pi\pi$

CLEO 2000 2694.5 .± 2.6 ± 2.4
40±9 $\Omega^-\pi$,$\Xi^-K\pi\pi$,$\Omega^-\pi\pi$

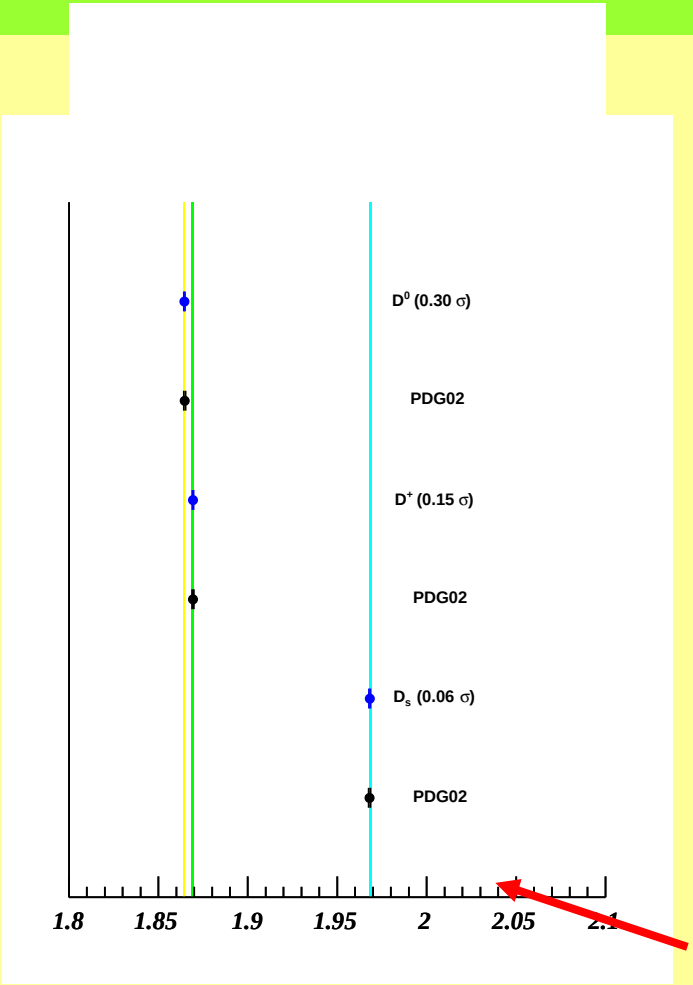
Belle 2001 2697.3 ± 1.5
24 Ω^- π

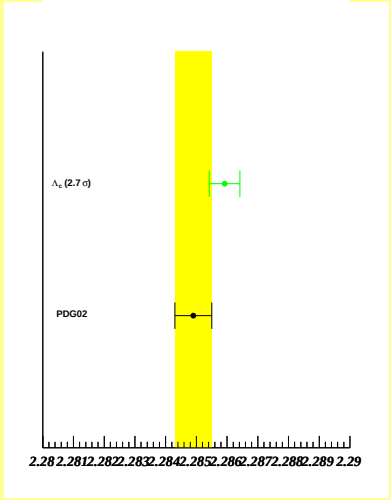
Comparing to PDG2002
2697.5 ± 2.6 MeV/c^2 is
2.7 σ

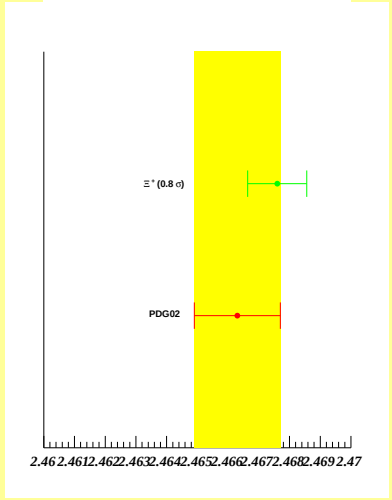
Not yet in PDG

- $\Xi^{\pm}_c$ mass =2467.6 ± 1.0 MeV/c^2
  PDG02 2466.3 ± 1.4 MeV/c^2
  → 0.8σ

Charm meson and b[illegible]s in [illegible]







Λ^+_c Ξ^+_c

Selex measurements are in very good agreement with PDG

Charm meson masses

Measurement of $(\Omega_c^0 \to \Omega^-\pi\pi\pi)/(\Omega_c^0 \to \Omega^-\pi)$ branching ratio

Theoretical motivation:complicated dinamics for charm baryon decays i.e. resonances in the final state

Acceptance after cuts $(5.8\pm 0.3)\ 10^{-4}$ $\Omega^0_c \to \Omega^-\pi\pi\pi$

$(9.4\pm 0.2)\ 10^{-4}$ $\Omega^0_c \to \Omega^-\pi$

Using $(1-x)^n$ and n=0

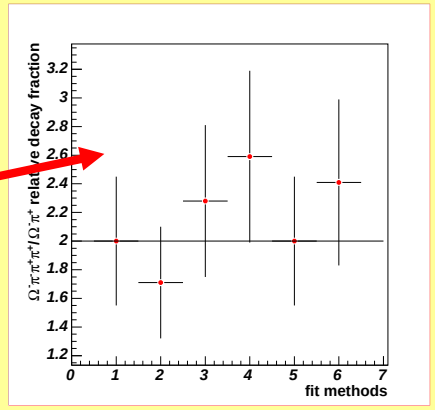
Relative BR $(\Omega^0_c \to \Omega^-\pi\pi\pi)/(\Omega^0_c \to \Omega^-\pi) = 2.13 \pm 0.45 \pm 0.30$

- BR varies of 2.3% if n=3

We fit the signal with Gaussian

and polynomial for bck

from mass fits → different polynomial order



Ω_c^0 Production

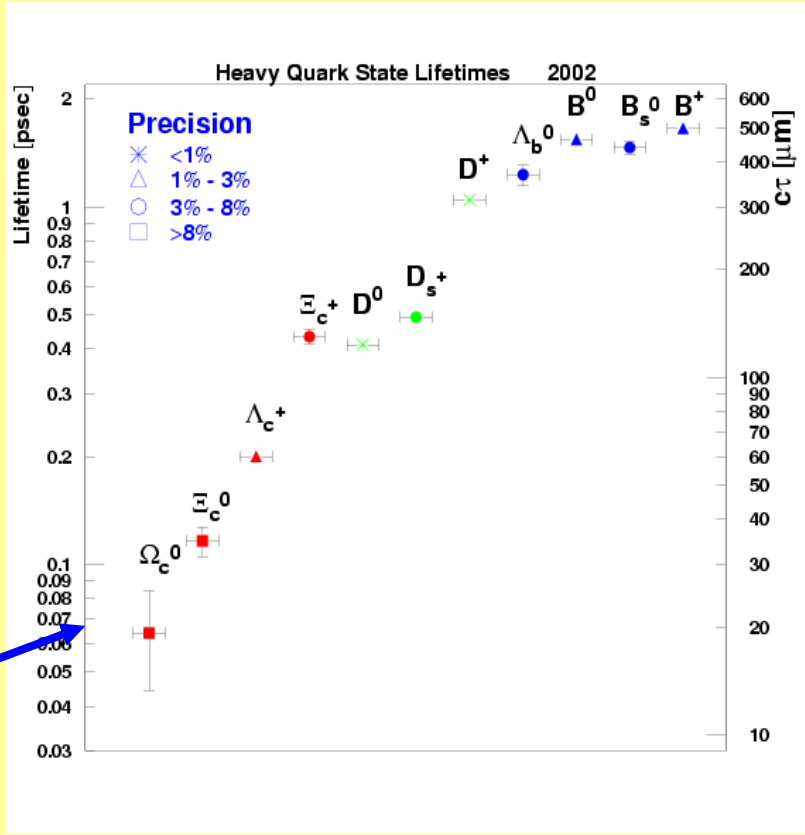
The valence quarks are relevant for the charm production, as Selex measured in D(cs) meson and Λc (udc) production. (Phys.Lett.B B558 2003 34 and 528 2002 49)

- The ratio Σ-(dds)/π(ud) for Ω^0_c (ssc) production favours the Σ- beam

Σ^-	D_s^-	Λ^+_c	Ω^0_c
<p>GeV/c	150	220	250
<x>	0.35	0.5	0.5
n	4.1+-0.3	2.45+0.18	

Ω_c^0 lifetime

- The hadronic partial width,Γ has contibutions from mechanism other than spectator:
- $\Gamma(\Omega^0_c) = \Gamma_{spec} + (10/3)\,\Gamma^+$
- Probe into non perturbative sector of heavy quark decay
- Need lifetime at 10% to quantify that
- expected hierarchy



Ω_c^0 lifetime measurement technique

- Reduced proper time used to minimize the acceptance correction $t=(L-N\sigma)/\beta\gamma c$ where N is the detachment, N=6
- Proper time resolution $\rightarrow$ 20 fs
- binned likelihood method
- The expected number of events in each t bin is:

$$N_s\,(1-\alpha)\,f(t)\tau^{-1}\,e^{-t/\tau} + \alpha N_s\,\{\beta\tau_1^{-1}e^{-t/\tau_1}+(1-\beta)\tau_2^{-1}e^{-t/\tau_2}\}$$

signal

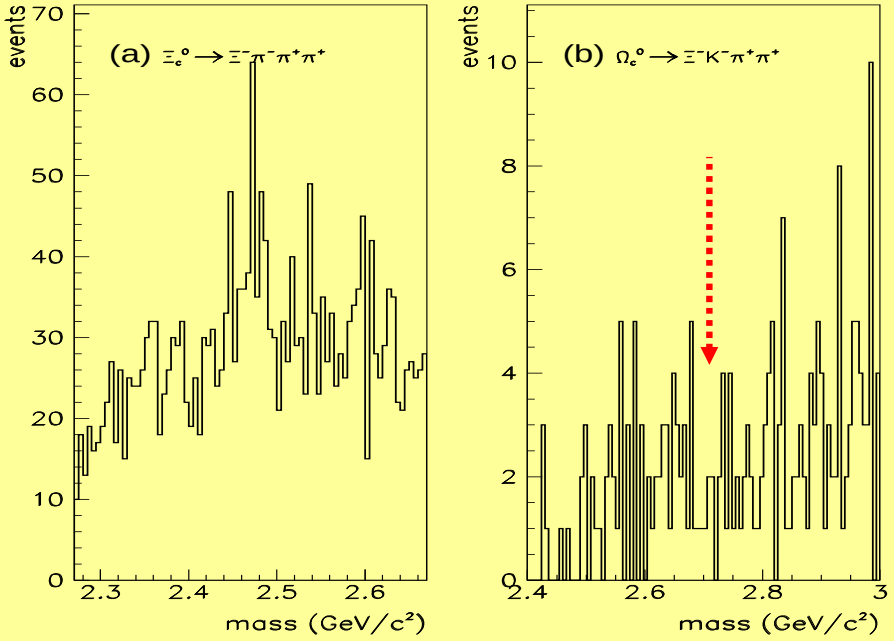
Background, 2exps

We maximize likelihood function

fit parameters are α,β,τ, τ_1 and τ_2

Ω_c^0 purity

- No charm reflection background from Ξ^0_c to Ω_c^0

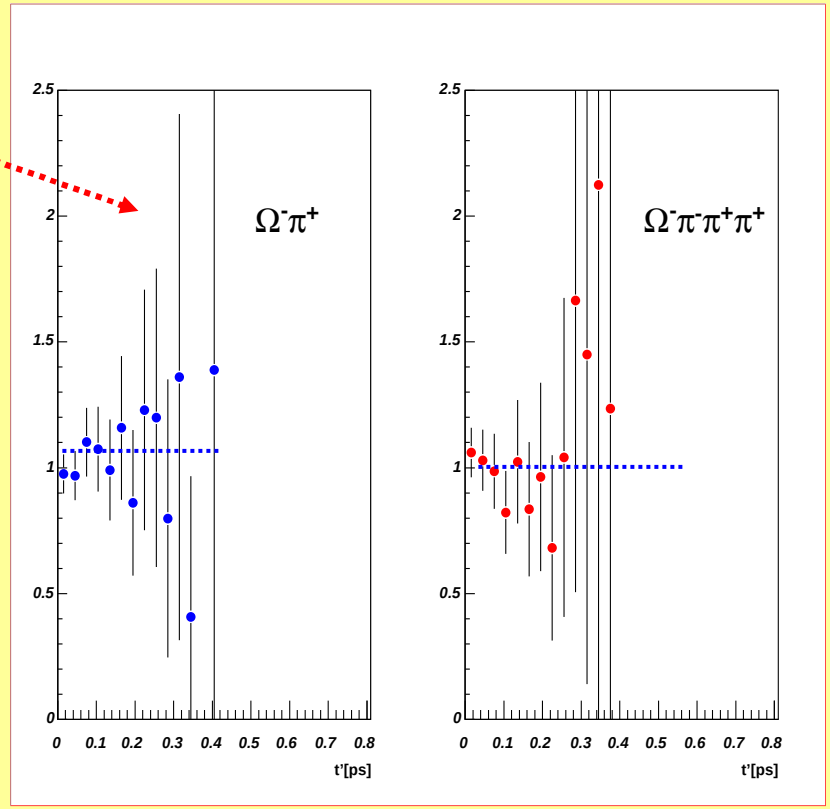


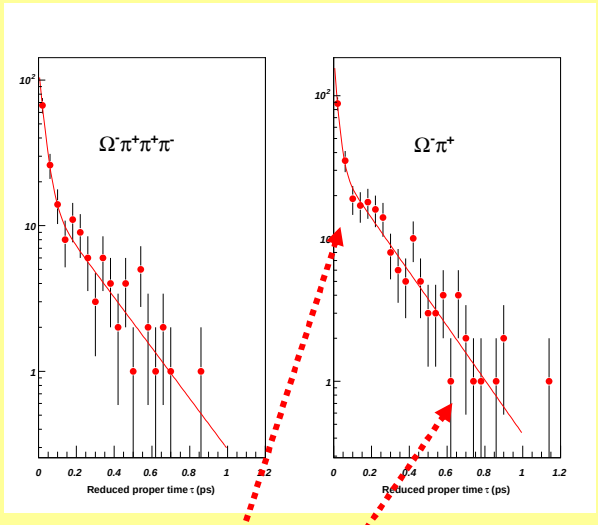
$\Xi^0_c \to \Xi\pi\pi\pi$ $\to \Omega\pi\pi\pi$

Preliminary

Ω_c^0 lifetime measurement

f(t) correction functions





Sidebands background behaviour:

Short lifetime Bck 25fs → strong decays

Long lifetime Bck 300 fs → other charm and strange decays

Preliminary

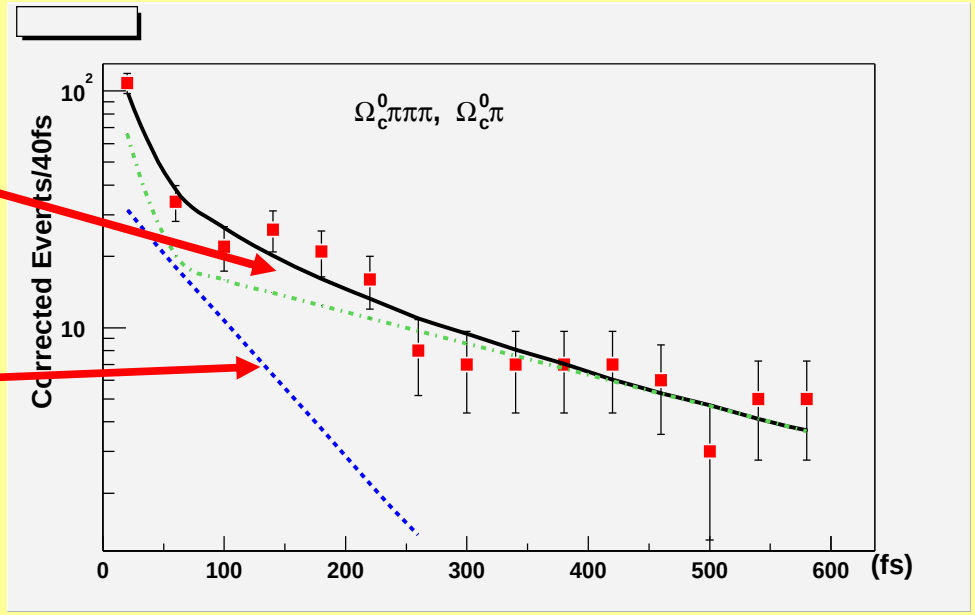
Lifetime fit for combined signals $\Omega^-\pi$,$\Omega^-\pi\pi$

Signal 79±12 events

The Fit finds 76±10

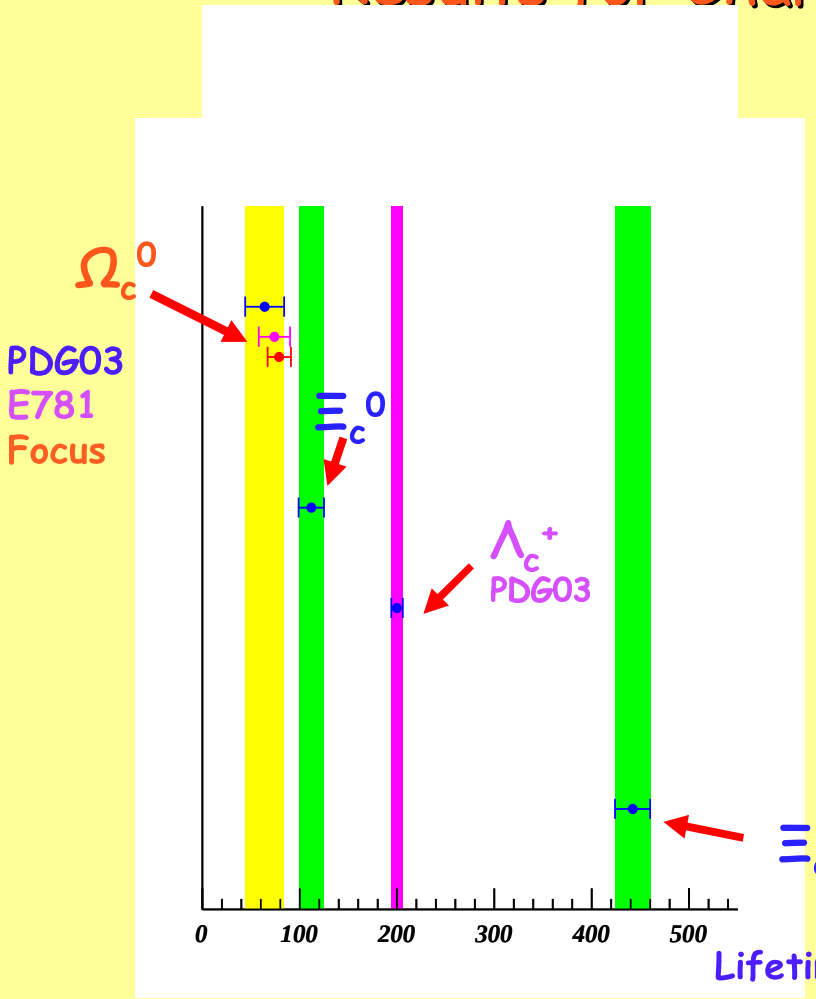
Predicted Background

$\tau(\Omega^0_c)$=74±16 fs



We have no yet performed the analsysis of systematic errors

Results for Charm Baryon lifetimes



$\tau(\Xi_c^0)/\tau(\Omega_c^0) = 1.5 \pm 0.3$
Theory predictions ~1

$\tau(\Xi_c^+)/\tau(\Lambda_c^+) = 2.15 \pm 0.13$
Theory predictions: 1.2-1.7

$T(\Omega^0_c)/\tau(\Lambda c+) = 0.38 \pm 0.08$
Theory predictions: 0.28-0.29

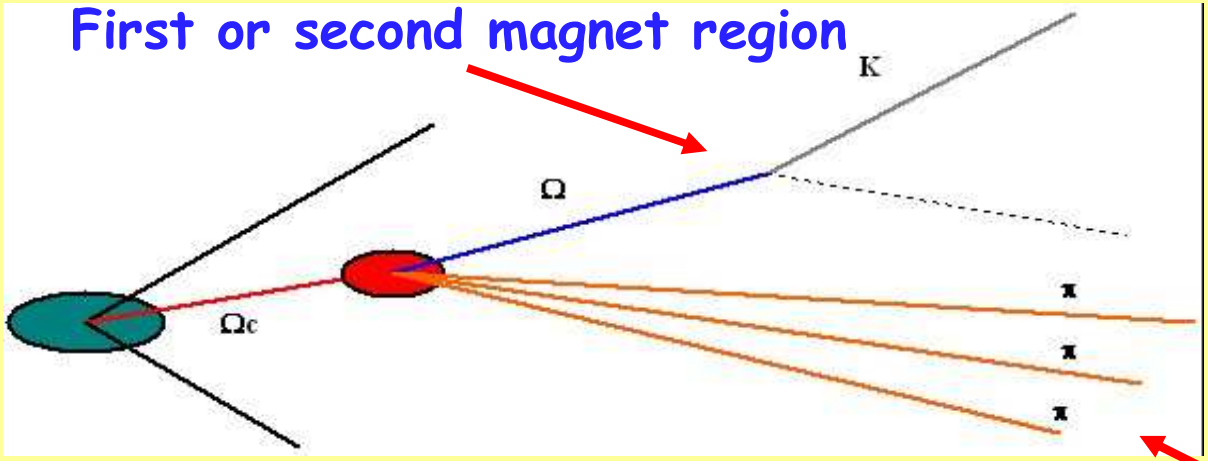
Conclusions

- ✓ Selex has detected the largest Ω_c^0 sample in 3 different decay modes :
  $\Omega_c^0 \rightarrow \Omega^- \pi\pi\pi$, $\Omega^- \pi$, $\Xi^- K\pi\pi$
- ✓ the combined mass is 2706.5 ± 2.1 ± 1.4 MeV/c^2
- ✓ relative branching ratio: 2.13± 0.45 ± 0.3
- ✓ Preliminary $\tau(\Omega_c^0)$= 74±16 fs

- backup

Search strategy

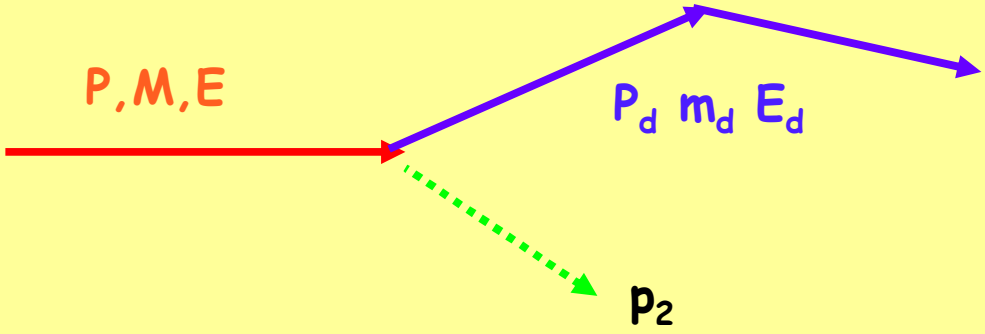
Typical event topology



Good primary and secondary vertices
Good detachment between the two vertices
Minimum momentum cut on π
Pid on decay tracks and on charged Ω- daughters

Silicon linked track

Kink algorithm



$P_2 = P - P_d \rightarrow (P_x - p_{dx}, P_y - p_{dy}, P_z - p_{dz})$

$P_x = aP$, $P_y = bP$, $P_z = cP$

$p_{dx} = \alpha p_d$, $p_{dy} = \beta p_d$, $p_{dz} = \lambda p_d$

$E_2^2 = (E - E_d)^2 = p^2_2 + m^2_2$

$(M^2 + m^2_d - m^2_2) + 2(P_x p_{dx} + P_y p_{dy} + P_z p_{dz}) = 2EE_d \rightarrow$ we find P

Check using Ω^-

- We checked the Ω^- lifetime
- 100<zkink<200cm
  downstream the target

- Same lifetime in the signal
  and side-bands regions

corrected lifetime in progres