New mesurement of the branching ratio of the decay $\Xi^0 \to \Sigma^0\gamma$

A.Zinchenko
JINR, Dubna

NA48 collaboration
(Cagliari, Cambridge, CERN, Dubna, Edinburg, Ferrara, Firenze, Mainz, Orsay, Perugia, Pisa, Saclay, Siegen, Torino, Vienna, Warsaw)

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Radiative Decays $\Xi^0 \to \Lambda^0\gamma / \Sigma^0\gamma$

Theoretical understanding poor:

Variety of models $\longrightarrow$ Predictions vary over an order of magnitude.

Experimental data not conclusive:

Br($\Xi^0 \to \Lambda^0\gamma$):

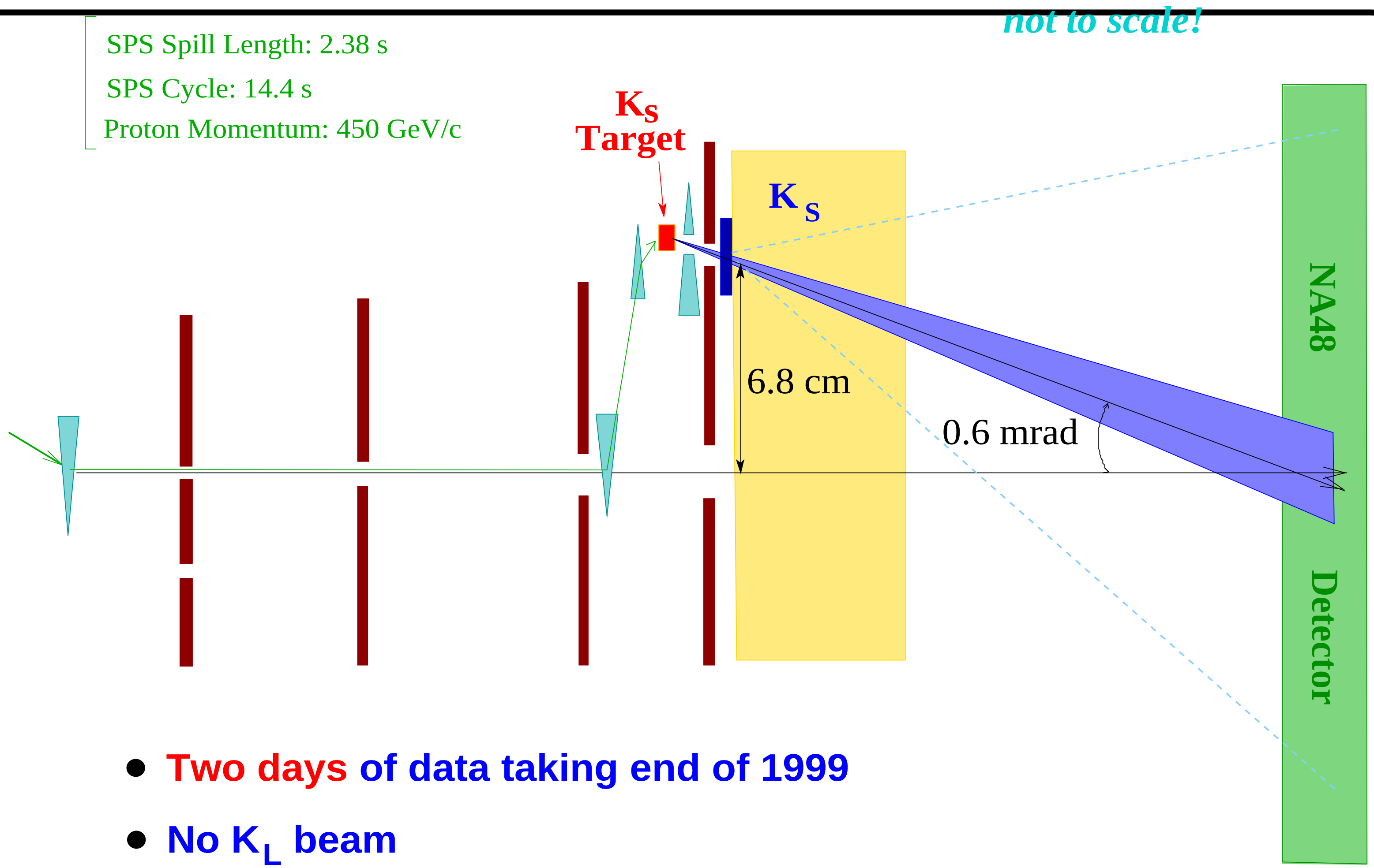
Fermilab (1990): $(1.06 \pm 0.16) \times 10^{-3}$

NA48 (1997 data): $(1.9 \pm 0.4) \times 10^{-3}$

Br($\Xi^0 \to \Sigma^0\gamma$):

Fermilab (1989): $(3.6 \pm 0.4) \times 10^{-3}$

NA48 (1997 data): $(3.1 \pm 0.8) \times 10^{-3}$



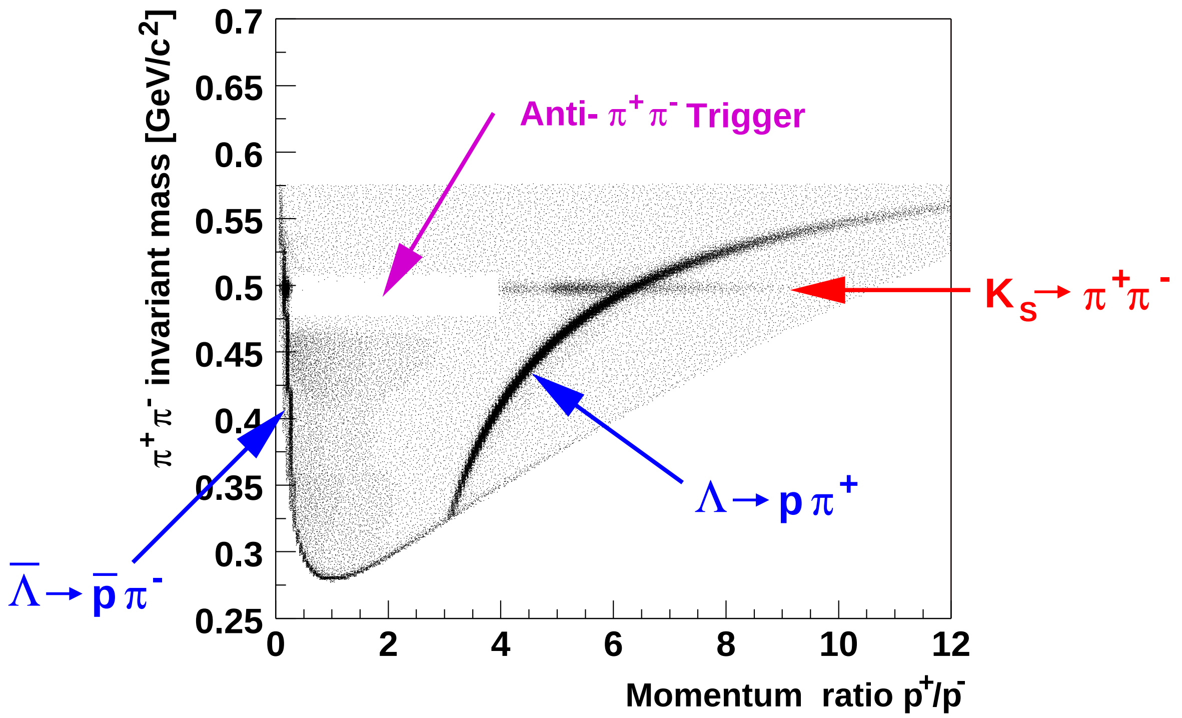
- Two days of data taking end of 1999
- No K_L beam
- 7 x 10^9 protons per spill on K_S target (200 times ε'/ε intensity)

Trigger Conditions

Hyperon trigger:

- Two tracks (one positive, one negative)
- "Anti $K_s \to \pi^+\pi^-$" trigger:

Combined cut on kaon mass and momentum ratio $p_+ p_-$.



- 41×10^6 2-track events
- 17×10^6 $\Lambda^0 \to p\pi^-$ events
- 2×10^6 $\bar{\Lambda}^0 \to \bar{p}\pi^+$

Hyperon selection

Charged tracks

- Two tracks form vertex
- Time difference $<$ 4.5 ns

Photons and π^0's:

- γ's well separated from tracks
- Time difference to tracks $<$ 3 ns
- $|m(\gamma\gamma) - m(\pi^0)| < 10MeV/c^2(\approx 3\sigma)$

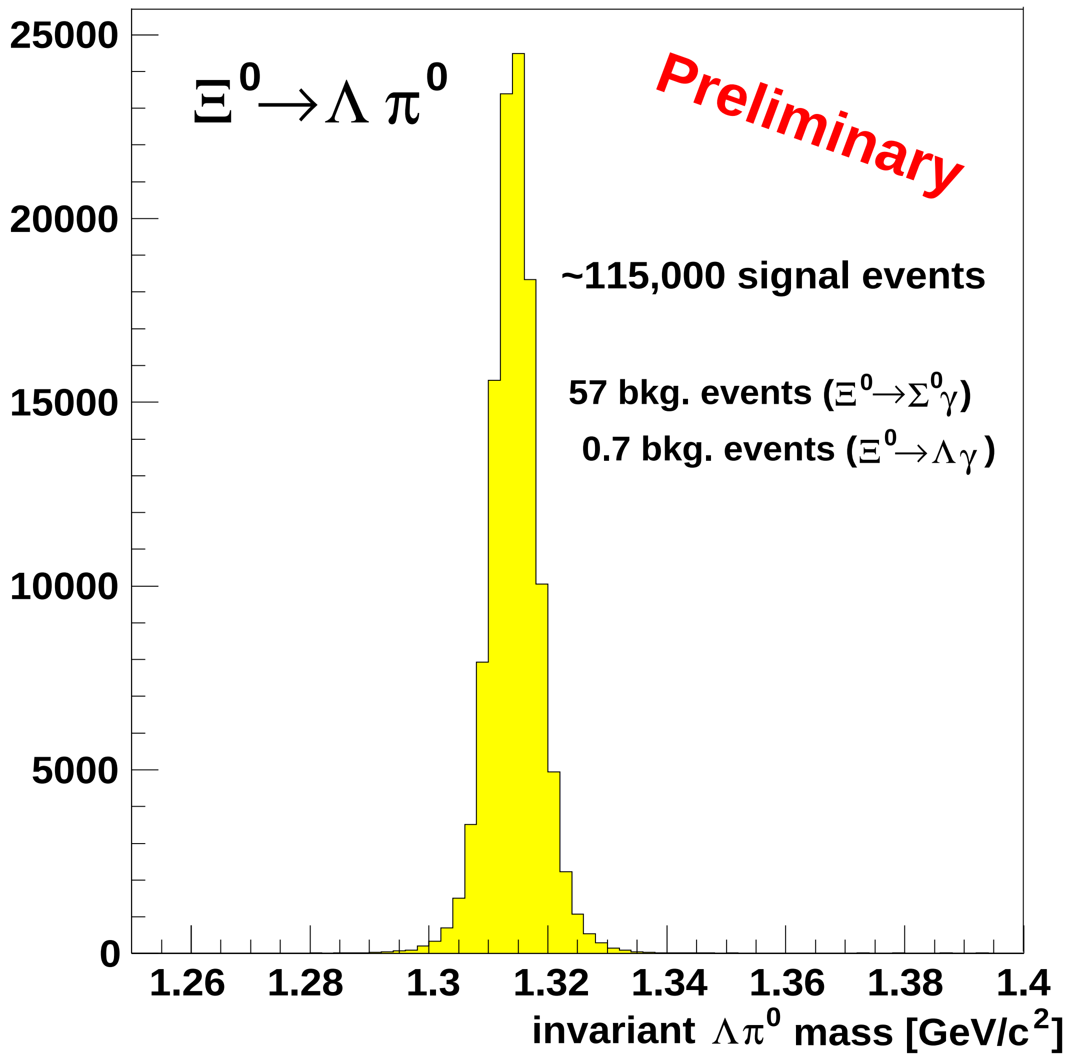
Hyperon candidates:

- No $K_L \to \pi^+\pi^-\pi^0$ candidate
- z - vertex $<$ 40 m (mean $(\Xi^0/\Lambda^0$ decay length $\sim$ 10 m)
- $|m(p\pi^-) - m(\Lambda^0)| < 2.5MeV/c^2(\approx 3\sigma)$

Normalization: $\Xi^0 \to \Lambda^0\pi^0$

$\Xi^0 \to \Lambda^0\pi^0$ is used for normalization.

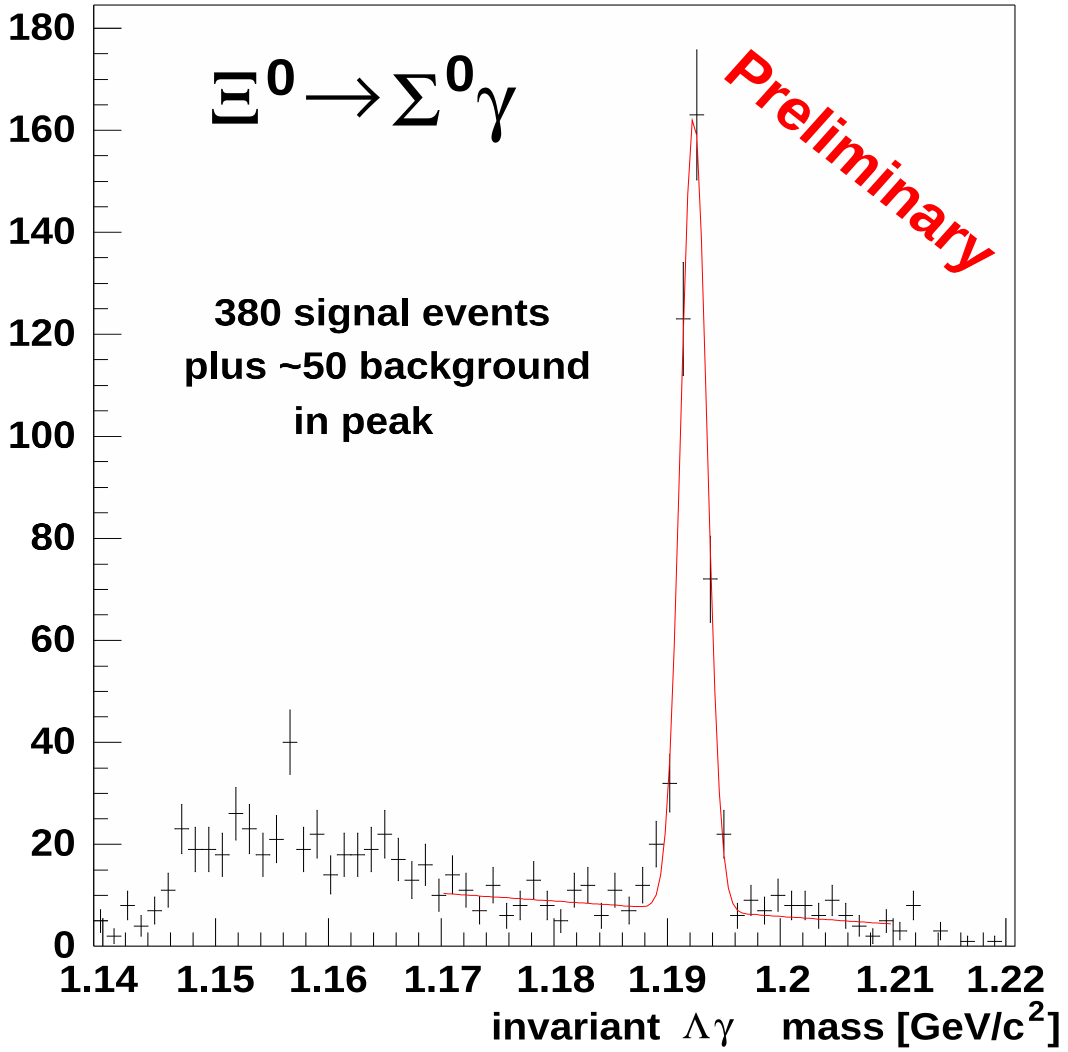
- $Br(\Xi^0 \to \Lambda^0\pi^0) = 99.5$
- Similar topology as most decays (2 tracks + LKR activity)
- Virtually background-free



We find 115,000 events in the accepted vertex energy region.

$\Xi^0 \to \Sigma^0\gamma$

Σ^0 lifetime $\sim 10^{-20}$ s
$\longrightarrow$ Almost same signature as $\Xi^0 \to \Lambda\pi^0$
$\longrightarrow$ Main background from $\Lambda\pi^0$
We find a signal of $\approx$ 380 events
over $\Xi^0 \to \Lambda\pi^0$ background of $\approx$ 50 events.



Preliminary result:

$\mathrm{Br}(\Xi^0 \to \Sigma^0\gamma) = (3.7\pm0.5)\times10^{-3}$

Summary

From 2 days of special high-intensity data taking for rare K_s and hyperon decays, we obtain preliminary results for Ξ^0 decay mode:

$$\Xi^0 \to \Sigma^0\gamma$$

From 380 signal candidates, we measure

$$Br(\Xi^0 \to \Sigma^0\gamma) = (3.7 \pm 0.5) \times 10^{-3}$$