$K_L \longrightarrow \pi^0\pi^0$ Search

- Data Sample and Selection
- Data Analysis and efficiencies
- Control Samples and Systematics
- BR ($K_L \longrightarrow \pi^0\pi^0$) / BR($K_L \longrightarrow \pi^0\pi^0\pi^0$)
- Conclusions

Data Sample

- The first 3.9 pb^{-1} analyzed in January
  - previous nevmod version – different selection
- All the numbers refer to 2000 Data

  Run 16211-17234 13,7 pb^{-1} 6.84M K_L tags
- Selected Sample : K_L tags+ neutral vertex (eclmod lib)
  - Total events : 25,571
- Cluster reconstruction - Run 16211-16811 made at the end of April to fix “timesmooth” correction
- MonteCarlo sample :
  - $K_S \rightarrow \pi^+\pi^-$ $K_L \rightarrow \pi^0\pi^0\pi^0$
    - 30 Runs – 1,200,000 triggers - 411,724 Selected Events – ~7.9 pb^{-1}
  - $K_S \rightarrow \pi^+\pi^-$ /$\pi^0\pi^0$ $K_L \rightarrow \pi^0\pi^0$
    - 5 Runs – 200,000 triggers - 20,964 Selected Events - ~95 pb^{-1}

Analysis Criteria

- All the events with
  - 3 and 4 photons connected to the neutral vtx are analyzed :
    - Pre-selection criteria:
      - Kl momenta from Φ and Kshort momenta and vertices –
        - » no selection applied
      - Photons energies from 4-momentum conservation –
        - » $0 < E\gamma < 600$ MeV required – Sample A
      - Photon coupling – π^0 search –
        - » Elliptic cut applied on $M(\pi^0)$, $E_{klr}(\pi^0)$ plane – Sample B
      - 2 π^0 sample :
        - » the total momentum must be roughly in agreement with the Kl - Sample C
    - Global Fit is done according to the pre-selection results:
      - 4-momentum conservation constraint applied on Sample A
      - $M(\pi^0)$, $E_{klr}(\pi^0)$ constraint applied to one π^0 on Sample B to both on Sample C
    - Minimized Functions, with and without constraints on π^0 are compared

Efficiencies

4-mom cons	N π^0.	Signal	Bckr
Yes	2	0.481	0.0015
Yes	1	0.210	0.0041
	0	0.123	0.169
	(2)	0.072	0.0061
No	2	0.049	0.0019
No	1	0.081	0.121

The percentages refer to events with 4 γ in the F.V. (0.4774,0.0388)

Efficiencies

4-mom cons	N π^0.	Signal	Bckr
Yes	2		
Yes	1 0 (2)	0.086	- 0.015
No	2		
No	1	0.547	0.088

The percentages refer to events with 3γ in the F.V. (0.11,0.00918)

Event Selection

All the events with 4 γ AND in the FV : abs(z) < 155. AND 30.<R<155. AND

4-mom cons	N π^0.	Signal	Bckr
Yes	2	0.481	0.0015
Yes	1	0.210	0.0041
	0 (All)	0.123	0.169
	0 (1)	0.0476	0.0810
	0 (2)	0.072	0.0061
No	2	0.049	0.0019
No	1	0.081	0.121

The percentages refer to events with 4 γ in the F.V. (0.4774,0.0388)

Event Selection

To increase S/B ratio a very loose cut on the minimized function

$\chi^2 < 65$, $\chi^2_\gamma < 30$ (~5% signal lost)

	S/B	Signal	Bckr
MonteCarlo	4.9(0.4)	0.793(0.009) 0.379(0.004)	0.0088(0.0007) $3.4(0.3)\ 10^{-4}$
Dati Tot: 1194 ev	4.9(0.4)	992(15)	202(15)
Dati		2600(90)	

The black percentages refer to events with 4γ in the F.V. (0.4774,0.0388)

The green percentages refer to events with Kltag AND neutr. vtx

Systematics Control Sample I

Low Background

	S/B	Signal	Bckr
MonteCarlo I	17(3)	0.230(0.003)	$6(1)\ 10^{-5}$
Dati I Tot: 543 ev	17(3)	513(6)	30(6)
Dati II (Fit)		500(30)	
Dati I		2230(100)	

The green percentages refer to events with Kltag AND neutr. vtx

Systematics Control Sample II

	S/B	Signal	Bckr
MonteCarlo I	3.9(0.6)	0.098(0.002)	1.06(0.15) 10^{-4}
Dati I Tot: 313 ev	3.9(0.6)	249(9)	64(9)
Dati I		2560(170)	

The green percentages refer to events with Kltag AND neutr. vtx

$$BR(K_L \longrightarrow \pi^0\pi^0) \,/\, BR(K_L \longrightarrow \pi^0\pi^0\pi^0)$$

	Eventi/Mc-eff	Estim. Ev.	Ratio
$K_L \longrightarrow 3\pi^0$	219,396 0.395(0.001)	555(2) 10^3	
Control Sample I	543	2230(100)	4.0(0.2) 10^{-3}
Control Sample II	313	2560(170)	4.6(0.3) 10^{-3}
Total	1194	2600(90)	4.7(0.2) 10^{-3}

The green percentages refer to events with Kltag AND neutr. vtx