Kloe Perspectives for ε'/ε

On behalf of the Kloe Collaboration

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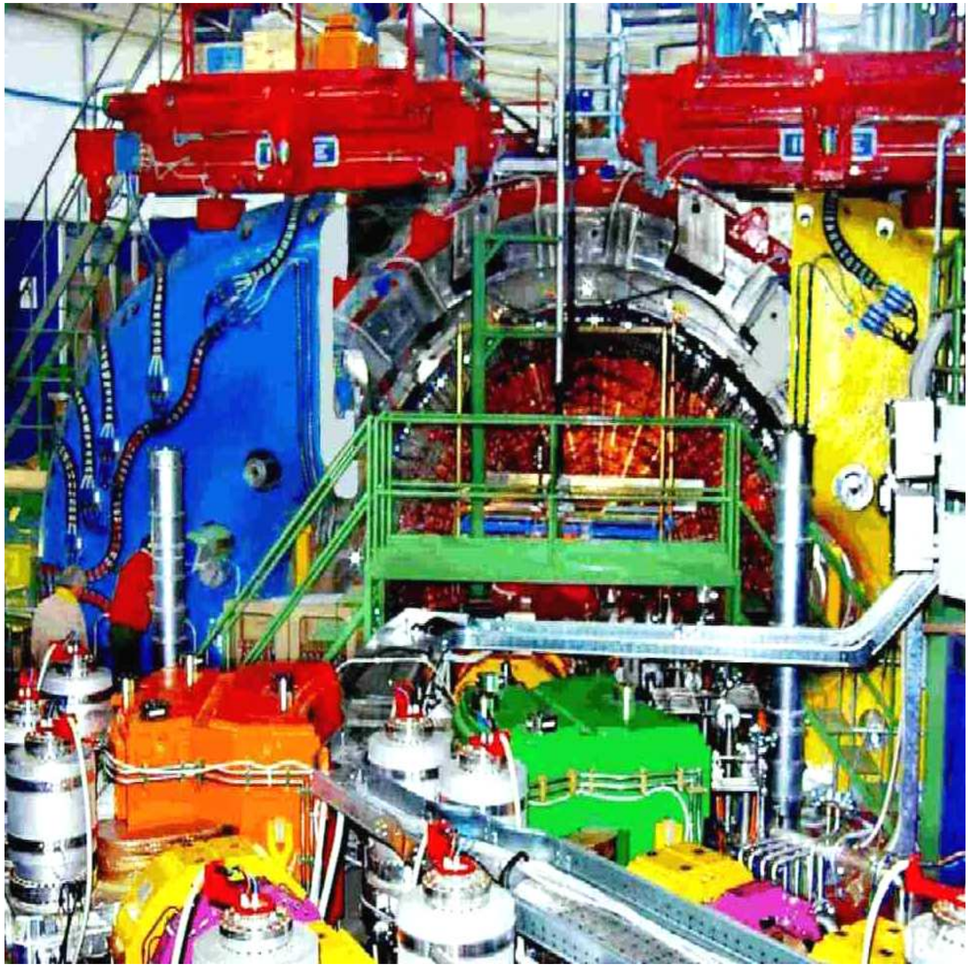
Laboratori Nazionali di Frascati dell'INFN

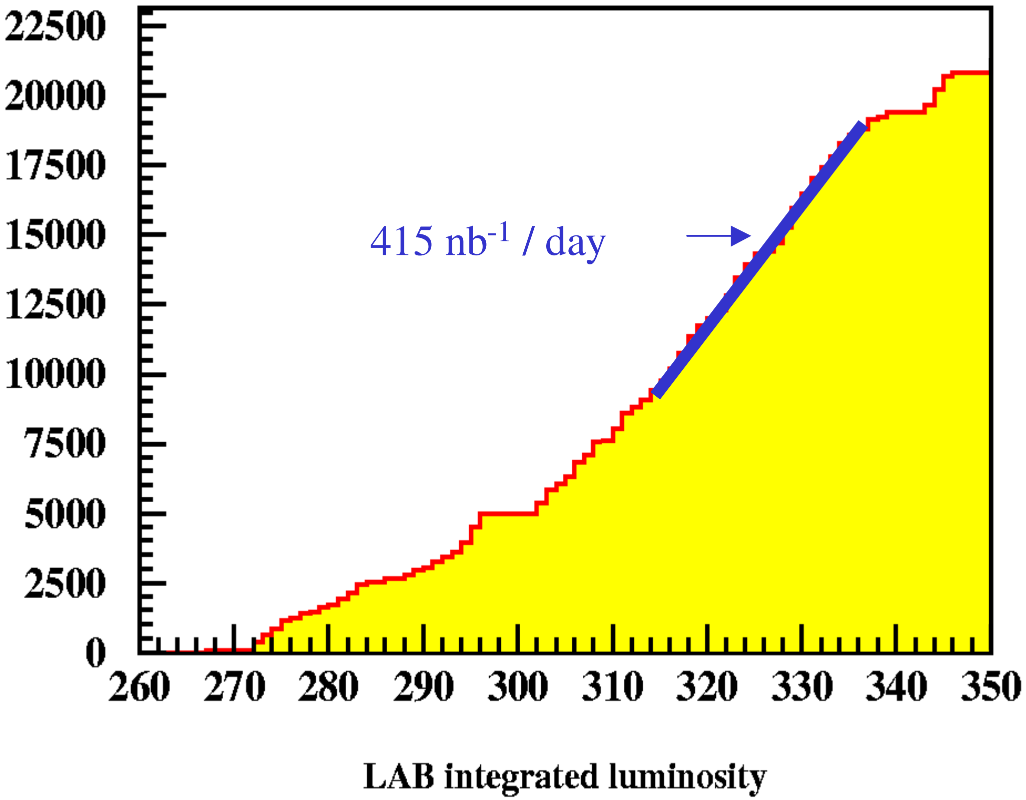
- Data taking Status Report
- Double ratio measurement
  - Ks Tagging and Decay Measurements
  - Kl Tagging and CP-violating Kl Decays
- Conclusions



Kaon 2001 - Pisa - 13 June 01

Y2K Data

Data taking: 23 Sep—11 Dec
5.61G triggers, 13.6 TB raw data



$\mathcal{L}\,dt$ **= 23.1 pb^{-1}**

Total events collected:

- 130M Bhabhas
- 10.9M K_L tags
- 7.2M K_L crash
- 19.5M K^+K^- w/ vertex

Y2K Data

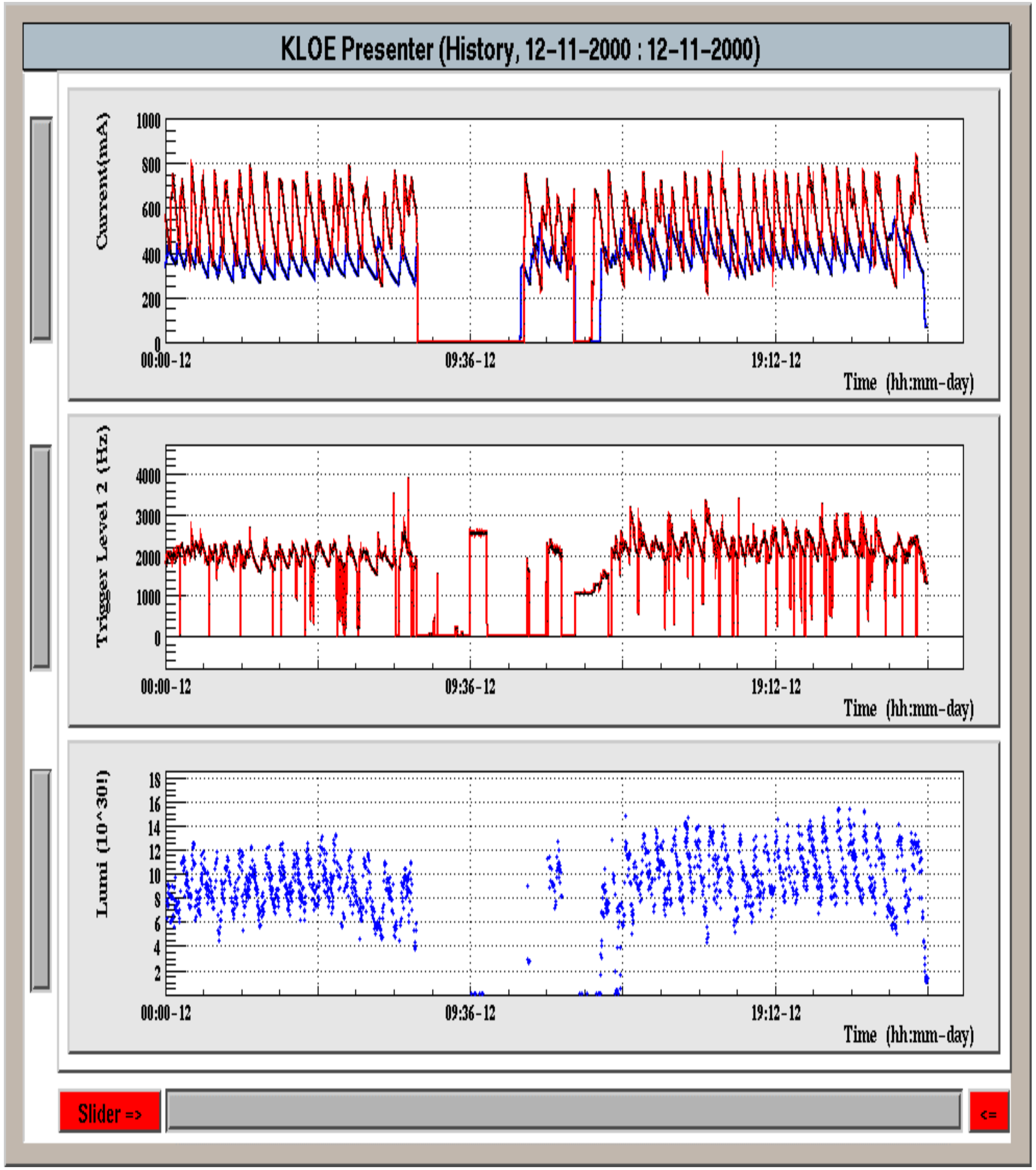
Unequal Tunes for e+/e- Rings

Luminosity and Duty Cycle limited by

Max current e- beam (500 mA)
Max current e+ beam allowing injection (~400 mA)

Transverse Instability in Multi-Bunch Operation

Peak Luminosity ~1.4 10^{31} cm^{-2} s^{-1}
Average/Peak Luminosity ~ 0.35



Data Taking - Y2001

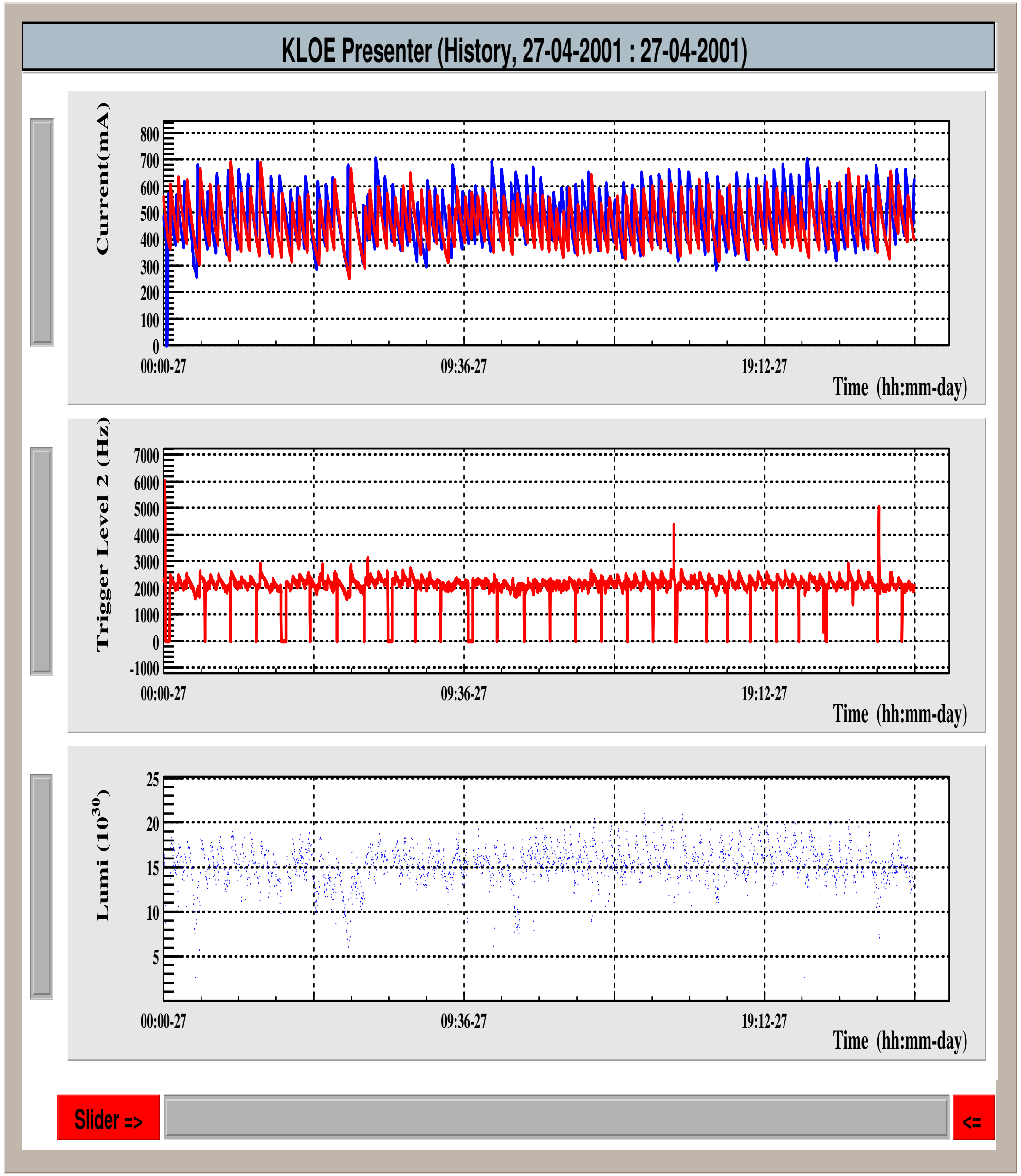
e+/e- Machines much more symmetric
- Lower Wiggler Field
- Beam Decoupling @DEAR

Easier Multibunch Operation
- Feedback system improved

Max Luminosity Limited by
- Background Level @KLOE

Single-bunch Luminosity -
- 10^{30} cm^{-2} s^{-1} reached @ 20 mA

Peak Luminosity ~1.9 10^{31} cm^{-2} s^{-1}
Average/Peak Luminosity ~ 0.55



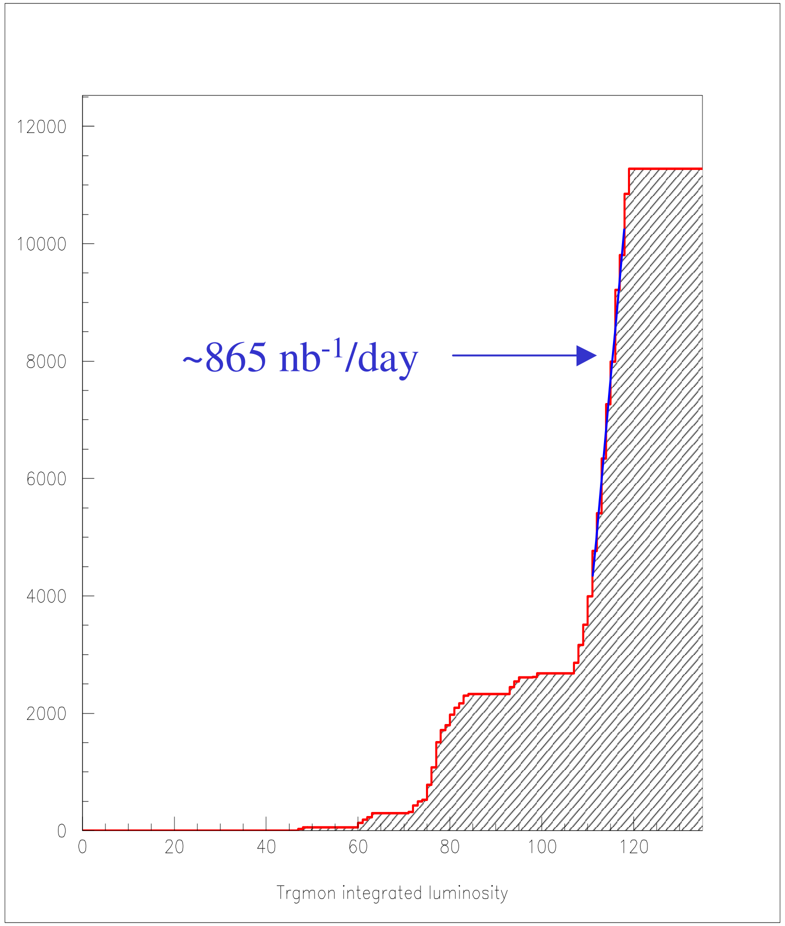
Data Taking -Y2001

Data taking: 16 — 29 Apr
2.16 G triggers, 5.3 TB raw data

$\mathcal{L}\,dt = 11.3\ \mathrm{pb}^{-1}$

Total events collected:

- 64 M Bhabhas
- 5.3M K_L tags
- 3.3M K_L crash
- 10 M K^+K^- w/ vertex



Data Taking - Y2001

- Machine Development
  - Tuning to reduce Background (now)
  - Insertion of Octupoles to correct Non-linear Distortions in the Wigglers (September)
    - Background Reduction
    - Increase in the Luminosity

- Kloe Data Taking :
  - 20 weeks till the end of the year
  - Exp. Integrated Luminosity : ~200 pb-1 , assuming
    - Little improvement in the Luminosity,
    - Stable running scenario

Data Yield - 200 pb^{-1}

- Ks $2\ 10^8$
  - Tagged Ks (Kl visible Interactions) $0.6\ 10^8$
    - Ks $\pi^+ \pi^-$ $0.3\ 10^8$ x BR ~ $2\ 10^7$
    - Ks $\pi^0 \pi^0$ $0.3\ 10^8$ x BR ~ $1\ 10^7$
    - Ks $\pi e \nu$ $0.9\ 10^7$ x BR ~ 6700
    - Ks $\gamma\gamma$ $3.3\ 10^7$ x BR ~ 70
    - Ks $\pi^0 e^+ e^-$ Single Event Sensitivity $0.8\text{-}1.5\ 10^{-7}$
    - Ks $\pi^0 \pi^0 \pi^0$ Single Event Sensitivity $3\ 10^{-8}$

- Kl $2\ 10^8$
  - Tagged Kl (Ks $\pi^+ \pi^-$) $0.9\ 10^8$
    - Kl Decay in FV (D.C.) $2.5\ 10^7$
    - . . .
    - Kl $\pi^+ \pi^-$ ~ $2.7\ 10^4$
    - Kl $\pi^0 \pi^0$ ~ $1.0\ 10^4$
    - Kl $\gamma\gamma$ ~ $0.5\ 10^4$

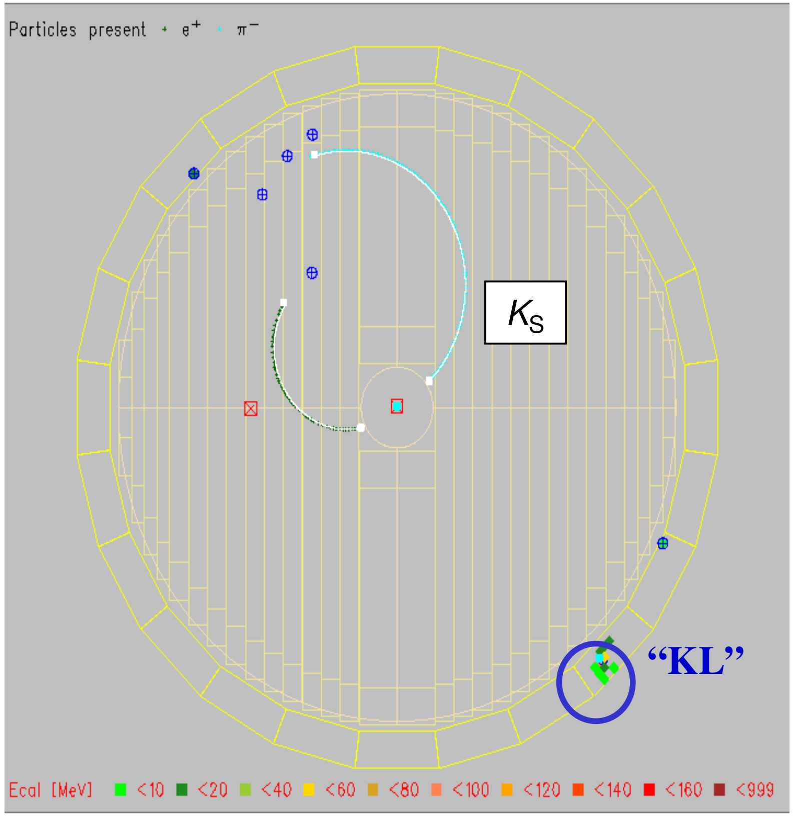
- $K^{+/-}$ $3\ 10^8$
  - Tagged K^+ (K^-) $0.7\ 10^8$
    - Reconstructed K^+ (K^-) $5\ 10^7$

Double Ratio Measurement

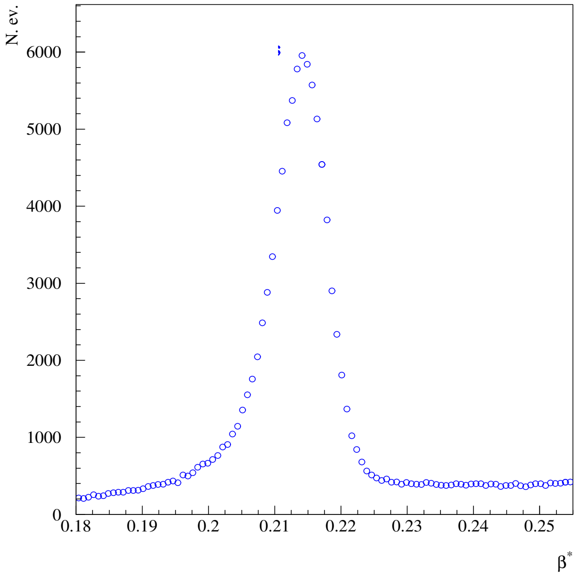
$$R = \frac{N(K_L \rightarrow \pi^0\pi^0) \,/\, N(K_L \rightarrow \pi^+\pi^-)}{N(K_S \rightarrow \pi^0\pi^0) \,/\, N(K_S \rightarrow \pi^+\pi^-)} = 1 - 6\Re(\varepsilon'/\varepsilon)$$

Ks tagging

Clean Ks selection by time of flight of K_L interacting in calorimeter



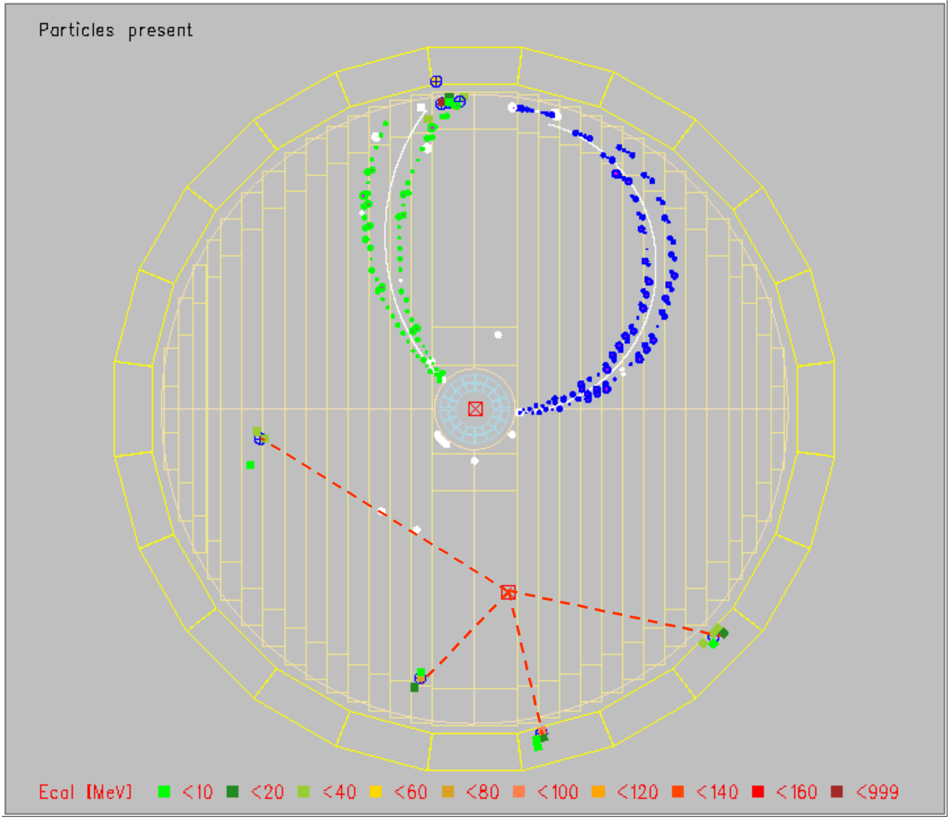
$\varepsilon_{TAG} \sim 30\ \%$



β^* distribution

$E_{cl} \geq 100$ MeV
$|\cos(\theta_{cl})| \leq 0.7$
$\beta^* = [0.195, 0.245]$

Kl tagging



Selection K_S:

- **charged vertex**
- **r < 5 cm from I.P.**
- **50 < P < 170 MeV/c**
- **400 < M < 600 MeV/c^2**

$\varepsilon_{tag} \approx 46\%$

$Ks \longrightarrow \pi^+\pi^-$ / $Ks \longrightarrow \pi^0\pi^0$ (1)

- Not limited by Statistics

- ~ 50,000 Ks $\pi^0\pi^0$ and 100,000 Ks $\pi^+\pi^-$ selected per pb^{-1}

- Selection Criteria $\varepsilon \sim 0.55$

  $\pi^0\pi^0$: 3-4 clusters in time E>20 MeV cost < 0.9

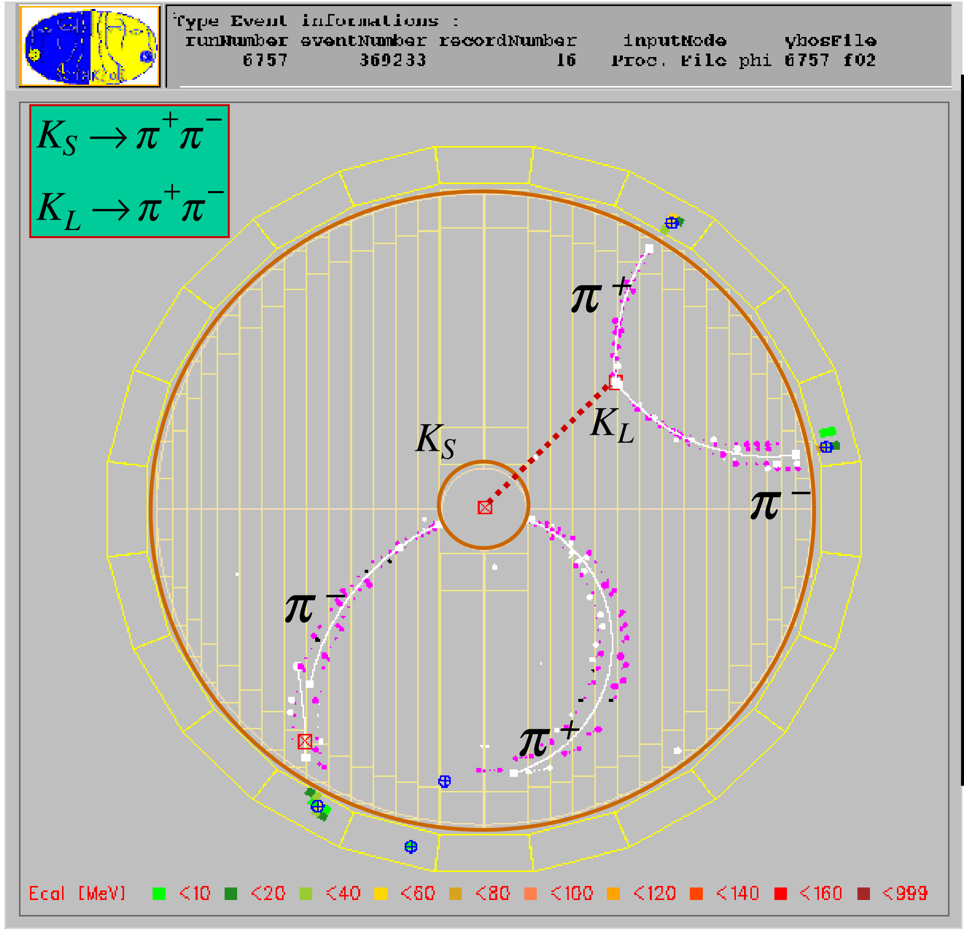
  $\pi^+\pi^-$: tracks from IP 190<p*<220 MeV/c cost<0.9

- Systematics to be analyzed:
  - t_0 AND Trigger Efficiency ← From Data
  - Relative tagging efficiency $\varepsilon^{00}_{TAG} / \varepsilon^{+-}_{TAG}$

  $\pi^+\pi^-$ efficiency ← MC + Photon and Track Efficiency from Data
  - Cluster efficiency

- Analysis and preliminary results presented by T.Spadaro, this afternoon

$K_L \rightarrow \pi^+\pi^-$ (1)

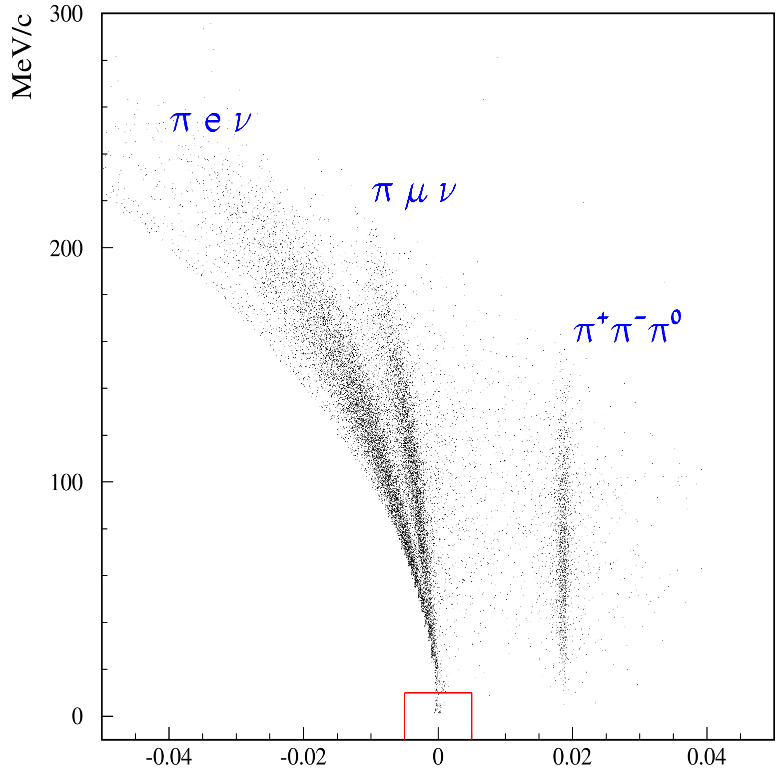


Selection	Normalization	ε
Tagged Kl Decay in FV	Produced Ks	~ 0.14
Kl vertex	Tagged Kl Decay in FV	~ 0.75
Preselection $P_{miss}^2+E_{miss}^2 < (30MeV)^2$	Kl vertex	~ 0.85
Final Cut on X^2 Kinematical Fit	Preselection	~ 0.89

- Purity ~98%
- Methods to control Efficiencies Under Study

$K_L \rightarrow \pi^+\pi^-$ (2)

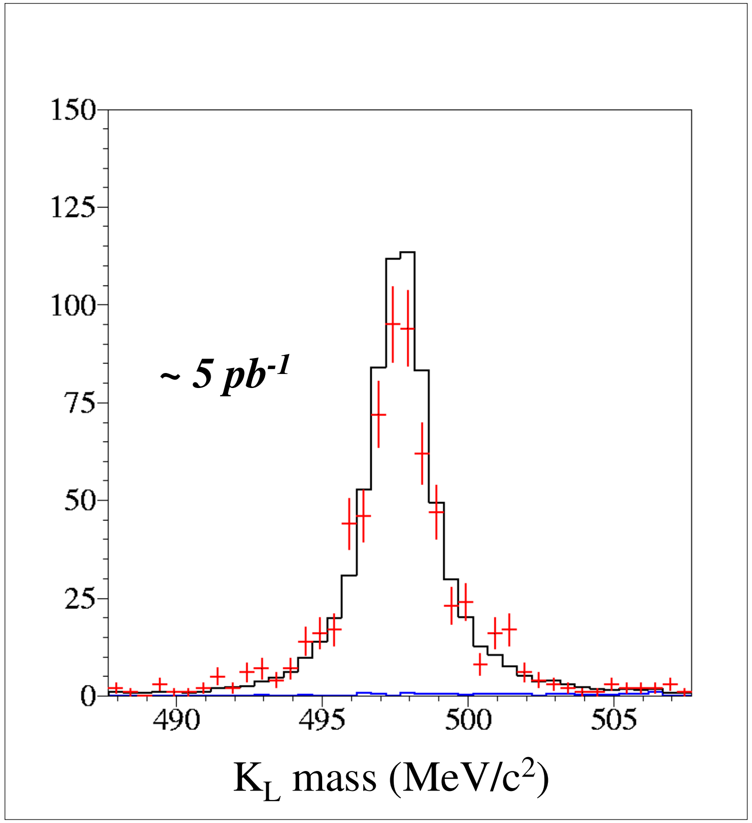
Preselection:



P_{miss} vs M^2_{miss}

After Kinematical fit

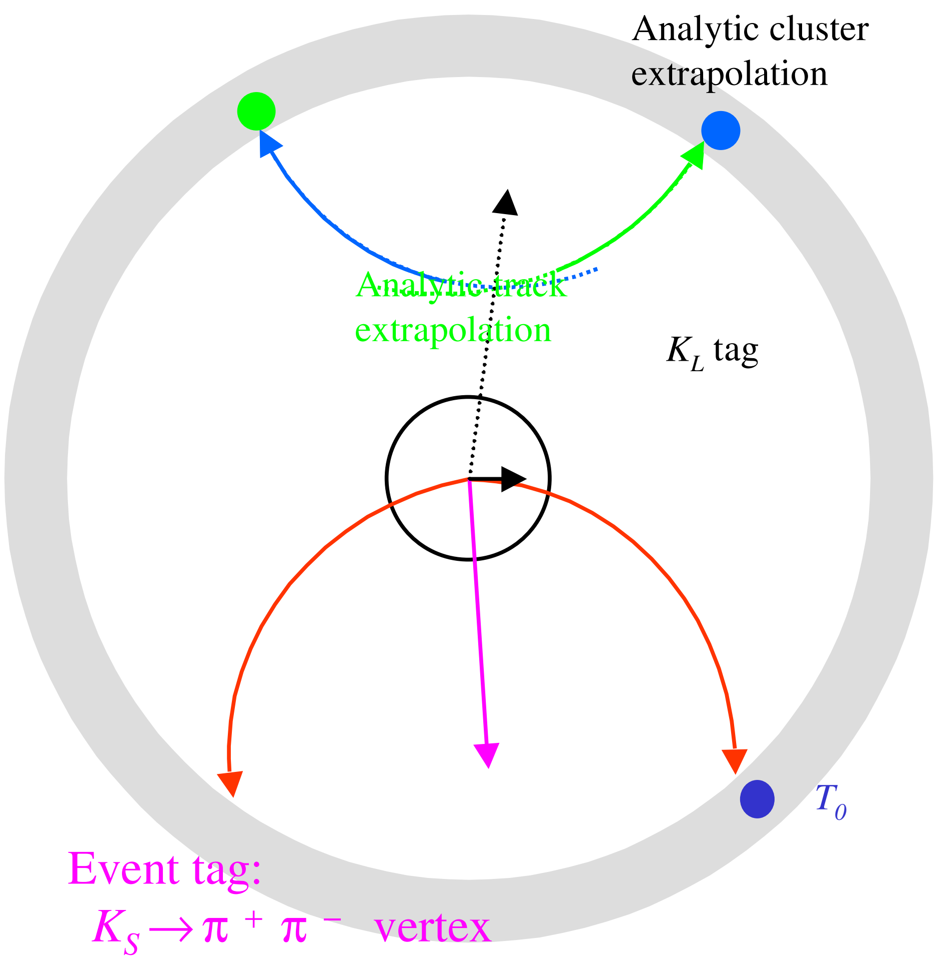
purity: 98%



$K_L \to \pi^+\pi^-$ Studies

1 track + cluster opposite

Vertex not required



Efficiency and Background from Data
Double Tag method

$N_1 = 2\varepsilon S + B_1$

$N_2 = \varepsilon^2 S\,(1-\rho) + B_2$

On ~ 17 pb^{-1} Sample :

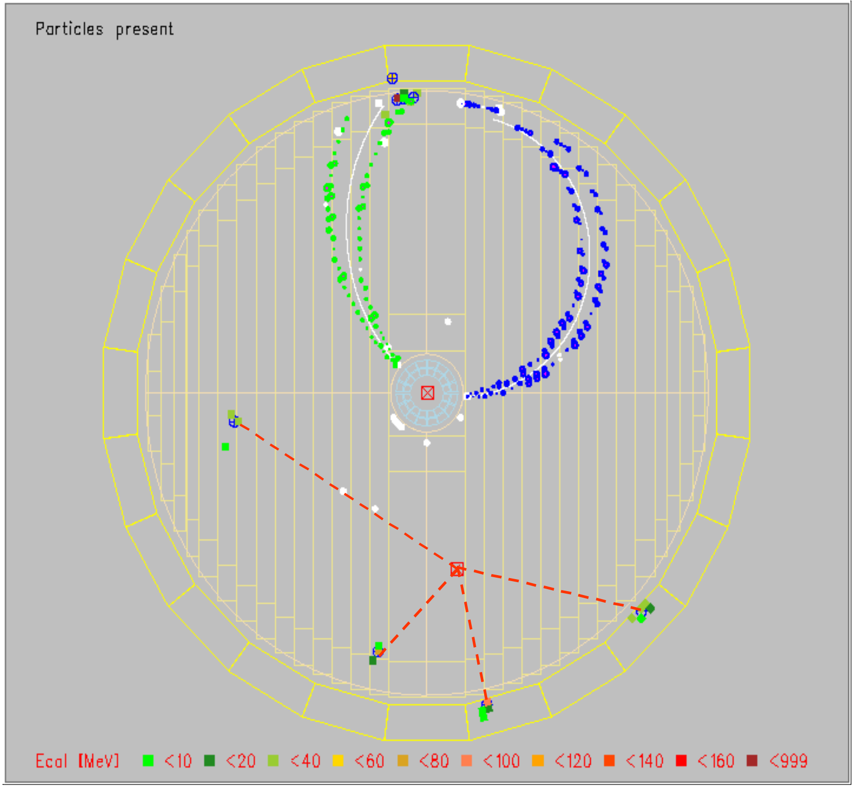
$N_1\text{-}B_1 = 3658 \pm 123$

$N_2\text{-}B_2 = 996 \pm 34$

$\varepsilon = 2N_2/N_1\,(1-\rho) = 0.433 \pm 0.019$

$S = N_1/2\varepsilon = 4226 \pm 287$

$K_L \rightarrow \pi^o \pi^o$ (1)



Selection	Normalization	ε
Tagged Kl Decay in FV	Produced Ks	~ 0.14
Kl neutral vertex with 4 γ	Tagged Kl Decay in FV	~ 0.73
Preselection: Good Total Energy , **P** Good 2 π^0	Kl neutral vertex , 4 γ	~ 0.60
Final Cut on X^2 - Kinematical Fit	Preselection	~ 0.80

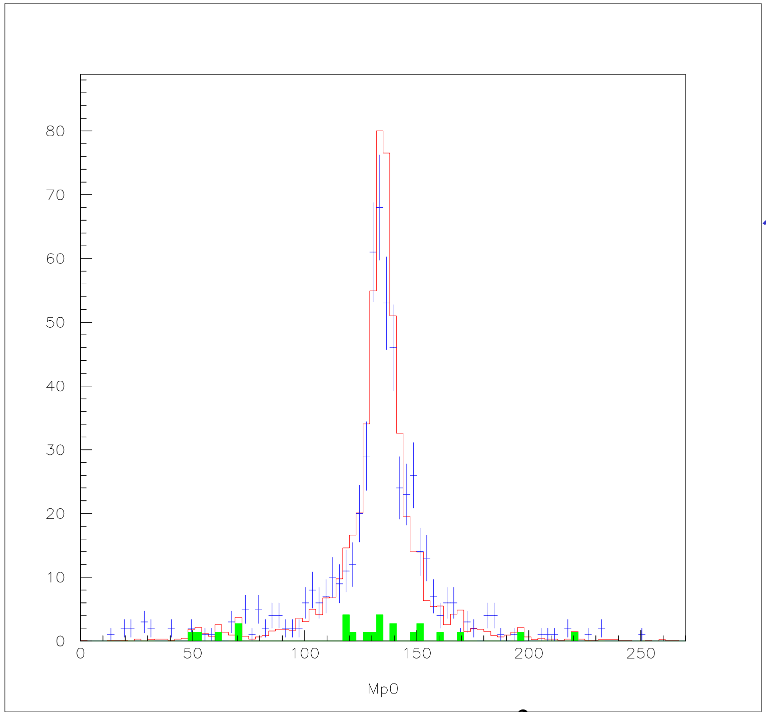
Purity ~95%

Method to control Efficiencies Under Study

$K_L \to \pi^0\pi^0$ (2)

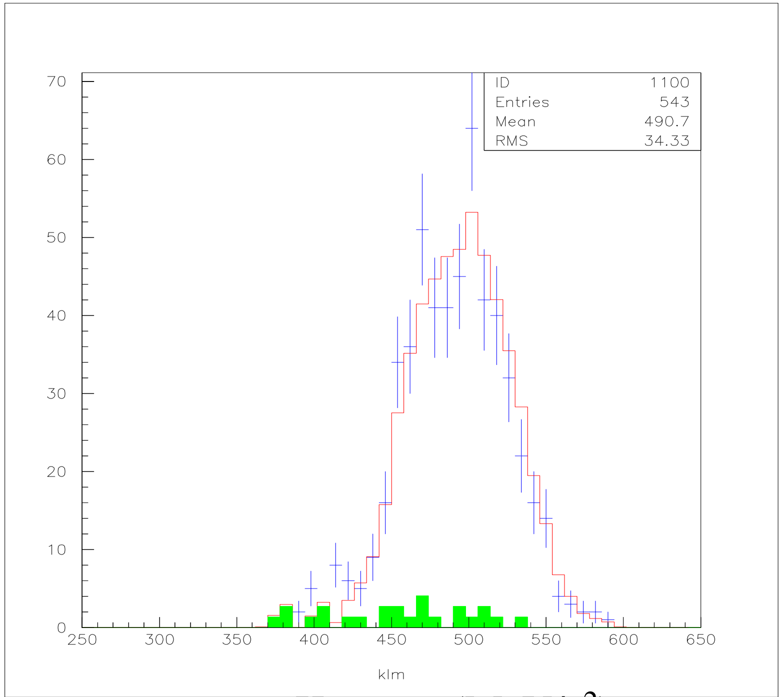
After Kinematical fit

purity: 95%



P0 mass (MeV/c^2)

~13 pb^{-1}



K_L mass (MeV/c^2)

Conclusions

- In April DaΦne Delivered a Luminosity of 1 pb^{-1} per day
- Present Data Taking will integrate ~200 pb^{-1} by the end of the year
- KLOE Milestones:
  - Improve the present knowledge of the Ks Branching Ratios
  - Reach ~1% sensitivity on $BR(Kl \rightarrow \pi^0\pi^0)$ corresponding to ~0.2% error on ε'/ε