DC efficiency and resolution

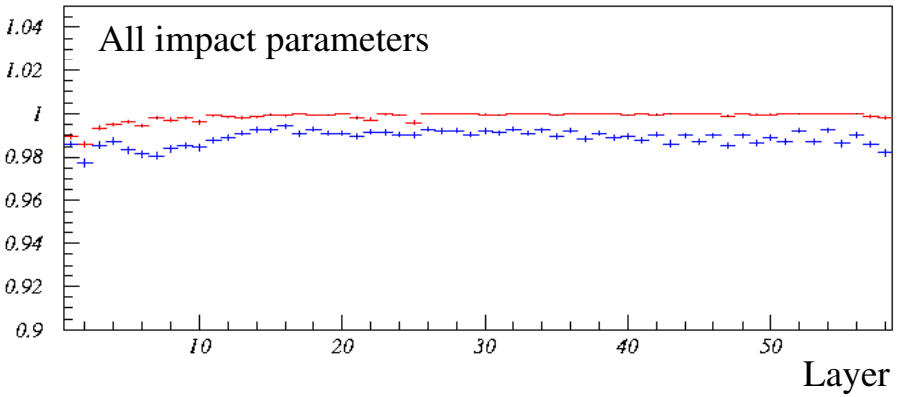
Efficiency is determined using *Bhabha* and cosmic ray events:

$$\varepsilon_{hardware} = \frac{\#\ fired\ hits\ in\ a\ cell}{\#\ fitted\ tracks\ through\ cell}$$

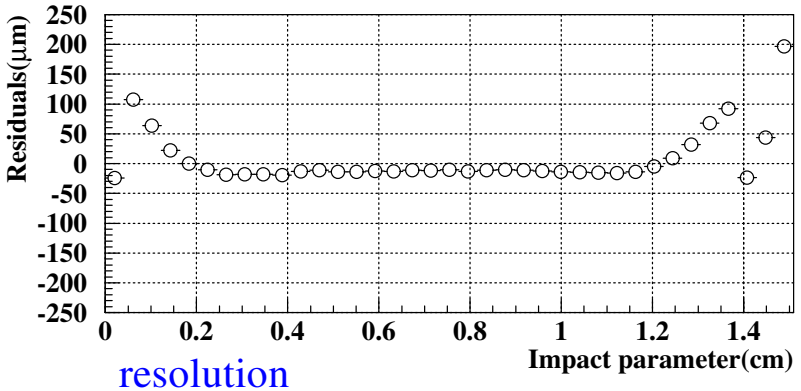
$$\varepsilon_{software} = \frac{\#\ fired\ and\ track\ associated\ hits\ in\ a\ cell}{\#\ fitted\ tracks\ through\ cell}$$

$\varepsilon_{HW} = 99\ \%$, $\varepsilon_{SW} = 97$

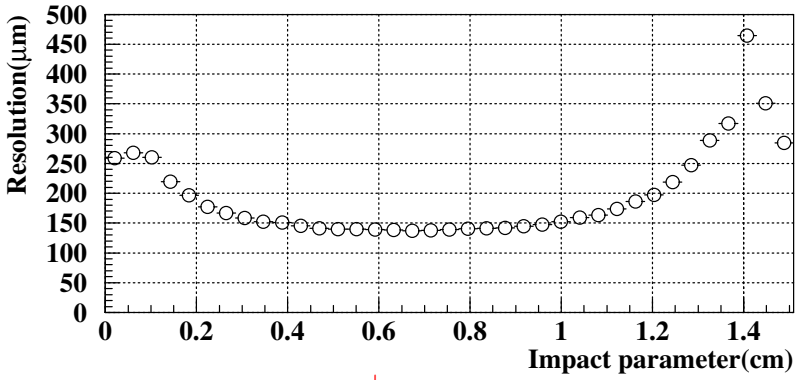
Efficiency



residuals = measured path − calc. from track



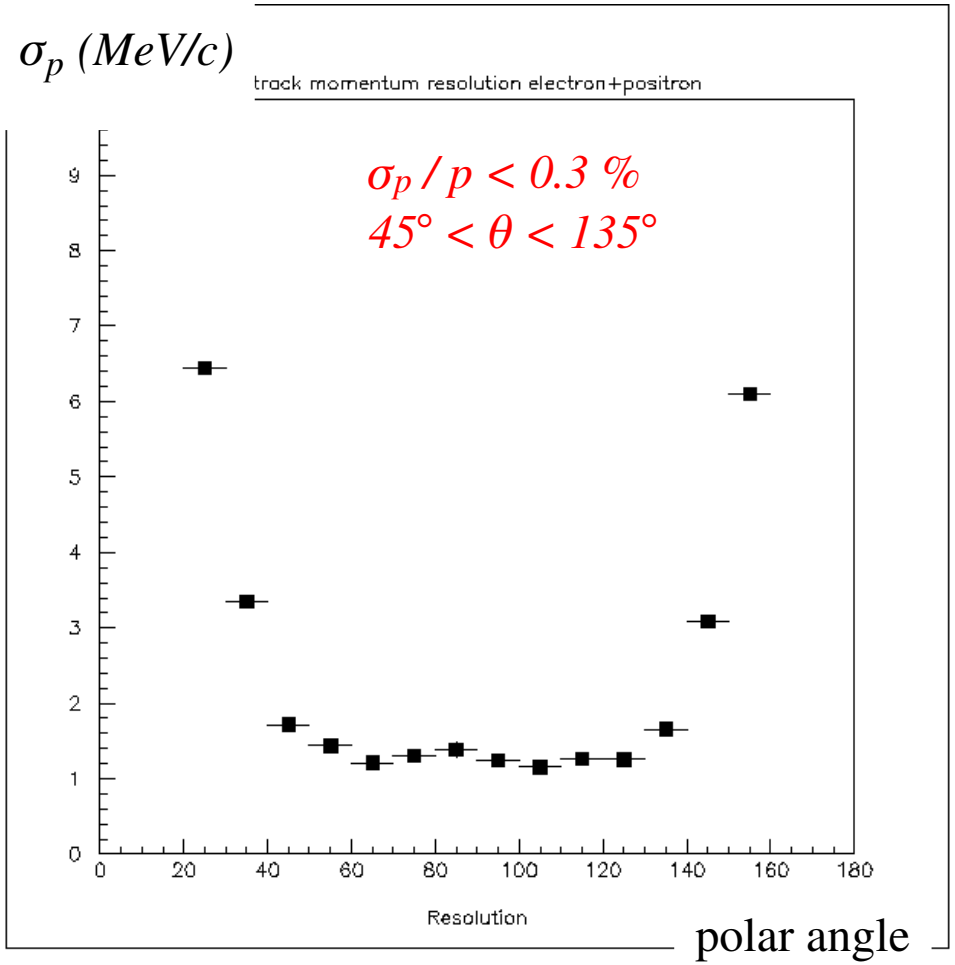
resolution



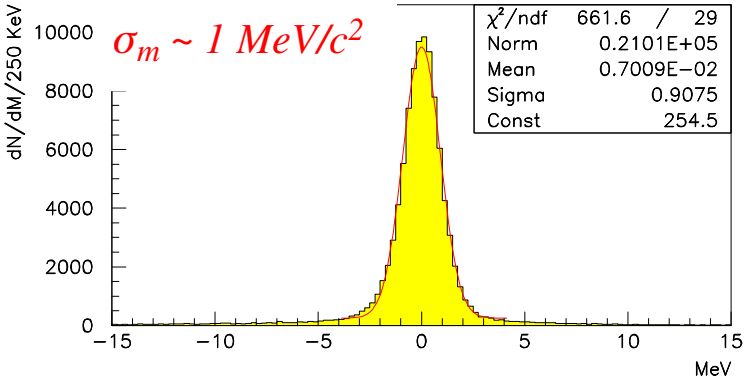
well below *200 μm* spatial resolution for most of the impact parameter range

DC performance

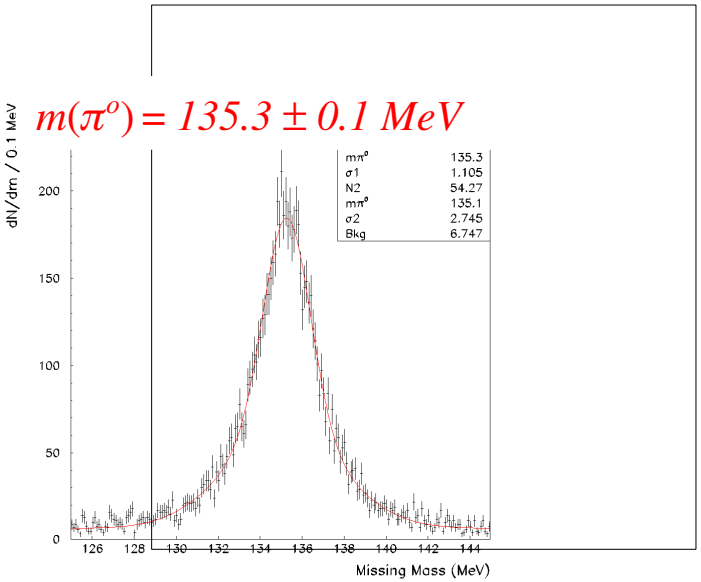
Bhabha events



$K_S \rightarrow \pi^+ \pi^-$

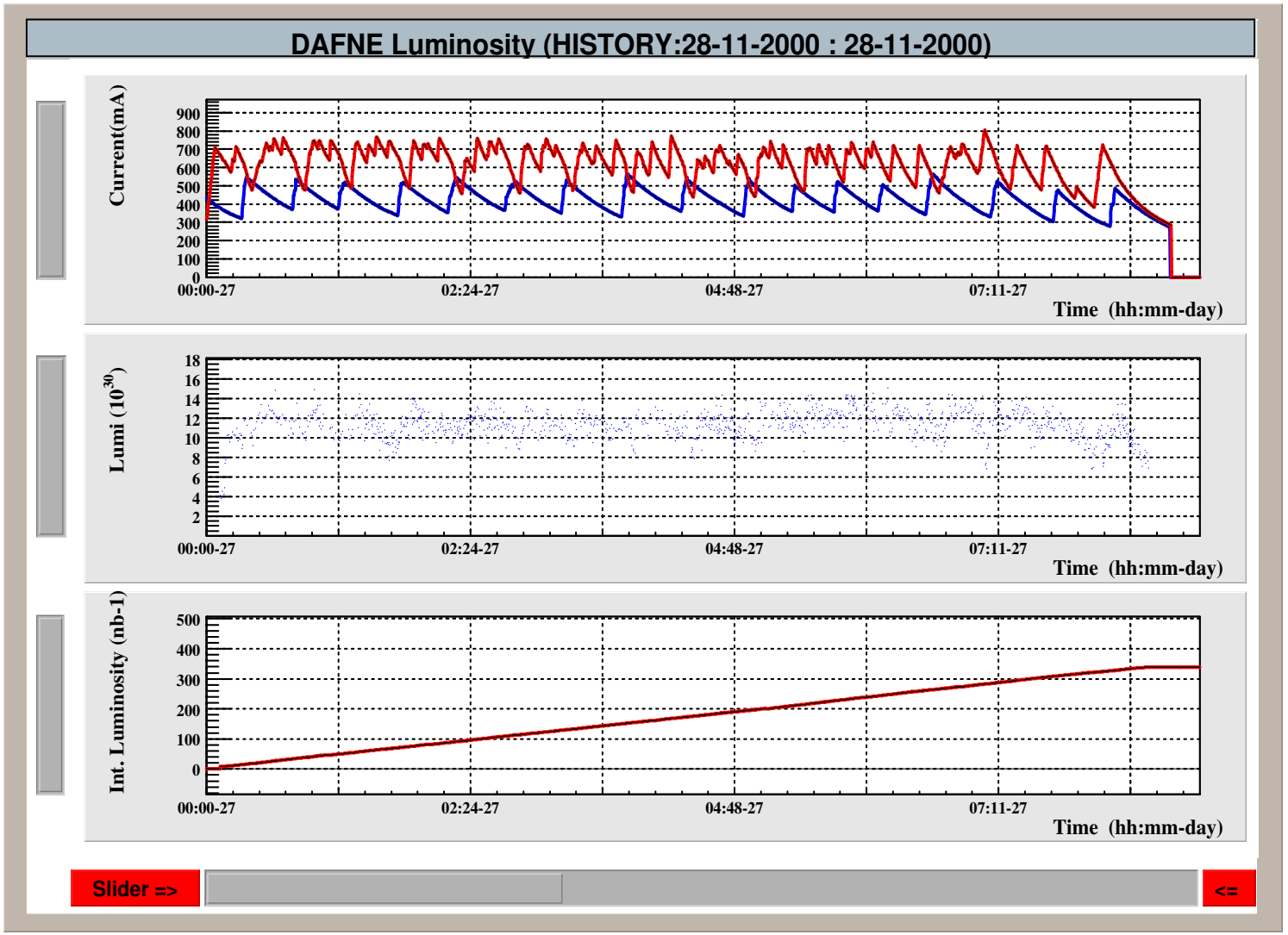


$K_L \rightarrow \pi^+ \pi^- \pi^o$



Running conditions November 2000

A ‘good’ day during the last data taking period (28. 11. 2000)



Currents:

$I^+ / I^- \approx 700 / 500 mA$

$t_{beam} \approx 60\ min$

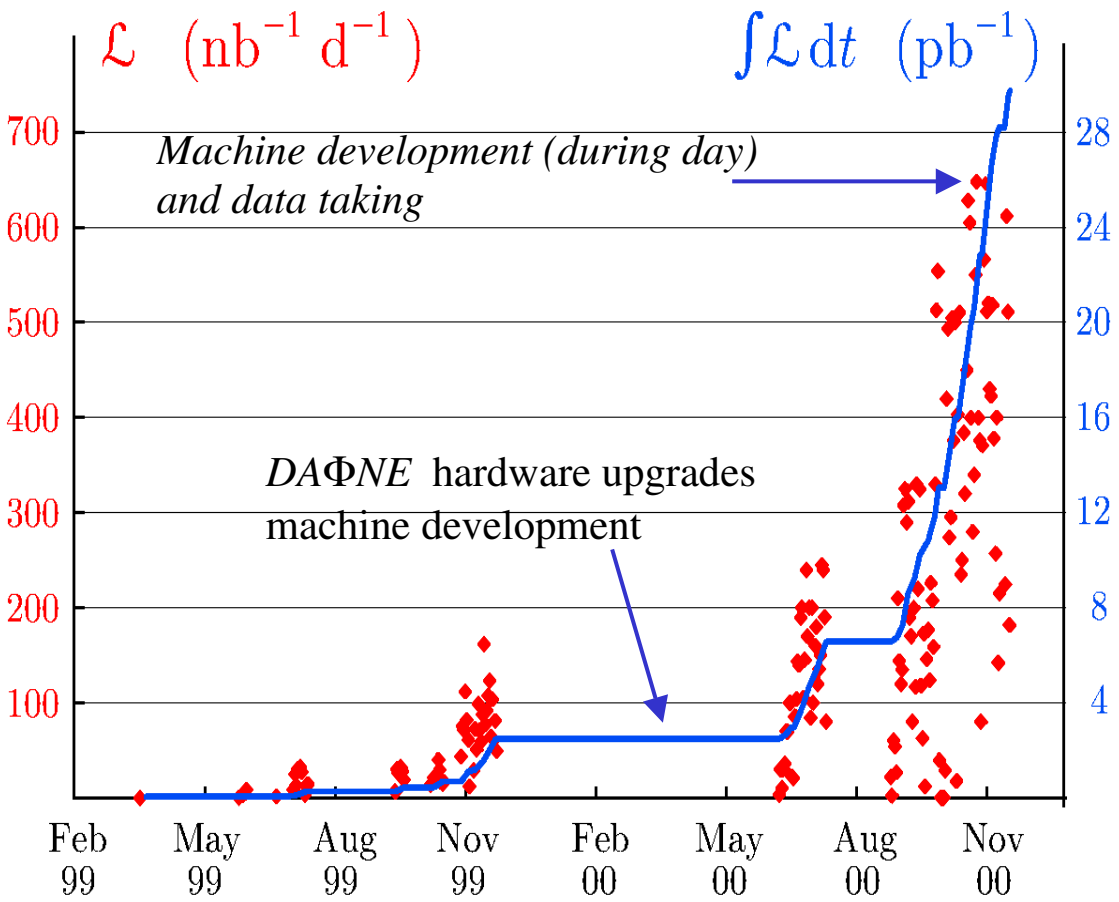
Luminosity:

$Peak \approx 1.5 \cdot 10^{31}\ cm^{-2}\ s^{-1}$

$Avg \approx 1.1 \cdot 10^{31}\ cm^{-2}\ s^{-1}$

$integrated \sim 37\ nb^{-1}/h$

DAΦNE and KLOE history



3 periods of continuous data taking

Dec. 1999
July 2000
Sept.- Dec. 2000

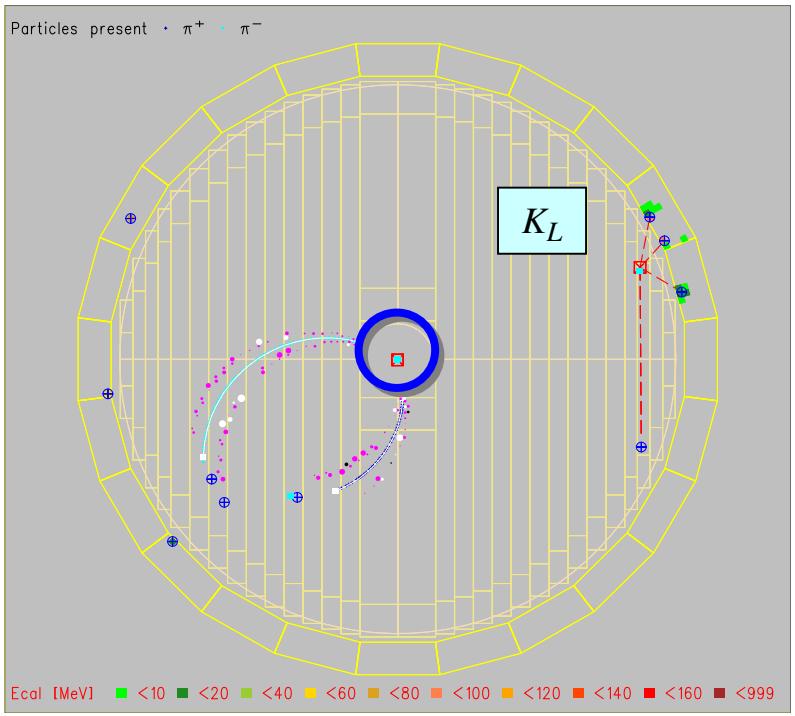
$L_{1\ bunch} = 4 \cdot 10^{29}$ @ *25 mA / bunch*
$L_{max} = 1.8 \cdot 10^{31}$ @ *600 mA / beam*
average beam lifetime ~*1h*

Total integrated luminosity collected:
$L \sim 28\ pb^{-1}$

130 M Bhabhas
67 M φ decays
25 M $K_S K_L$ tagged events
19.5 M $K^+ K^-$ events with vertex

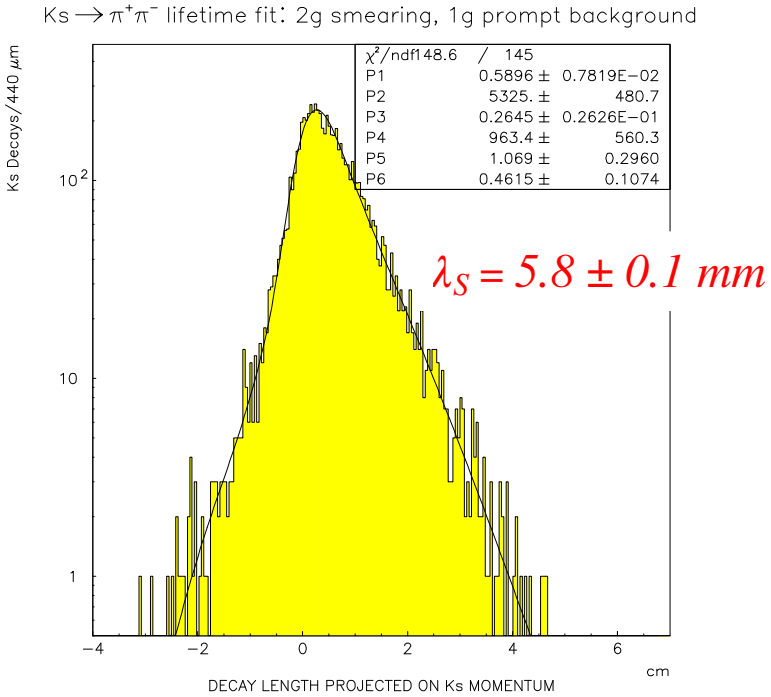
3. First results

K_L tagged by $K_S \rightarrow \pi^+ \pi^-$



Selection K_S:

- charged vertex
- $r < 5$ *cm* from *Interaction Point*
- $50 < p < 170$ *MeV/c*
- $400 < m < 600$ *MeV/c*^{2}



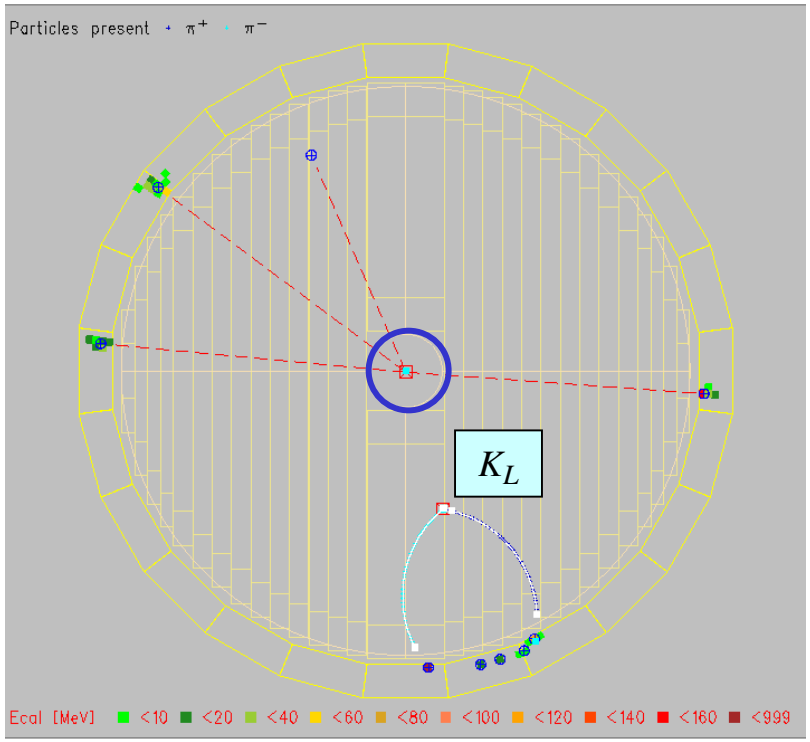
$\lambda_S = 5.8 \pm 0.1$ *mm*

$\varepsilon_{tag} / BR\,(K_S \rightarrow \pi^+ \pi^-) \approx 72\%$

$background < 1\%\ \ (\phi \rightarrow K^+ K^-)$

$BR(K_S \rightarrow \pi^+ \pi^-) = 68.6\ \%$

K_L tagged by $K_S \rightarrow \pi^o \pi^o$

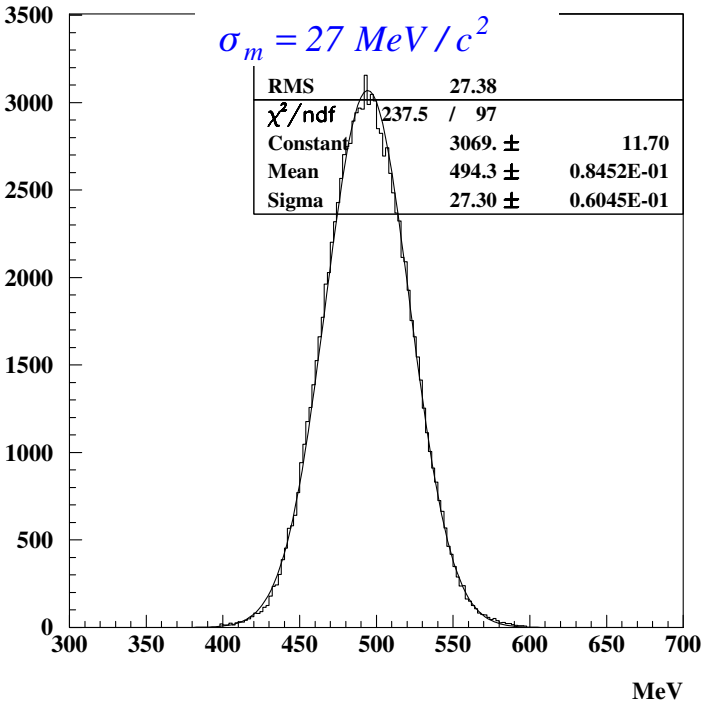


Selection K_S :

- *4* prompt clusters ($0.9 < \beta < 1.2$)
- no associated track
- $\theta > 21°$ (rejects machine background)
- $390 < m < 600\ MeV/c^2$

$m(4\gamma) = 494\ MeV/c^2$

$\sigma_m = 27\ MeV/c^2$

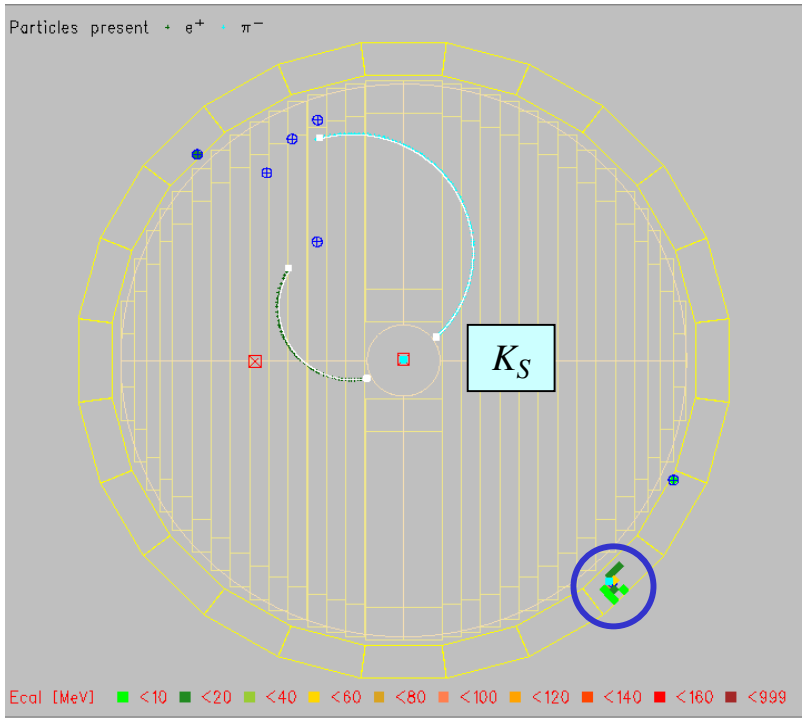


$\varepsilon_{tag} / BR\ (K_S \rightarrow \pi^o \pi^o) \approx 65\%$

background < *1%* (machine)

$BR(K_S \rightarrow \pi^o \pi^o) = 31.4\ \%$

K_S tagging by K_L 'cluster' in *EmC*

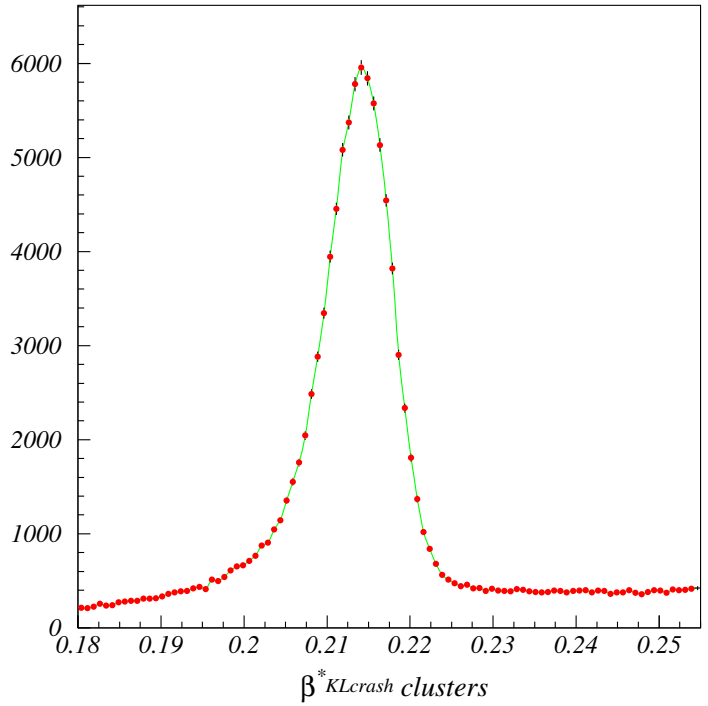


$\varepsilon_{tag} \approx 31\%$

Cluster efficiency $\approx 50\ \%$
(65 % of all K_L leave FV, but interact in EmC)

Selection :

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



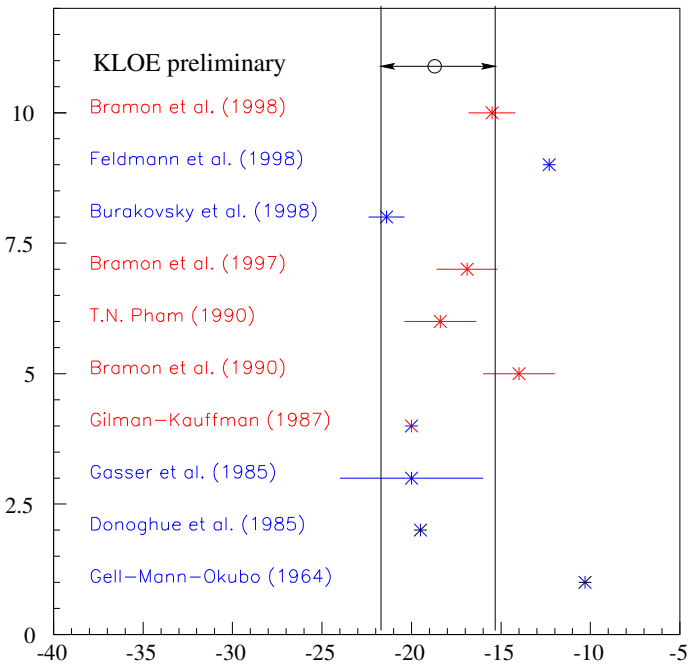
sensitive to ϕ boost and machine energy spread

$\eta - \eta'$ mixing angle ϑ_p

combining the two *KLOE* results for η and η'

Bramon formula ($\phi - \omega$ mixing
plus *SU(3)* breaking effects)

$$\vartheta_p = (-18.9^{+3.6}_{-2.8} \pm 0.6)^\circ$$



Radiative ϕ decays

$\sigma\,(e^+ e^- \to \phi)$ via $\phi \to \eta\,\gamma$

KLOE : $(\ 3.19 \pm 0.02 \pm 0.26\ )\ \mu b$

CMD-2 : $(\ 3.114 \pm 0.034 \pm 0.048\ )\ \mu b$

$\sigma\,(e^+ e^- \to \omega\,\pi^o \to \pi^o\,\pi^o\,\gamma\ )$

KLOE : $(\ 0.67 \pm 0.04 \pm 0.05\ )\ nb$

SND : $(\ 0.64 \pm 0.08\ )\ nb$

$BR\,(\phi \to f_o\,\gamma \to \pi^+\pi^-\,\gamma\ )$

KLOE : $< 1.6 \cdot 10^{-4}$ @ 95% C.L.

CMD-2 : $(\ 1.93 \pm 0.68\ ) \cdot 10^{-4}$

$BR\,(\phi \to f_o\,\gamma \to \pi^o\,\pi^o\,\gamma\ )$

KLOE : $(\ 0.81 \pm 0.09 \pm 0.06\ ) \cdot 10^{-4}$

SND: $(\ 1.14 \pm 0.10 \pm 0.12\ ) \cdot 10^{-4}$

CMD-2 : $(\ 1.06 \pm 0.09 \pm 0.06\ ) \cdot 10^{-4}$

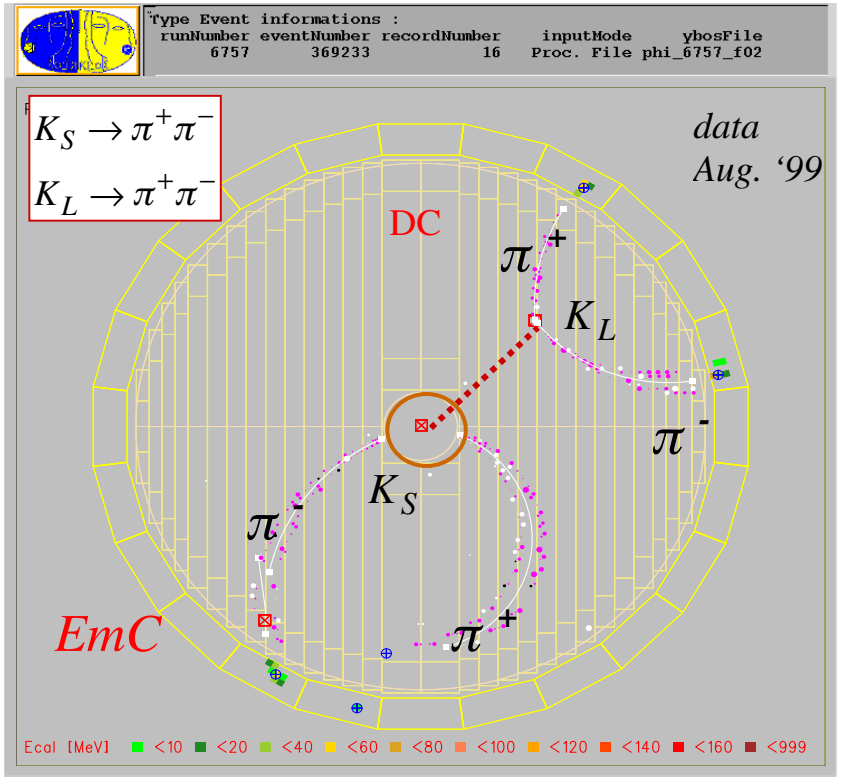
$BR\,(\phi \to a_o\,\gamma \to \eta\,\pi^o\,\gamma \to 5\,\gamma)$

KLOE : $(\ 0.77 \pm 0.15 \pm 0.10\ ) \cdot 10^{-4}$

SND: $(\ 0.89 \pm 0.14 \pm 0.06\ ) \cdot 10^{-4}$

CMD-2 : $(\ 0.83 \pm 0.23\ ) \cdot 10^{-4}$

First studies for ε'/ε



First measurement of direct $\mathcal{CP}$ violation at *KLOE* will be done using the double ratio

$$R = \frac{BR(K_L \to \pi^+\pi^-)/BR(K_S \to \pi^+\pi^-)}{BR(K_L \to \pi^o\pi^o)/BR(K_S \to \pi^o\pi^o)} = 1 + 6\,\Re e(\varepsilon'/\varepsilon)$$

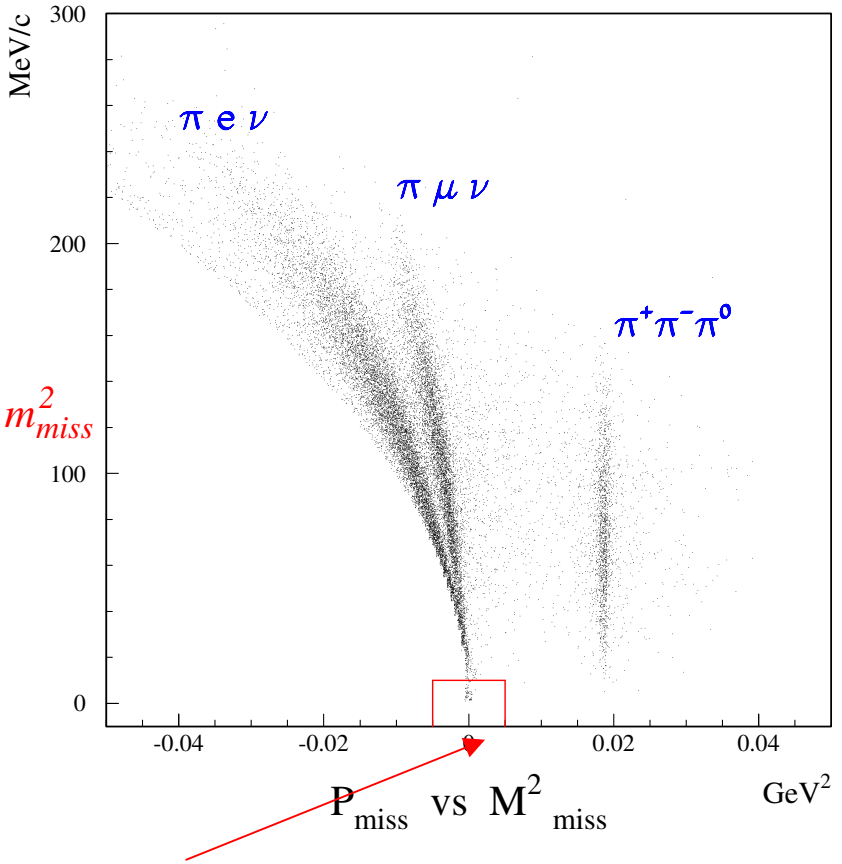
1999 data has been used to investigate the systematics for this measurement:

- tagging strategies
- background rejection
- vertex reconstruction
- definition of fiducial volume *FV*

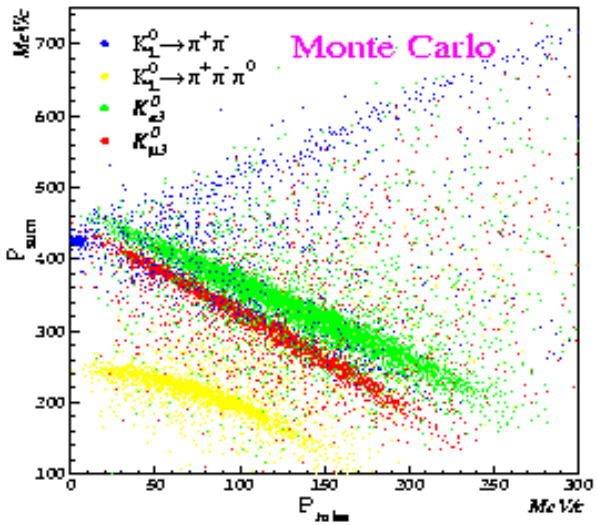
Isolation of $\mathcal{CP}$ violating decays $K_L \to \pi^+ \pi^-$

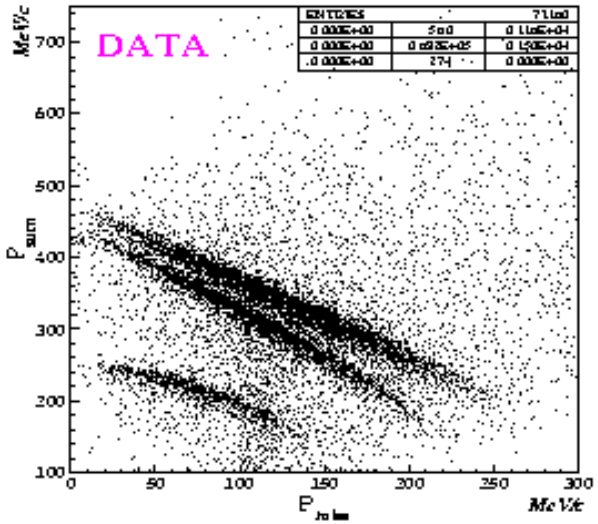
compute p_{miss} and m^2_{miss} under the hypothesis of $\pi\pi$ decay

$$m^2_{miss} = \begin{cases} 0 & K_L \to \pi^+\pi^- \\ < 0 & K_{\ell 3} \\ m^2_\pi & K_L \to \pi^+\pi^-\pi^o \end{cases}$$



$\mathcal{CP}$ violating events
$m^2_{miss} = p_{miss} = 0$





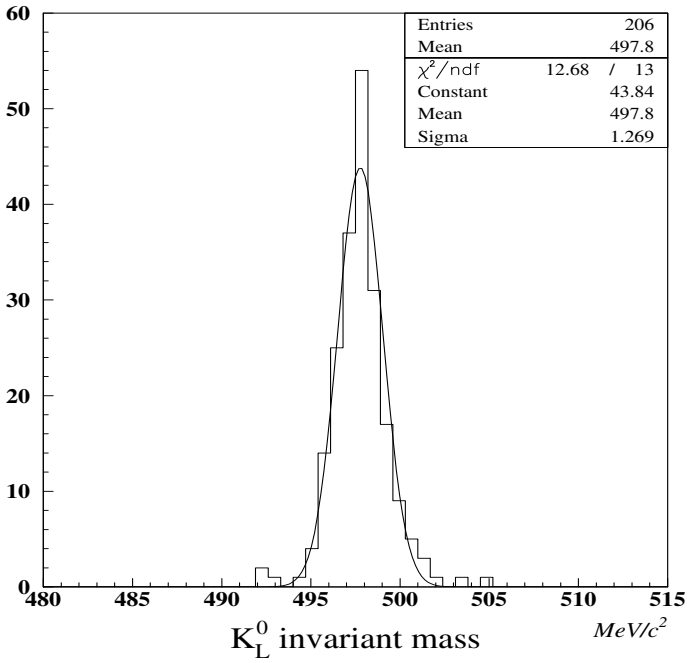
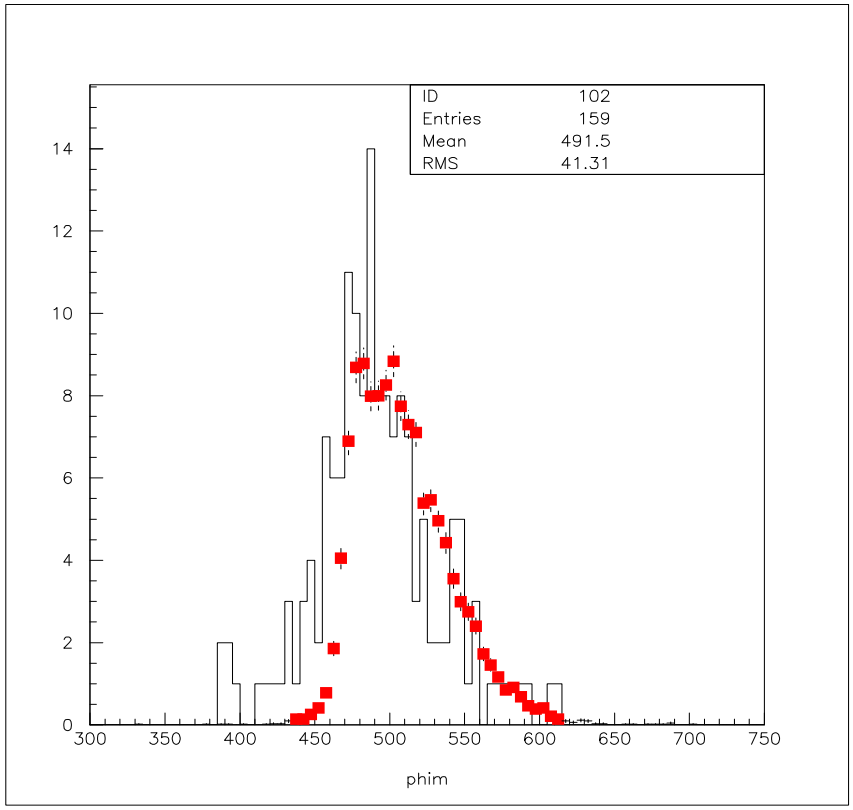
$$p_{sum} = | \vec{p}_+ | + | \vec{p}_- |$$

$$p_{miss} = | \vec{p}_{K_L} - \vec{p}_+ - \vec{p}_- |$$

$$\vec{p}_{K_L} = \vec{p}_\phi - \vec{p}_{K_S}$$

K_L decays and particle identification

$\mathcal{CP}$ violating K_L decays

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

$K_L \to \pi^o \pi^o$