Recent results from KLOE at DAΦNE

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on behalf of the KLOE Collaboration

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XLII Rencontres de Moriond on
ELECTROWEAK INTERACTIONS AND UNIFIED THEORIES
La Thuile, Aosta, Italy, 10 – 17 March 2007

Kaons at a ϕ-factory

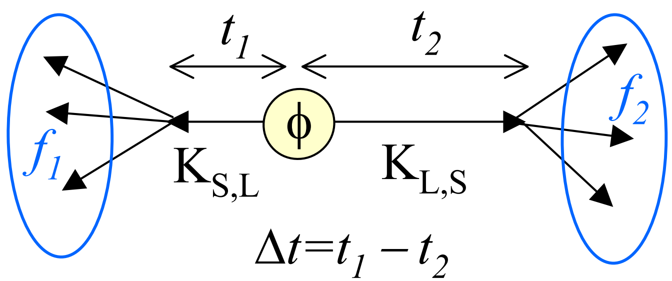
- $e^+e^- \to \phi$ $\sigma_\phi \sim 3\ \mu b$
  W = m_ϕ = 1019.4 MeV
- highly pure K_S, K_L, K^+, K^- beams

ϕ decay mode	BR
K^+K^-	**49.1%**
K_SK_L	**34.1%**

- ~10^6 neutral kaon pairs per pb^{-1} produced in an antisymmetric quantum state with $J^{PC} = 1^{--}$

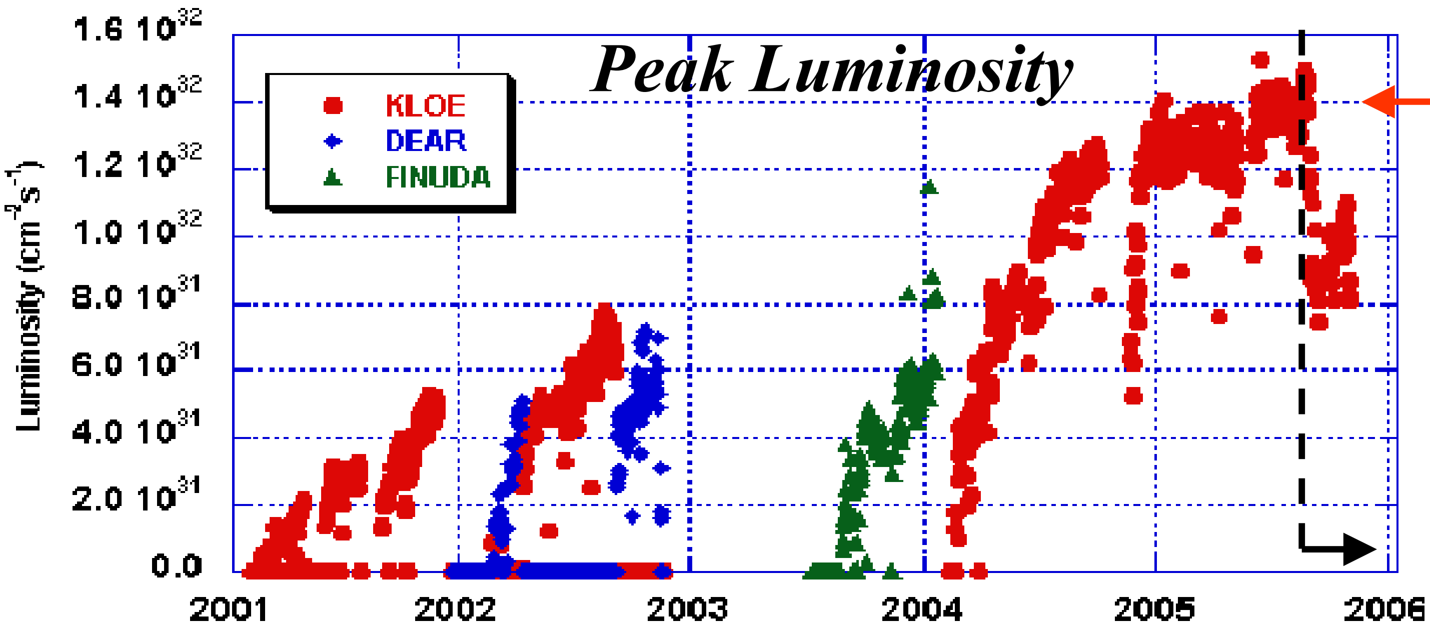
$$|i\rangle = \frac{1}{\sqrt{2}}\left[|K^0(+\vec{p})\rangle|\bar{K}^0(-\vec{p})\rangle - |\bar{K}^0(+\vec{p})\rangle|K^0(-\vec{p})\rangle\right]$$
$$= \frac{N}{\sqrt{2}}\left[|K_S(+\vec{p})\rangle|K_L(-\vec{p})\rangle - |K_L(+\vec{p})\rangle|K_S(-\vec{p})\rangle\right]$$

p_K = 110 MeV/c
λ_S = 6 mm **λ_L = 3.5 m**



The detection of a kaon at large (small) times tags a K_S (K_L)
$\Rightarrow$ possibility to select a pure K_S beam (**<u>unique</u>** at a ϕ-factory, not possible at fixed target experiments)

DAΦNE performance up to Dec 2005



L=1.4 x 10^{32} cm^{-2}s^{-1}

Off peak run

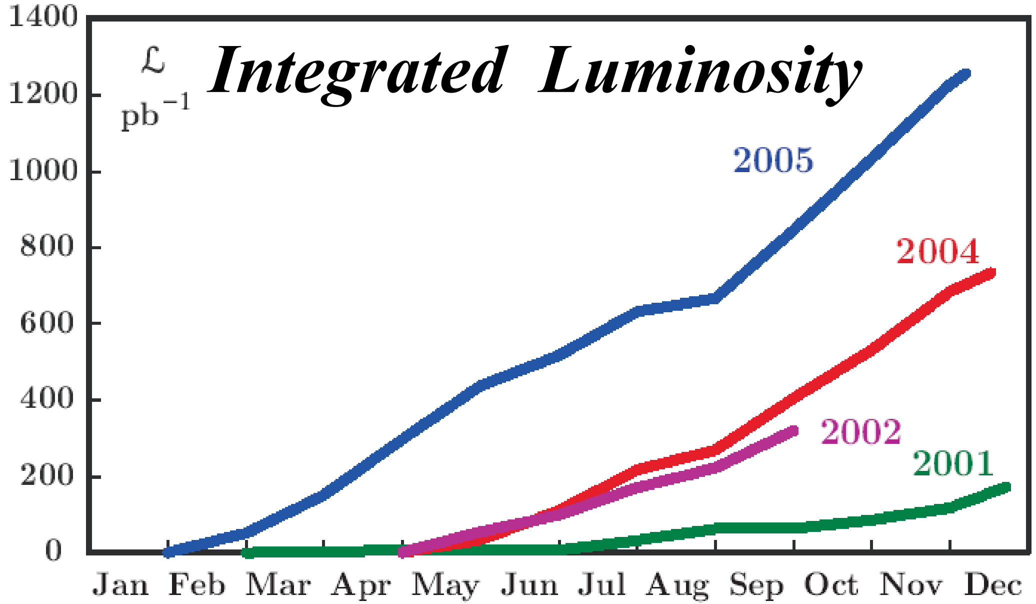
Day performance: 7-8 pb^{-1}

Best month $\int \mathcal{L}\, dt$ ~ 200 pb^{-1}

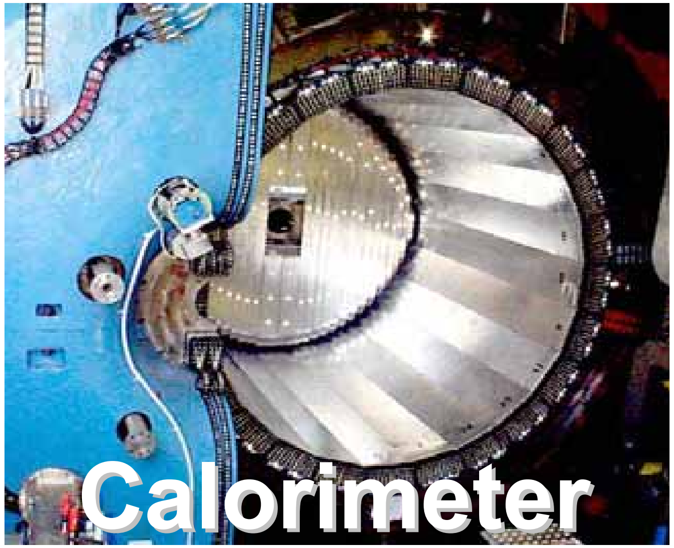
Total KLOE $\int \mathcal{L}\, dt$ ~ 2500 pb^{-1} (2001 - 05)

→ ~2.5×10^9 $K_S K_L$ pairs

→ ~3.6×10^9 K^+K^- pairs



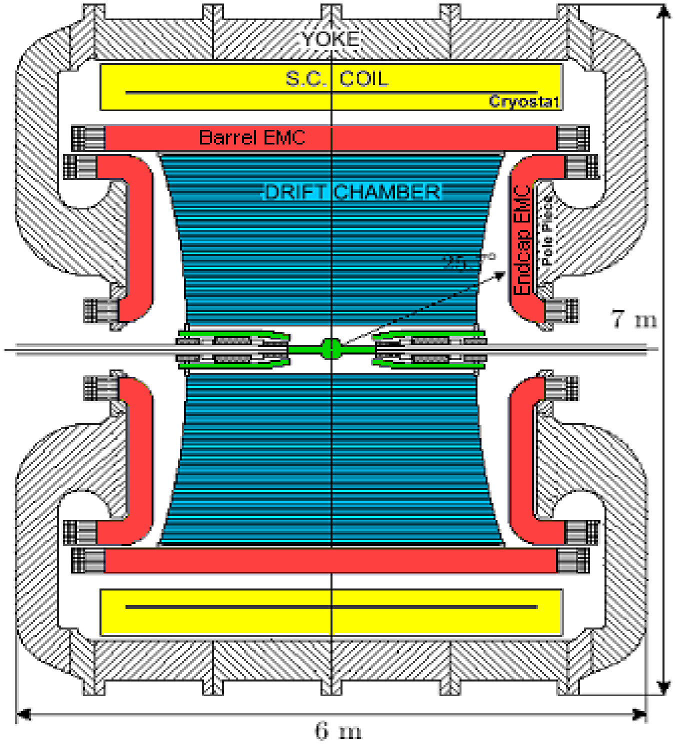
The KLOE detector



Lead/scintillating fiber
4880 PMTs
98% coverage of solid angle

Superconducting coil

B = 0.52 T



4 m diameter × 3.3 m length
90% helium, 10% isobutane
12582/52140 sense/total wires
All-stereo geometry

$\sigma_E/E \cong 5.7\% / \sqrt{E(\mathrm{GeV})}$

$\sigma_t \cong 54\ \mathrm{ps} / \sqrt{E(\mathrm{GeV})} \oplus 50\ \mathrm{ps}$
(relative time between clusters)

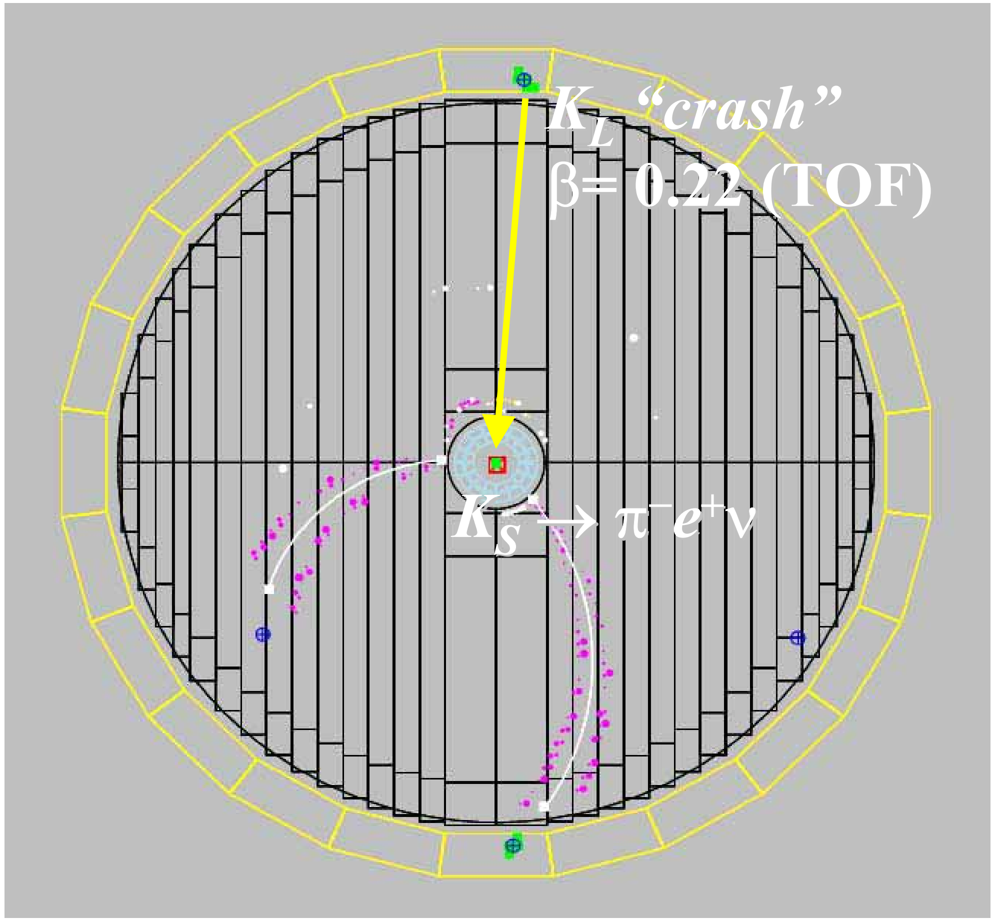
$\sigma_{\gamma\gamma} \sim 2\ \mathrm{cm}$ (π^0 from $K_L \to \pi^+\pi^-\pi^0$)

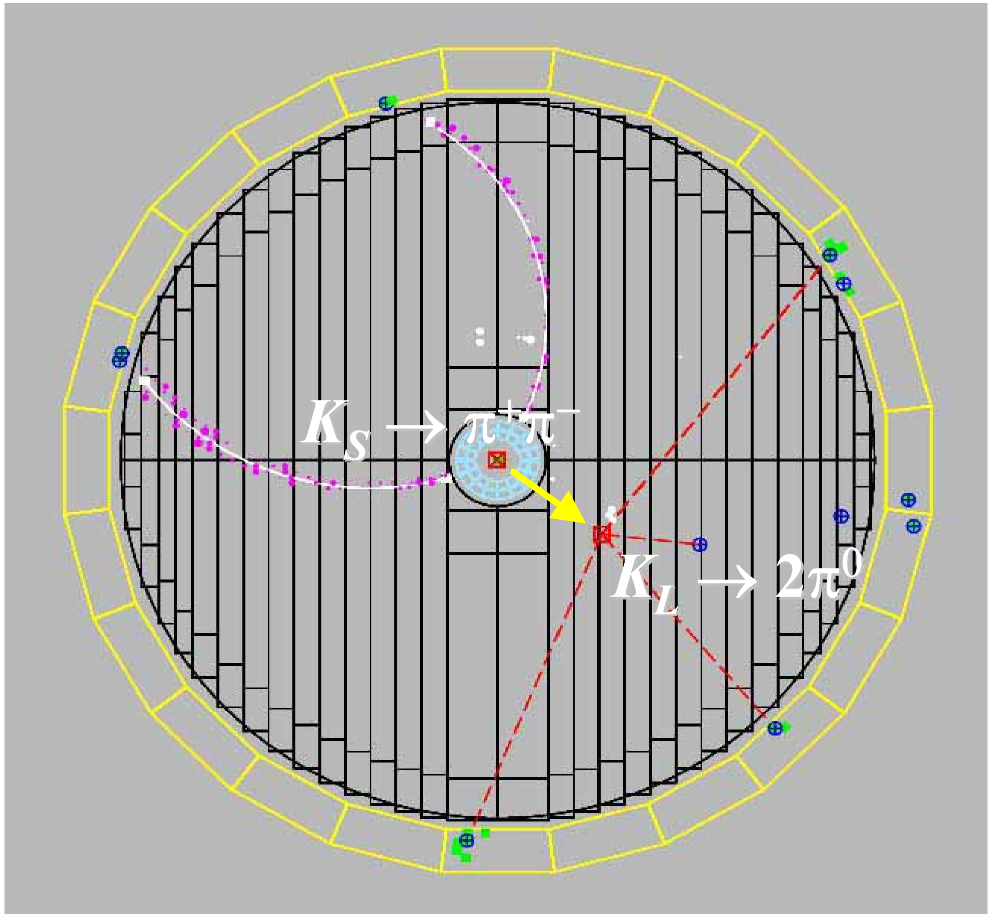
$\sigma_p/p \cong 0.4\ \%$ (tracks with $\theta > 45°$)

$\sigma_x^{hit} \cong 150\ \mu\mathrm{m}$ (xy), 2 mm (z)

$\sigma_x^{vertex} \sim 1\ \mathrm{mm}$

K_S and K_L Tagging





K_S tagged by K_L interaction in EmC
Efficiency ~ 30% (largely geometrical)
K_S angular resolution: ~ 1° (0.3° in ϕ)
K_S momentum resolution: ~ 2 MeV

K_L tagged by $K_S \to \pi^+\pi^-$ vertex at IP
Efficiency ~ 70% (mainly geometrical)
K_L angular resolution: ~ 1°
K_L momentum resolution: ~ 2 MeV

Search for the decay $K_S \to e^+e^-$

SM prediction is low but precise BR($K_S \to e^+e^-$) = 1.6×10^{-15} *[Ecker, Pich 91]*
leaving room for possible new physics effects to be detected

event selection (1.32 fb^{-1})

- K_S tagged by K_L crash
- 2 tracks from IP to EmC with M_{inv} [e+e- hypo] > 420 MeV

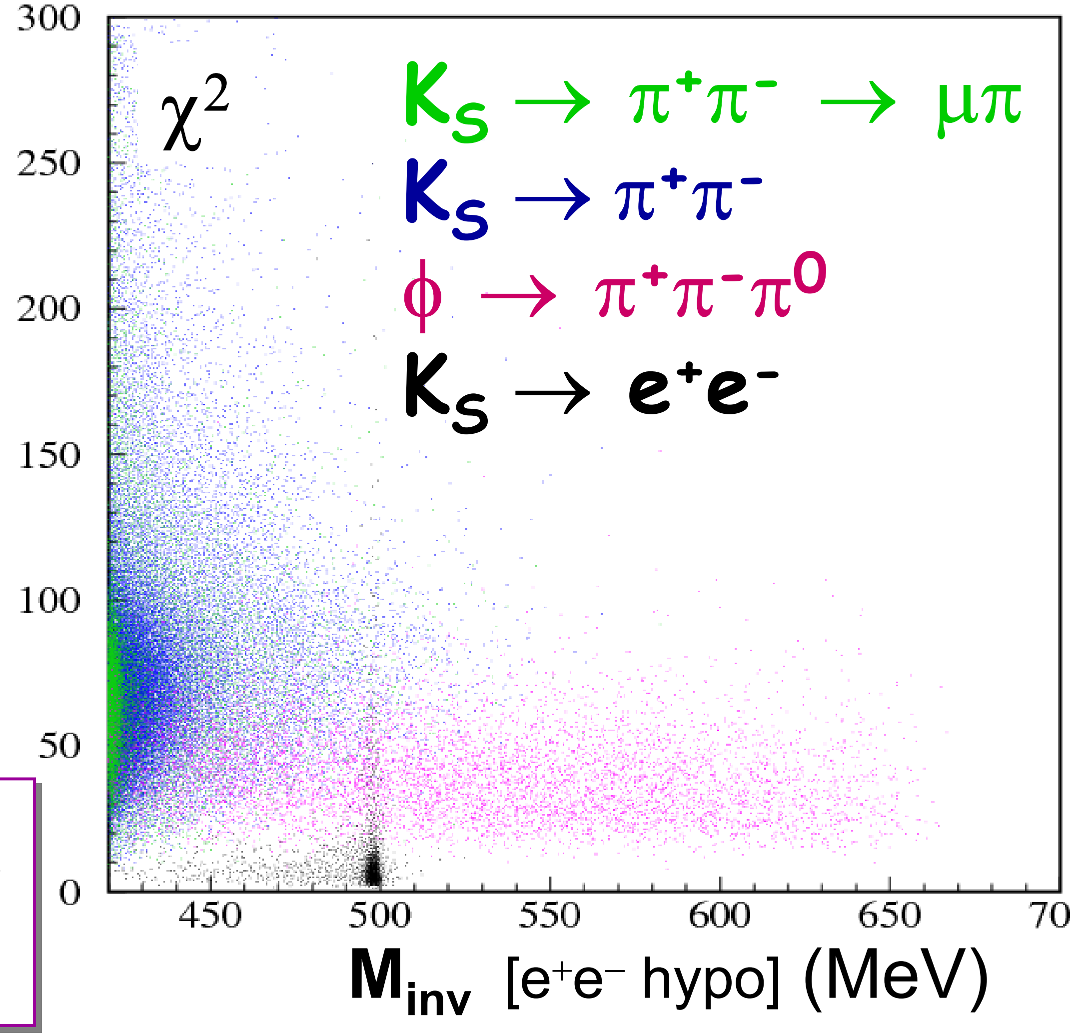
χ^2-like variable based on EmC:

- Σ and Δ of (T_{clu}-L/βc) for the 2 particles
- E/p
- transverse distance between track impact point and the closest EmC cluster

further bck rejection

- P* (π hypo) in the K_S rest frame > 220 MeV
- M_{miss} > 380 MeV to reject residual $\pi^+\pi^-\pi^0$

MC



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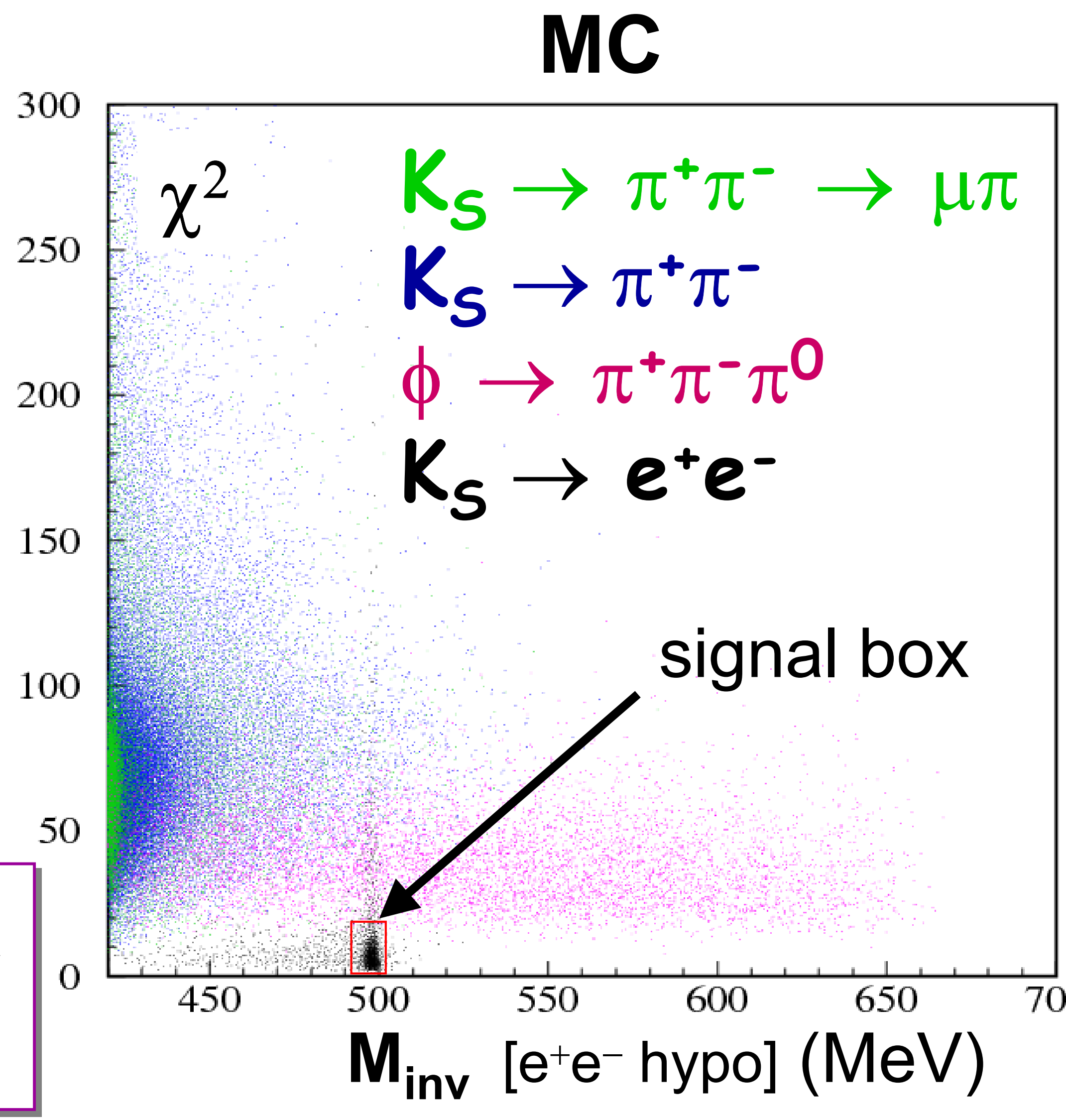


Search for the decay $K_S \to e^+e^-$

- optimization of signal box definition on MC: (492 < M_{inv} < 504) MeV and $\chi^2 < 20$
- in the signal box, we find $N_{obs} = 3$ and $\mu_{BKG} = 7.1 \pm 3.6$

- from these UL(μ_{sig}) = 4.3 @ 90% CL
  (without background subtraction UL(μ_{sig}) = 6.68 @ 90% CL)

- normalize signal counts to $K_S \to \pi\pi(\gamma)$ counts in the same data set

$$UL(BR) = UL(\mu_{sig}) \times \frac{\varepsilon_{\pi\pi}}{\varepsilon_{sig}} \times \frac{BR_{\pi\pi}}{N_{\pi\pi}}$$

$\varepsilon_{sig} = \varepsilon_{presel} \times \varepsilon_{sel} \times \alpha\gamma\text{-rad}\ (E^*_\gamma < 6\ \text{MeV}) = 0.785 \times 0.888 \times 0.8 = 0.558$

$\varepsilon_{\pi\pi} = 0.6$, $N_{\pi\pi} \sim 1.5 \times 10^8$

KLOE preliminary:

$BR(K_S \to e^+e^-(\gamma)) < 2.1 \times 10^{-8}$ @ 90% CL

CPLEAR: $< 1.4 \times 10^{-7}$

$K_S \to \gamma\gamma$

BR($K_S \to \gamma\gamma$) is an important test of χPT [PRD 49 (1994) 2346]

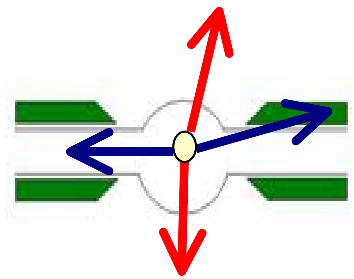
event preselection (1.6 fb^{-1})

- K_S tagged by K_L crash
- 2 and only 2 γ's with
  $E\gamma > 7$MeV
  $\cos(\theta_{\gamma\gamma}) > 0.95$
  $(T_\gamma - R/c) < 5\sigma_t$

event selection

- kinematic fit
  $P_{KS}(\gamma\gamma) = P_{KS}(K_L\text{crash})$
  $M_{\gamma\gamma} = M_{KS}$
  $T_\gamma = R/c$ for both γ's
- QCAL veto →

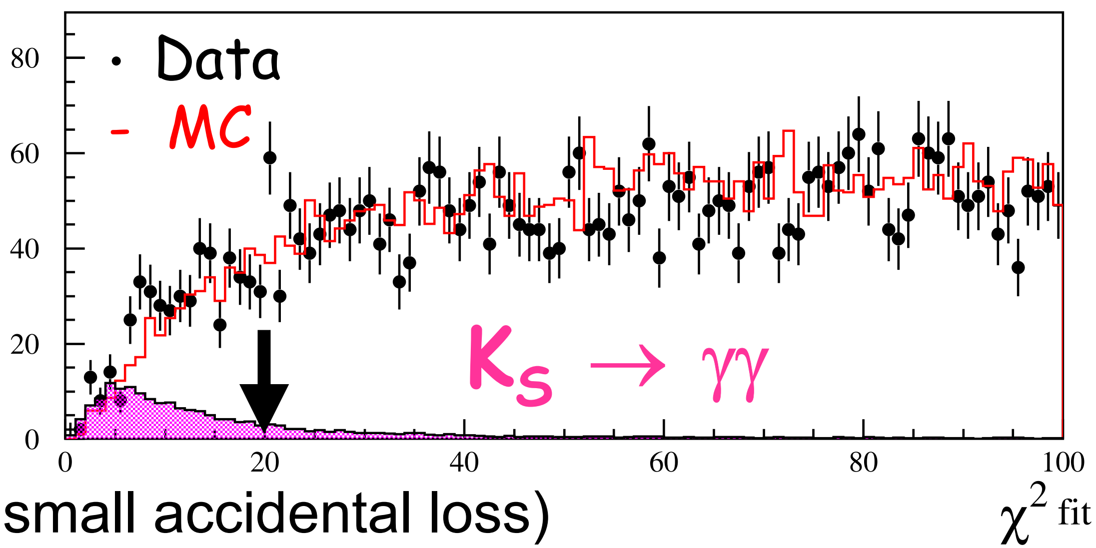
$K_S \to 2\pi^0$ (2γ bckg)



$$BR = N_{\gamma\gamma} \times \frac{\varepsilon_{2\pi 0}}{\varepsilon_{sig}} \times \frac{BR_{2\pi 0}}{N_{2\pi 0}}$$

$\varepsilon_{\gamma\gamma} = \varepsilon_{presel} \times \varepsilon_{sel} = 0.83 \times 0.63 = 0.52$

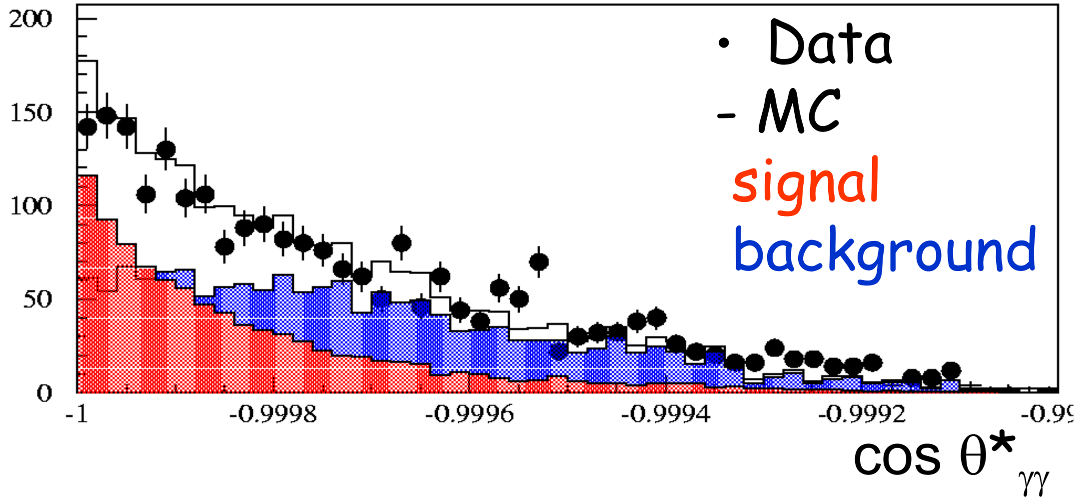
$\varepsilon_{2\pi 0} = 0.65$

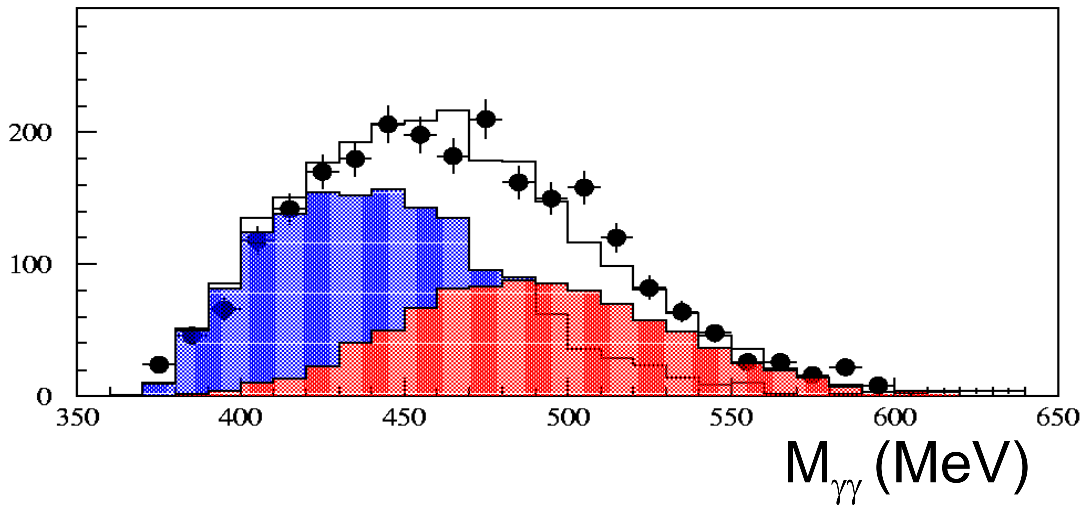


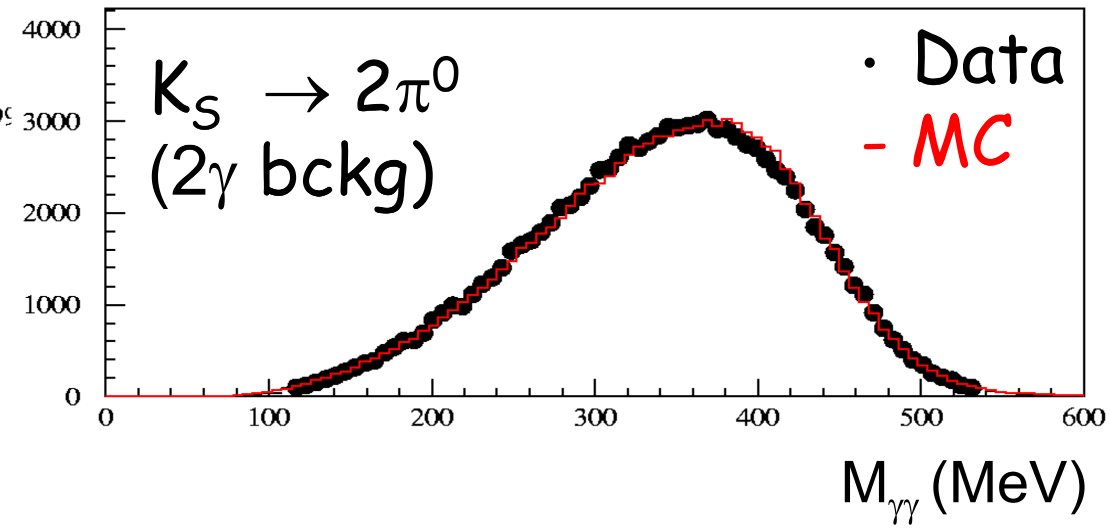
- ε(QCAL veto) ~ 100% on signal (very small accidental loss)

$K_S \rightarrow \gamma\gamma$

- count signal events fitting the 2D plot of $M_{\gamma\gamma}$ and $\cos\theta^*_{\gamma\gamma}$ in the K_S cms with MC shapes

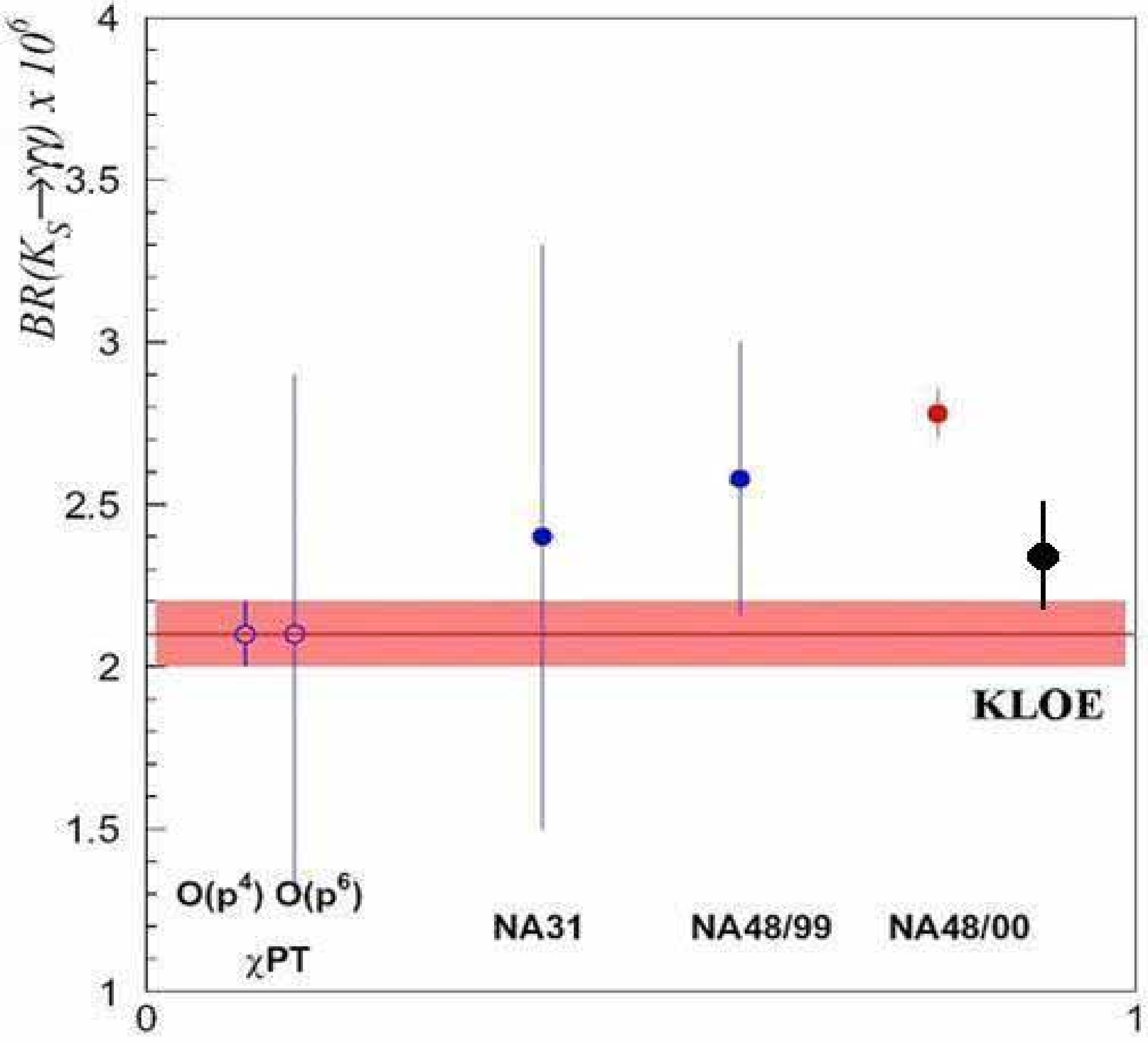






- $K_L \rightarrow \gamma\gamma$ control sample selected to further check the energy scale on data-MC
- signal free from $K_L \rightarrow \gamma\gamma$ bckg

$K_S \to \gamma\gamma$



KLOE preliminary:

BR = (2.35 ± 0.14) × 10^{-6}

- 2.7 σ from NA48 result
- 1.5 σ in agreement with χPT O(p^4) prediction

$K_L \to \pi e \nu \gamma$

measurement of BR and the Direct Emission term in the γ spectrum

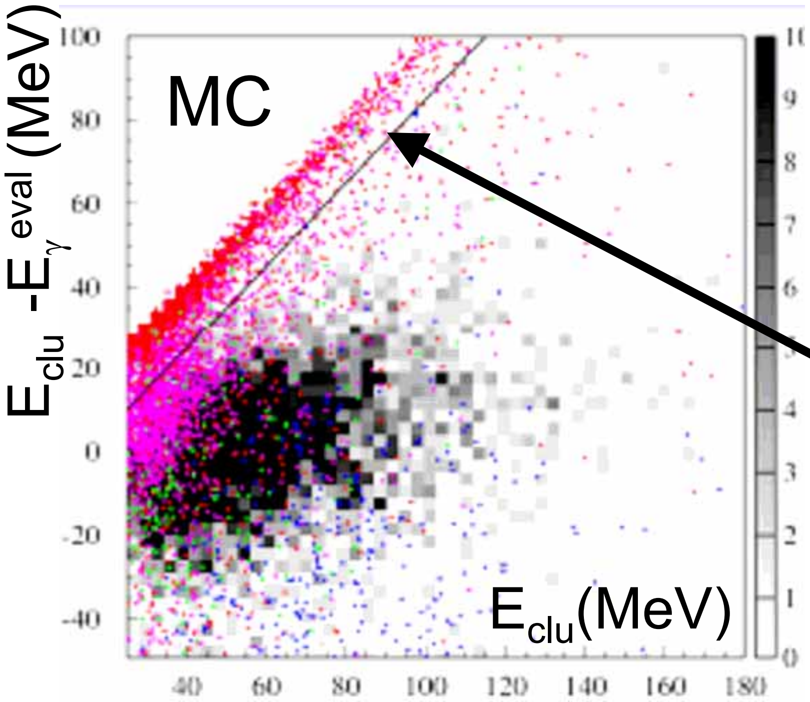
inclusive selection (328 pb^{-1}):

- K_L tagged by $K_S \to \pi^+\pi^-$
- (E_{miss}-$|\mathbf{P}_{miss}|$) in different mass hypothesis to remove ~90% of bck
- ToF to separate e/π (after PID ~ 0.7% contamination)

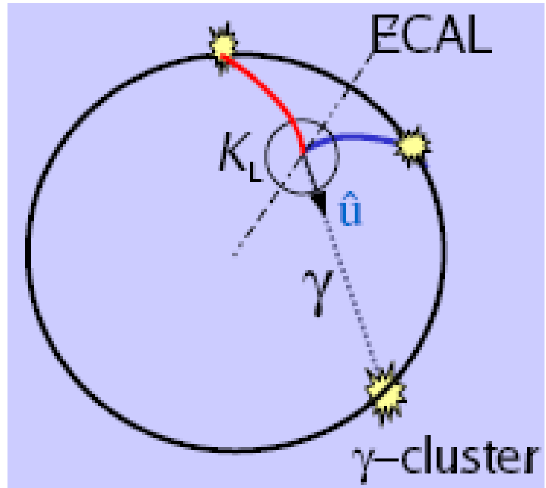
➔ 2×10^6 K_{e3}

radiative sample selection:

- $K_L\gamma$ vtx -> comparing ToF of K_L and the γ-cluster time
- cluster position to close the kinematic and evaluate $E\gamma$ -> $p_\nu^2 = 0 = (p_K - p_\pi - p_e - p_\gamma)^2$



Signal
$Ke3\gamma$ out of acceptance
not radiative K_{e3}
$\phi \to \pi^+\pi^-\pi^0$
$K\mu3$



bck reduction:

- this cut to remove not radiative K_{e3}
- E_{clu}> 25 MeV to remove accidentals
- NN trained with EmC infos to remove $K\mu3$ and $\pi^+\pi^-\pi^0$

$K_L \to \pi^+\pi^-\pi^0$ control sample to check γ efficiency, energy and vertex resolutions

$K_L \to \pi e \nu \gamma$

- fit 2D plot of E^*_γ and $\theta^*_{e-\gamma}$ with the MC shapes
- we measure:

$$R = \frac{BR(Ke3\gamma;\ E^*\gamma > 30\ \text{MeV},\ \theta^*_{e-\gamma} > 20^0)}{BR(Ke3(\gamma))}$$

theory [Gasser et al.,EPJ 40C (2005)205]:

R = (0.96 ± 0.01)% (uncertainty mainly due to the DE term)

KLOE preliminary:

$R = (0.92 \pm 0.02_{stat} \pm 0.02_{syst})\%$

with 2.5 pb^{-1} → $\pm 0.01_{stat}\%$

KTEV(05) R=(0.916 ± 0.017)%

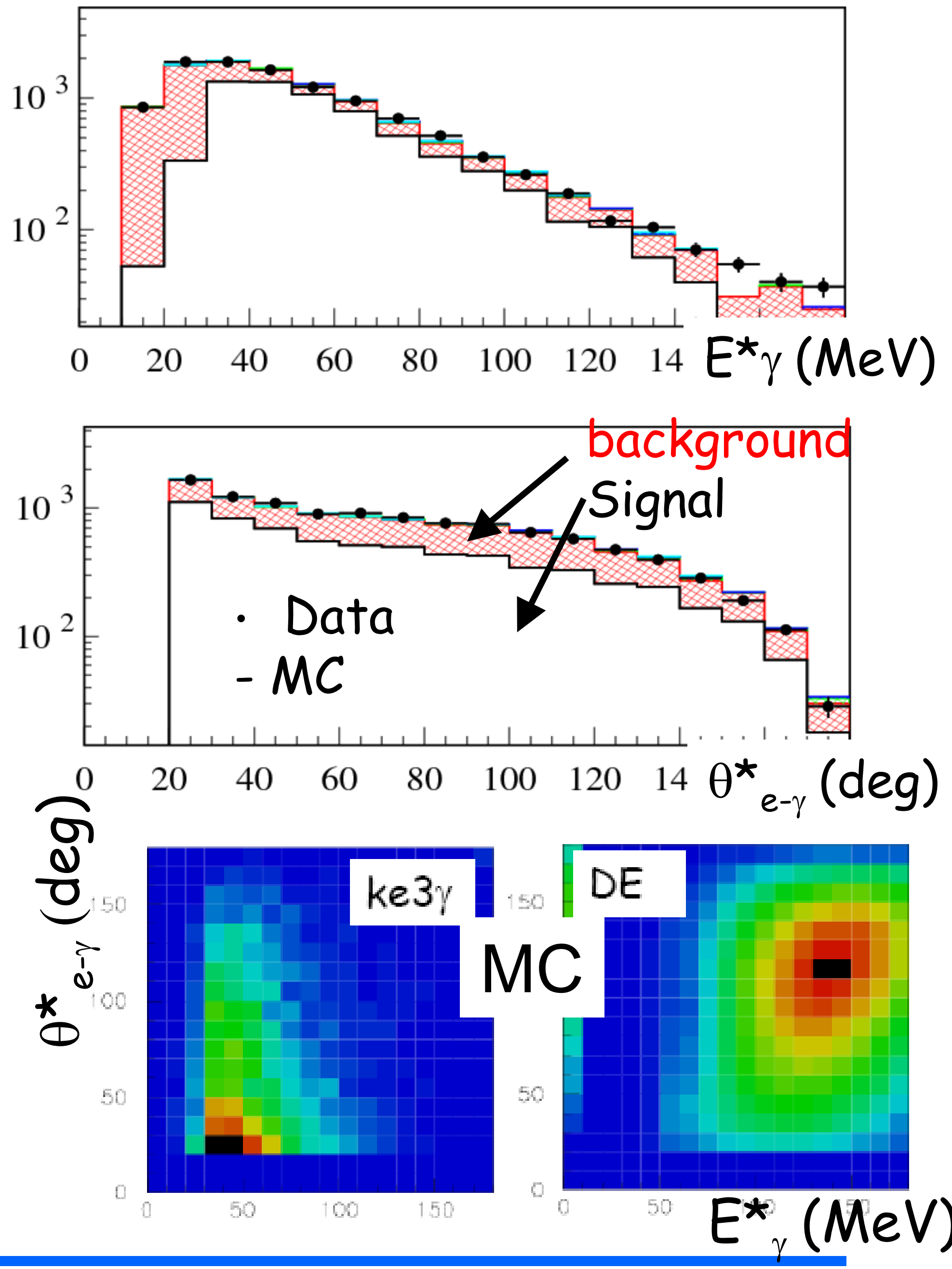
NA48(05) R=(0.964 ± 0.013)%

using DE-γ spectrum calculated in χPT $O(p^6)$ [Gasser et al. EPJ 40C (2005)205] →

KLOE preliminary:

$BR_{DE} = (-3.1 \pm 3.0) \times 10^{-5}$

$BR_{DE} < 2.5\times10^{-5}$ @ 90% CL



$K_{L\mu3}$ form factor slope λ_0

relevant for V_{us} and to test e/μ universality

Selection (328 pb^{-1}):

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

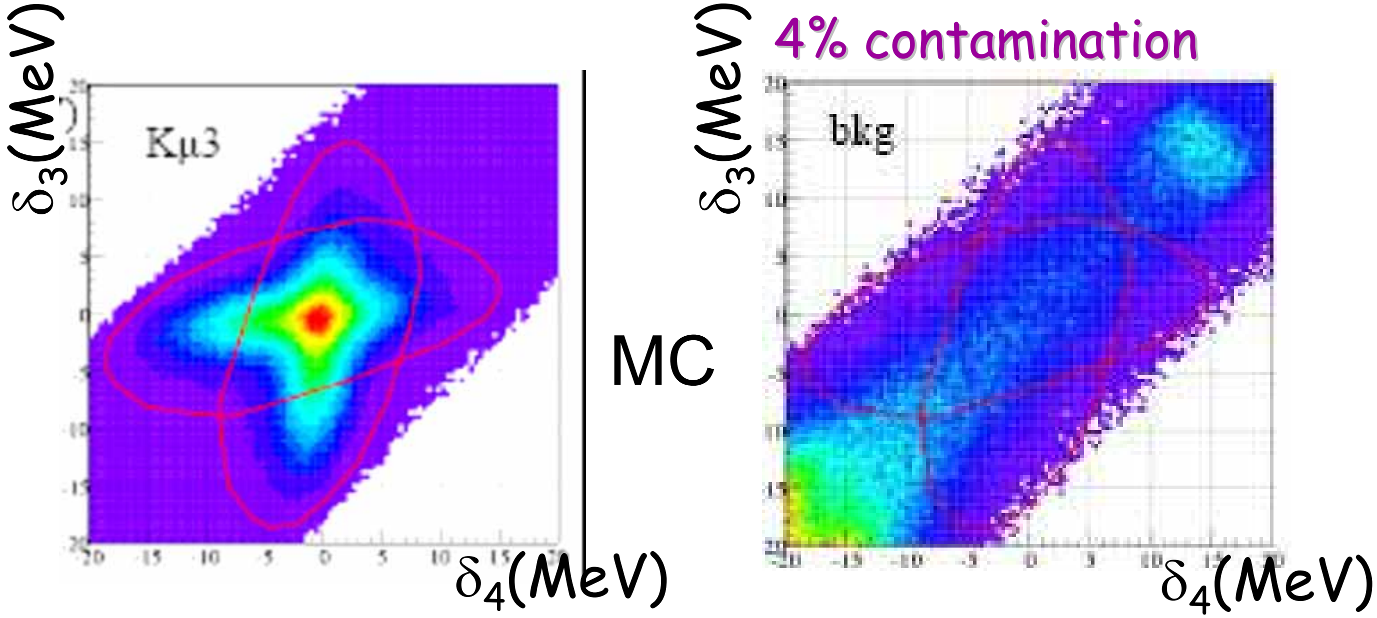
- veto on $\pi^+\pi^-$: $\sqrt{(E_{miss}(\pi,\pi)^2 + p^2_{miss})} > 10\,MeV$
- veto on $\pi^+\pi^-\pi^0$: $E_{miss}(\pi,\pi)^2 - p^2_{miss} - m^2_{\pi^0} > 10^{-3}\,MeV^2$
- veto on K_{e3}: $\min(|\delta_1|,|\delta_2|) > 10\,MeV$

$(\delta_1 = E_{miss}(\pi^+,e^-) - |\vec{p}_{miss}|, \delta_2 = E_{miss}(\pi^-,e^+) - |\vec{p}_{miss}|)$

- further cut on

  $\delta_3 = E_{miss}(\pi^+,\mu^-) - |\mathbf{p}_{miss}|$

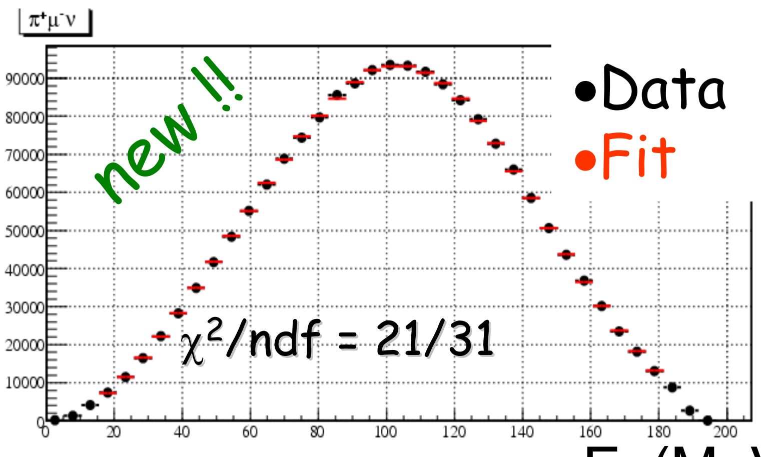
  $\delta_4 = E_{miss}(\pi^-,\mu^+) - |\mathbf{p}_{miss}|$

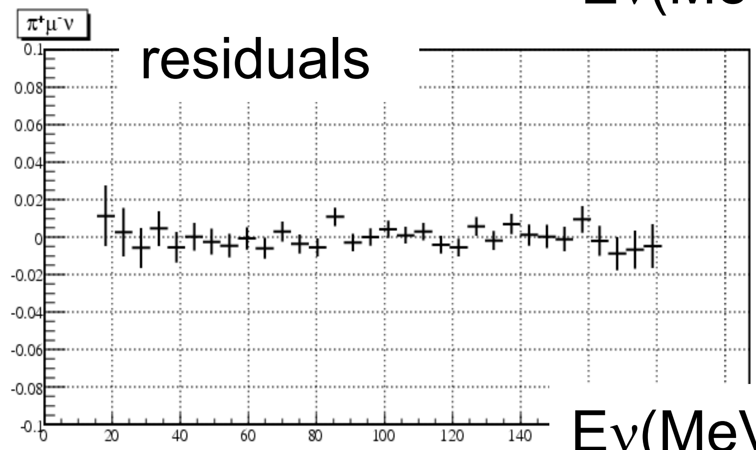


- background contamination reduced to $\cong$ 1.5% using NN and TOF measurements

$K_{L\mu3}$ form factor slope λ_0

π/μ separation at low energies is difficult ➔
λ_0 slope obtained by fitting the E_ν distribution, combined fit with K_{Le3} results for λ'_+, λ''_+



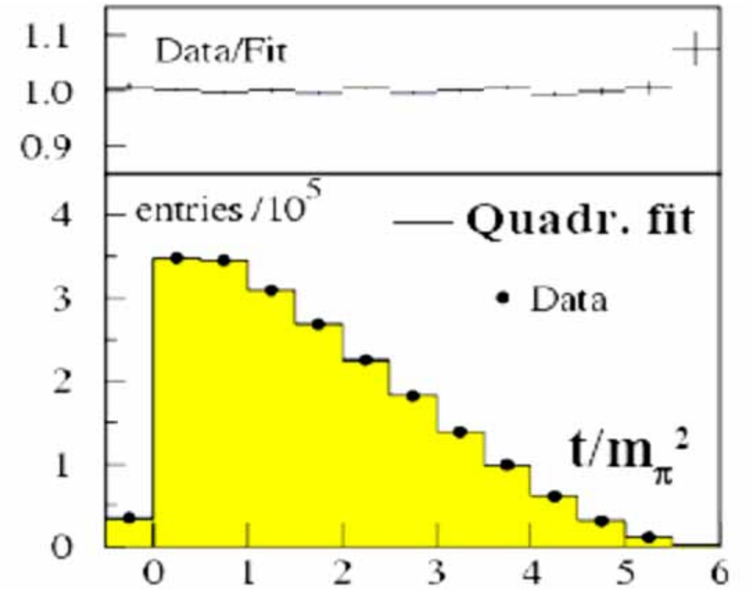


$\lambda'_+ = (25.6 \pm 1.8) \times 10^{-3}$
$\lambda''_+ = (1.44 \pm 0.79) \times 10^{-3}$

correlation matrix

λ'_+	λ''_+	λ_0
1	-0.95	0.31
X	1	-0.41
X	X	1

[PLB 636 (2006) 166]



KLOE preliminary: $\delta\lambda_0/\lambda_0$~ 5-10% with 2.5 fb^{-1}

$\lambda_0 = (15.6 \pm 1.8_{stat} \pm 1.9_{syst}) \times 10^{-3}$

KTeV PRD 70(2004) $\lambda_0 = (12.8 \pm 1.8)\times10^{-3}$ NA48 preliminary $\lambda_0 = (9.1 \pm 1.4)\times10^{-3}$
ISTRA+ PLB 589(2004) $\lambda_0 = (17.1 \pm 2.2)\times10^{-3}$

V_{us} $f_+(0)$ from KLOE results

	KLOE final			KLOE preliminary	
	K_L e3	K_L μ3	K_S e3	$K^\pm$e3	$K^\pm$μ3
BR	0.4008(15)	0.2699(15)	7.046(91)×10^{-4}	0.05047(92)	0.03310(81)
τ	50.84(23) ns		89.58(5) ps	12.367(78) ns	

Slopes KLOE final

$\lambda'_+ = 0.0256(18)$

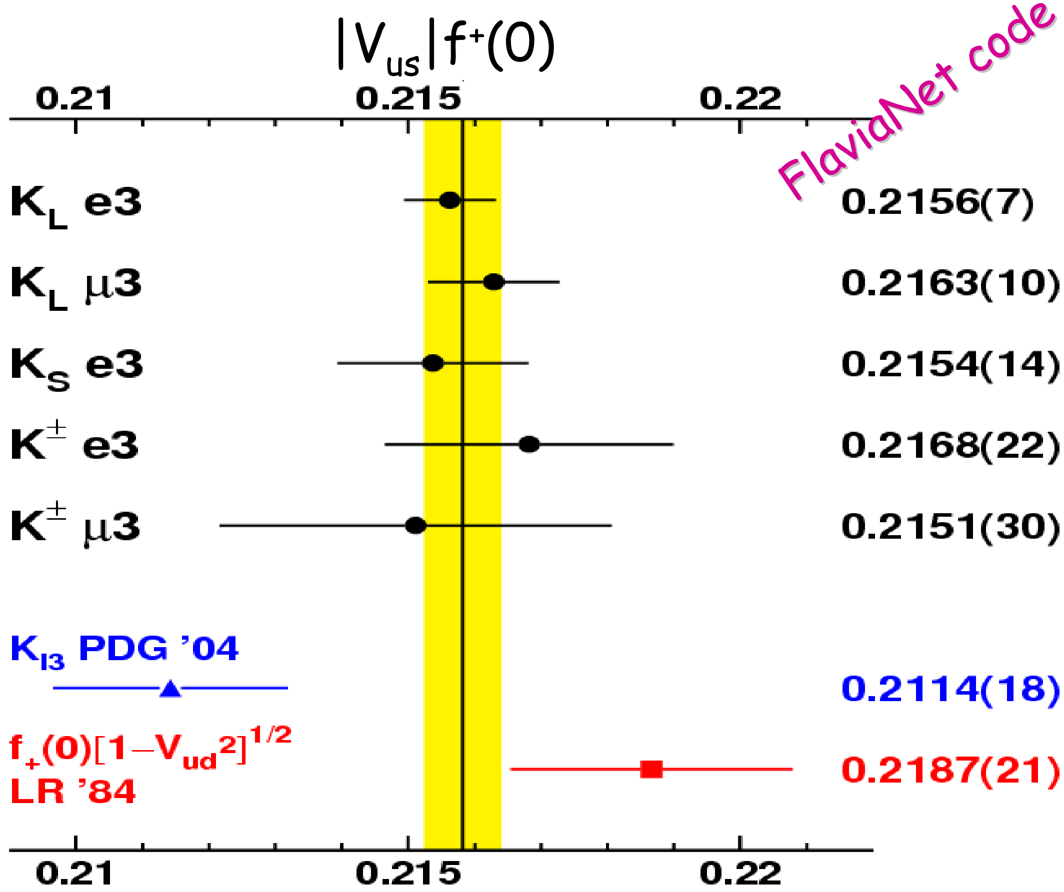
$\lambda''_+ = 0.0014(8)$

$\lambda_0 = 0.0156(26)$

KLOE prelim.

using $f_+(0) = 0.961(8)$, $V_{ud} = 0.97377(27)$

$\Delta = 1 - V_{ud}^2 - V_{us}^2 = (-13\pm10)\times10^{-4}$



$\langle V_{us}\times f_+(0)\rangle_{KLOE\ AV.} = 0.2158\pm0.0006$ (~ 0.3%)

From unitarity

- $f_+(0)=0.961(8)$
  Leutwyler and Roos Z. [Phys. **C25**, 91, 1984]
- $V_{ud}=0.97377(27)$
  Marciano and Sirlin [Phys.Rev.Lett.96 032002,2006]

$V_{us}\times f_+(0) = 0.2187(21)$

e/μ universality

K_L $[G_F(\mu)/G_F(e)]^2 = 1.0065(98)$
cfr with PDG04 1.047(14)

$K^\pm$ $[G_F(\mu)/G_F(e)]^2 = 0.984(25)$
cfr with PDG04 1.004(16)

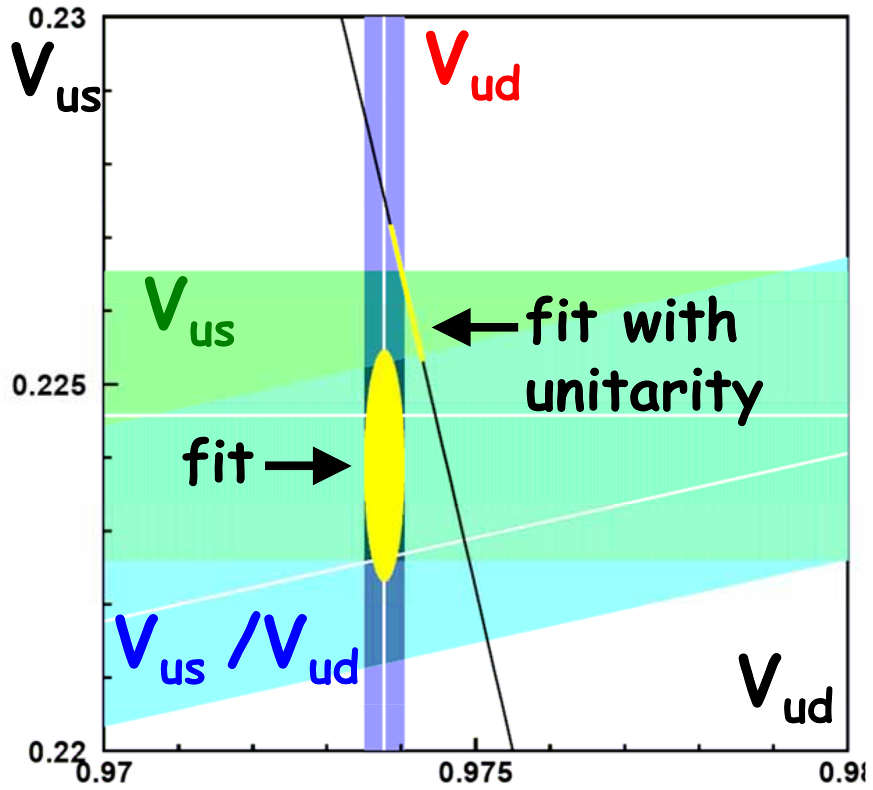
V_{us} – V_{ud} plane

- get $|V_{us}/V_{ud}|$ from K,π → μν widths: $$\frac{\Gamma(K\to\mu\nu(\gamma))}{\Gamma(\pi\to\mu\nu(\gamma))} \propto \left|\frac{V_{us}}{V_{ud}}\right|^2 \times \frac{f_K^2}{f_\pi^2}$$
(Marciano PRL93 231803, 2004)
- from the KLOE analysis of 175 pb^{-1} [PLB 632,76]

$BR(K^+\to\mu^+\nu(\gamma))$ = 0.6366(9)(15)

- from lattice [MILC Coll. 2006]

$f_K/f_p = 1.208(2)(^{+7}_{-14})$



Inputs

$V_{us}/V_{ud} = 0.2286(^{+27}_{-15})$

V_{us} = 0.2246(20)

K_{l3} KLOE, using $f_+(0)$=0.961(8)

V_{ud} = 0.97377(27)

Marciano and Sirlin
Phys.Rev.Lett.96 032002,2006

Fit results, no constraint

χ^2/ndf = 0.35/1
$P(\chi^2)$ = 0.56
V_{us} = 0.2239(16)
V_{ud} = 0.97377(27)

$\Delta = 1 - V_{ud}^2 - V_{us}^2 = (1.6\pm1.2)\times10^{-3}$

Fit results, unitarity constraint
χ^2/ndf = 3.74/2, $P(\chi^2)$ = 0.15, V_{us} = 0.2262(9), V_{ud} = 0.97407(22)

Recent KLOE published results on kaons

$K_S K_L \to \pi^+\pi^-\pi^+\pi^-$	QM and CPT tests	PLB 642(2006) 315	
Bell-Steinberger rel.	CP and CPT violation parameters	JHEP 0612(2006)011	
$K_S \to \pi e \nu$	BR, charge asymmetry, form factor slope	PLB 636(2006) 173	NEW PDG06
$K_S \to \pi^+\pi^-, \pi^0\pi^0$	$\Gamma(\pi^+\pi^-)/\Gamma(\pi^0\pi^0)$	EPJ C48(2006) 767	NEW PDG06
$K_S \to \pi^0\pi^0\pi^0$	upper limit on BR at 10^{-7}	PLB 619(2005) 61	NEW PDG06
$K_L \to \pi e \nu, \pi\pi\pi$	Absolute BR's KL lifetime from Sum BR's =1	PLB 632(2006) 43	NEW PDG06
K_L lifetime	from $K_L \to \pi^0\pi^0\pi^0$	PLB 626(2005) 15	NEW PDG06
$K_L \to \pi^+\pi^-$	BR to 1.1%	PLB 638(2006) 140	NEW PDG06
$K_L \to \pi e \nu$	form factor slopes	PLB 636(2006) 166	NEW PDG06
$K^+ \to \mu^+ \nu$	Absolute BR	PLB 632(2006) 76	NEW PDG06

CPT test: the Bell-Steinberger relation

Measurements of K_S K_L observables used for the CPT test from unitarity :

$$\begin{pmatrix} \dfrac{\Re\varepsilon}{1+|\varepsilon|^2} \\ \Im\delta \end{pmatrix} = \frac{1}{N}\begin{pmatrix} 1+k(1-2b) & (1-k)\tan\phi_{SW} \\ (1-k)\tan\phi_{SW} & -(1+k) \end{pmatrix}\begin{pmatrix} \sum_i \Re\alpha_i \\ \sum_i \Im\alpha_i \end{pmatrix}$$

$k = \tau_S/\tau_L$

$b = B(K_L \to \pi\ell\nu)$

$N = (1+k)^2 + (1-k)^2\tan^2\phi_{SW} - 2bk(1+k)$

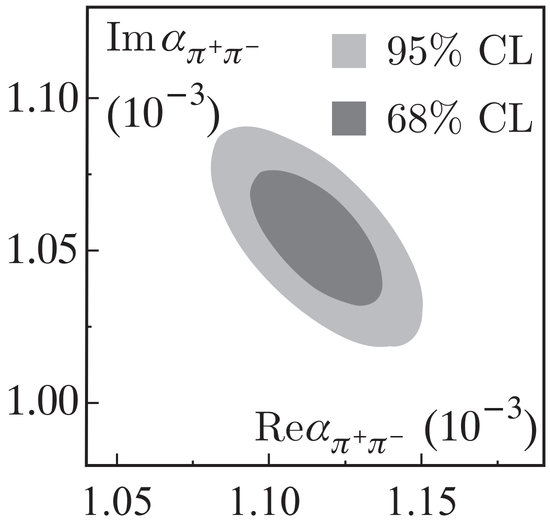
$\alpha_{+-} = \eta_{+-}\, B(K_S\to\pi^+\pi^-)$ $\quad \alpha_{+-0} = \tau_S/\tau_L\, \eta_{+-0}^{*}\, B(K_L\to\pi^+\pi^-\pi^0)$

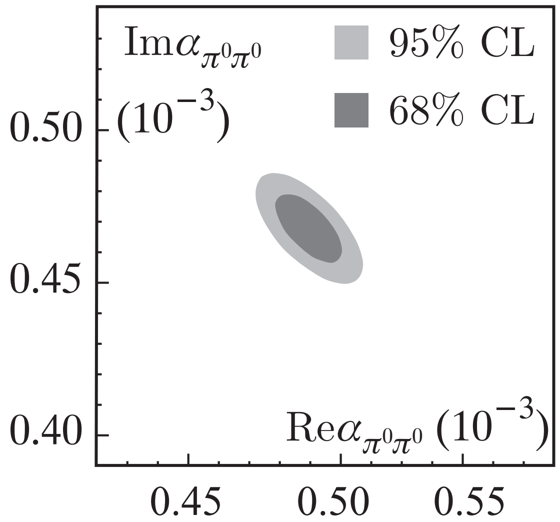
$\alpha_{00} = \eta_{00}\, B(K_S\to\pi^0\pi^0)$ $\quad \alpha_{+-\gamma} = \eta_{+-}\, B(K_S\to\pi^+\pi^-\gamma)$ $\quad \alpha_{000} = \tau_S/\tau_L\, \eta_{000}^{*}\, B(K_L\to\pi^0\pi^0\pi^0)$

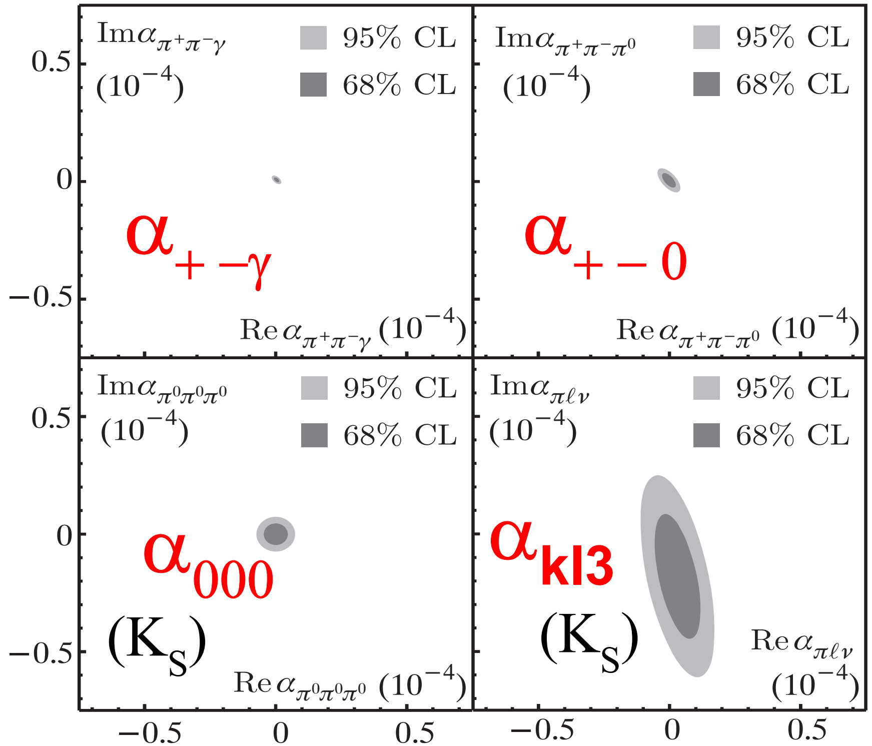
$\alpha_{kl3} = 2\tau_S/\tau_L\, B(K_L l3)\, [(A_S+A_L)/4 - i\, \mathrm{Im}\, x_+]$

main uncertainty now comes from η_{+-}

α_{+-} $\quad$ α_{00}







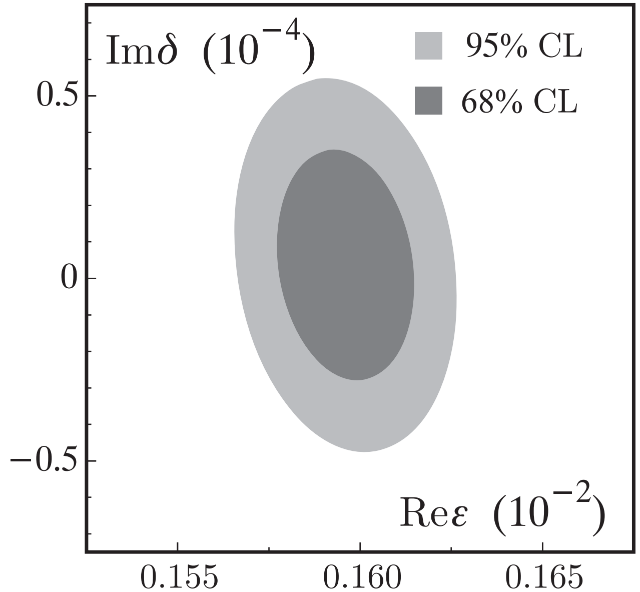
CPT test: the Bell-Steinberger relation

JHEP12(2006) 011

KLOE result:

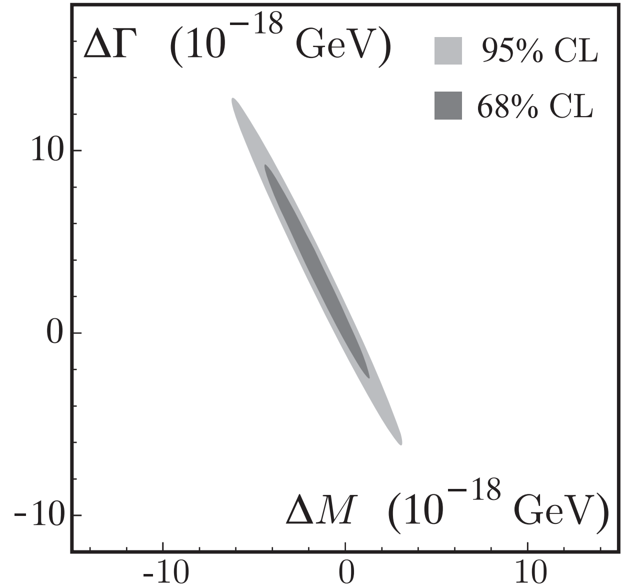
Re ε = (159.6 ± 1.3) ×10^{-5}
Im δ =(0.4 ± 2.1) × 10^{-5}

CPLEAR:
Re ε = (164.9 ± 2.5) × 10^{-5}
Im δ =(2.4 ± 5.0) × 10^{-5}



$$\Delta\Gamma = \Gamma\left(K^0\right) - \Gamma\left(\overline{K}^0\right)$$
$$\Delta M = M\left(K^0\right) - M\left(\overline{K}^0\right)$$

$$\delta = \frac{1}{2}\frac{\Delta M - \frac{i}{2}\Delta\Gamma}{\left(M_L - M_S\right) + \frac{i}{2}\left(\Gamma_S - \Gamma_L\right)}$$



Assuming ΔΓ=0, i.e. no CPT viol. in decay:
-5.3×10^{-19} GeV < ΔM < 6.3×10^{-19} GeV at 95% C.L.

$\phi \rightarrow K_S K_L \rightarrow \pi^+\pi^- \pi^+\pi^-$: test of quantum coherence

$$I(2\pi,2\pi;\Delta t) = \frac{N}{2}\Big[\left|\langle 2\pi,2\pi | K^0\overline{K}^0(\Delta t)\rangle\right|^2 + \left|\langle 2\pi,2\pi | \overline{K}^0 K^0(\Delta t)\rangle\right|^2$$

$$-2\Re\left(\langle 2\pi,2\pi | K^0\overline{K}^0(\Delta t)\rangle\langle 2\pi,2\pi | \overline{K}^0 K^0(\Delta t)\rangle^*\right)\Big]$$

$\phi \rightarrow K_S K_L \rightarrow \pi^+\pi^- \pi^+\pi^-$: test of quantum coherence

$$I(2\pi,2\pi;\Delta t) = \tfrac{N}{2}\Big[\left|\langle 2\pi,2\pi|K^0\bar{K}^0(\Delta t)\rangle\right|^2 + \left|\langle 2\pi,2\pi|\bar{K}^0K^0(\Delta t)\rangle\right|^2$$

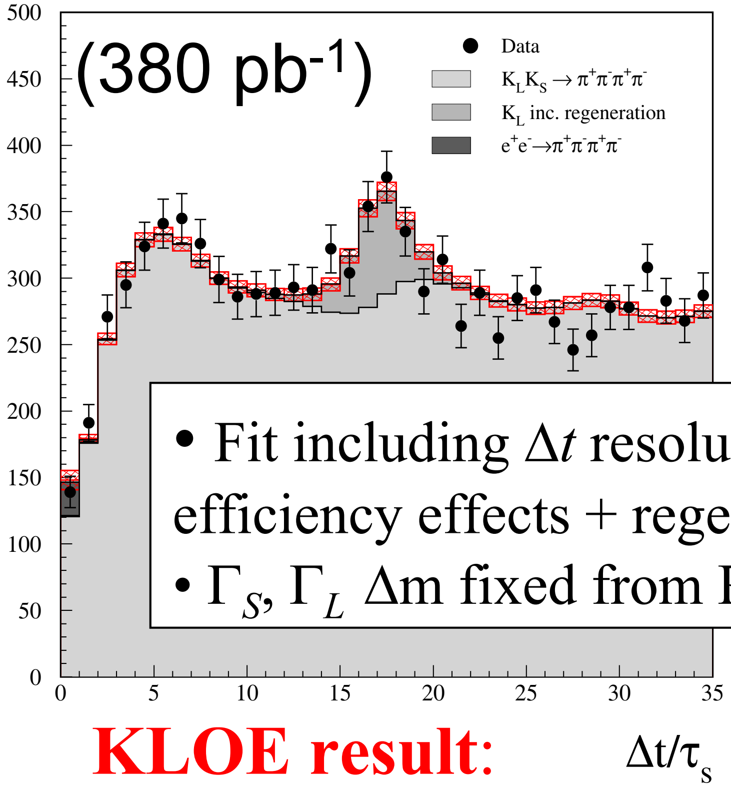
$$-\left(1-\zeta_{0\bar{0}}\right)\cdot 2\Re\left(\langle 2\pi,2\pi|K^0\bar{K}^0(\Delta t)\rangle\langle 2\pi,2\pi|\bar{K}^0K^0(\Delta t)\rangle^*\right)\Big]$$

Decoherence parameter:

$\zeta_{0\bar{0}} = 0 \rightarrow$ QM

$\zeta_{0\bar{0}} = 1 \rightarrow$ total decoherence

$\phi \to K_S K_L \to \pi^+\pi^- \pi^+\pi^-$: test of quantum coherence



- Fit including Δt resolution and efficiency effects + regeneration
- Γ_S, Γ_L Δm fixed from PDG

$$I(2\pi,2\pi;\Delta t) = \frac{N}{2}\Big[\left|\langle 2\pi,2\pi|K^0\bar{K}^0(\Delta t)\rangle\right|^2 + \left|\langle 2\pi,2\pi|\bar{K}^0 K^0(\Delta t)\rangle\right|^2$$

$$-\left(1-\zeta_{0\bar{0}}\right)\cdot 2\Re\left(\langle 2\pi,2\pi|K^0\bar{K}^0(\Delta t)\rangle\langle 2\pi,2\pi|\bar{K}^0 K^0(\Delta t)\rangle^*\right)\Big]$$

Decoherence parameter:

$\zeta_{0\bar{0}} = 0 \quad \to \quad$ QM

$\zeta_{0\bar{0}} = 1 \quad \to \quad$ total decoherence

KLOE result:

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$$\zeta_{0\bar{0}} = \left(1.0 \pm 2.1_{STAT} \pm 0.4_{SYST}\right)\times 10^{-6}$$

with 2.5 fb^{-1} : $\pm 0.8_{STAT} \times 10^{-6}$

as $O(|\eta_{+-}|^2) \sim 10^{-6}$ => high sensitivity to ζ

From CPLEAR data, Bertlmann et al. (PR D60 (1999) 114032) obtain:

$$\zeta_{0\bar{0}} = 0.4 \pm 0.7$$

In the B-meson system, BELLE coll. (quant-ph/0702267) obtains:

$$\zeta_{0\bar{0}}^{B} = 0.029 \pm 0.057$$

$\phi \to K_S K_L \to \pi^+\pi^- \pi^+\pi^-$: CPT violation in correlated K states

In presence of decoherence and CPT violation induced by quantum gravity (CPT operator "ill-defined") the definition of the particle-antiparticle states could be modified. This in turn could induce a breakdown of the correlations imposed by Bose statistics (EPR correlations) to the kaon state [Bernabeu, et al. PRL 92 (2004) 131601, NPB744 (2006) 180]:

$$|i\rangle \propto (K_S K_L - K_L K_S) + \omega (K_S K_S - K_L K_L)$$

|ω| could be at most: $$|\omega|^2 = O\left(\frac{E^2/M_{PLANCK}}{\Delta\Gamma}\right) \approx 10^{-5} \Rightarrow |\omega| \sim 10^{-3}$$

KLOE result (ω measured for the first time)

$$\Re\omega = \left(1.1^{+8.7}_{-5.3\,STAT} \pm 0.9_{SYST}\right) \times 10^{-4}$$

$$\Im\omega = \left(3.4^{+4.8}_{-5.0\,STAT} \pm 0.6_{SYST}\right) \times 10^{-4}$$

$$|\omega| < 2.1 \times 10^{-3} \quad \text{at } 95\%\ \text{C.L.}$$

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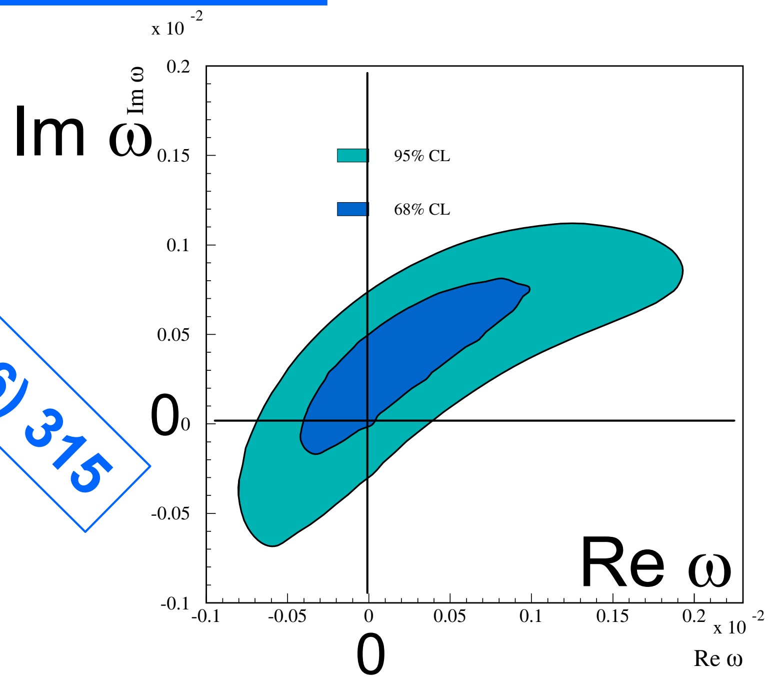
with L=2.5 fb^{-1}: $$\delta(\Re\omega) = \pm 2.8_{STAT} \times 10^{-4}$$ $$\delta(\Im\omega) = \pm 2.0_{STAT} \times 10^{-4}$$



Conclusions

- KLOE has obtained new preliminary results on:
  - BR($K_S \to e^+e^-(\gamma)$) < 2.1 $\times 10^{-8}$ @ 90% CL
  - BR ($K_S \to \gamma\gamma$) = $(2.35 \pm 0.14) \times 10^{-6}$
  - $K_L \to e\pi\nu\gamma$ -> R = $(0.92 \pm 0.02_{stat} \pm 0.02_{syst})\%$,
    $BR_{DE} < 2.5 \times 10^{-5}$ @ 90% CL
  - $K_{L\mu3}$ form factor slope $\lambda_0 = (15.6 \pm 1.8_{stat} \pm 1.9_{syst}) \times 10^{-3}$

- Recent KLOE measurements greatly improve knowledge of V_{US} ;
- Final results on $K^{\pm}_{l3}$, and $K^{\pm}$ lifetime (two different methods → see P. Massarotti's talk) are under way;
- Several parameters related to CPT and QM tests are measured at KLOE, Re(ω) and Im(ω) for the first time;
- With the analysis of the full data sample (2.5 fb^{-1}) KLOE will further improve all results;

- KLOE and DAΦNE are going to be upgraded.

KLOE-2 at upgraded DAΦNE

Proposals to upgrade DAΦNE in luminosity (and energy):

Crabbed waist scheme at DAΦNE (proposal by P. Raimondi)

- increase L by a factor *O*(5)
- requires minor modifications
- relatively low cost

- Experimental test at DAΦNE in autumn 2007
- If successful KLOE-2 data taking could start already in 2009

KLOE-2 Physics issues:

- Neutral kaon interferometry, CPT symmetry & QM tests
- Kaon physics, rare K_S decays
- η,η' physics
- Light scalars, $\gamma\gamma$ physics
- Hadron cross section at low energy, muon anomaly
- (baryon electromagnetic form factors, $e^+e^- \to pp$, nn, $\Lambda\Lambda$)

KLOE-2 Detector upgrade issues:

- Inner tracker R&D
- Calorimeter, increase of granularity
- FEE maintenance and upgrade
- Computing and networking update
- $\gamma\gamma$ tagging system
- etc.. (Trigger,software, …)