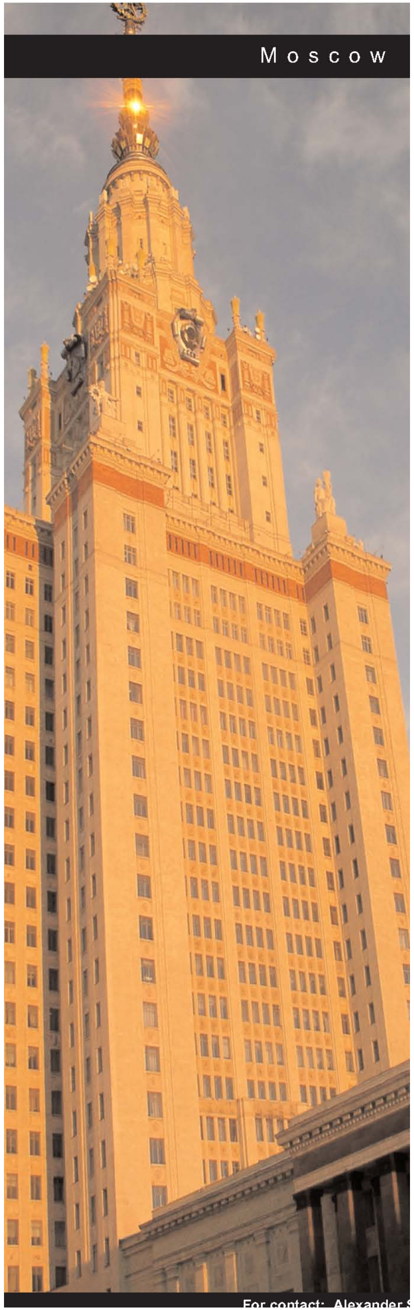


Recent results from KLOE experiment

A. De Santis

Univ. "Sapienza" & sez. INFN Roma

On behalf of the KLOE Collaboration

XIV Lomonosov Conference
Moscow State University
18-25 August 2009

Outline

- KLOE experiment
- Kaon physics
  - V_{us}
  - Quantum interference
  - $K_{e2}/K_{\mu 2}$
- Hadron physics
  - $\eta \rightarrow \pi\pi ee/eeee$
  - Gluonium
  - Scalars
  - Cross sections
- Conclusion and perspective

DAΦNE Facility at Frascati

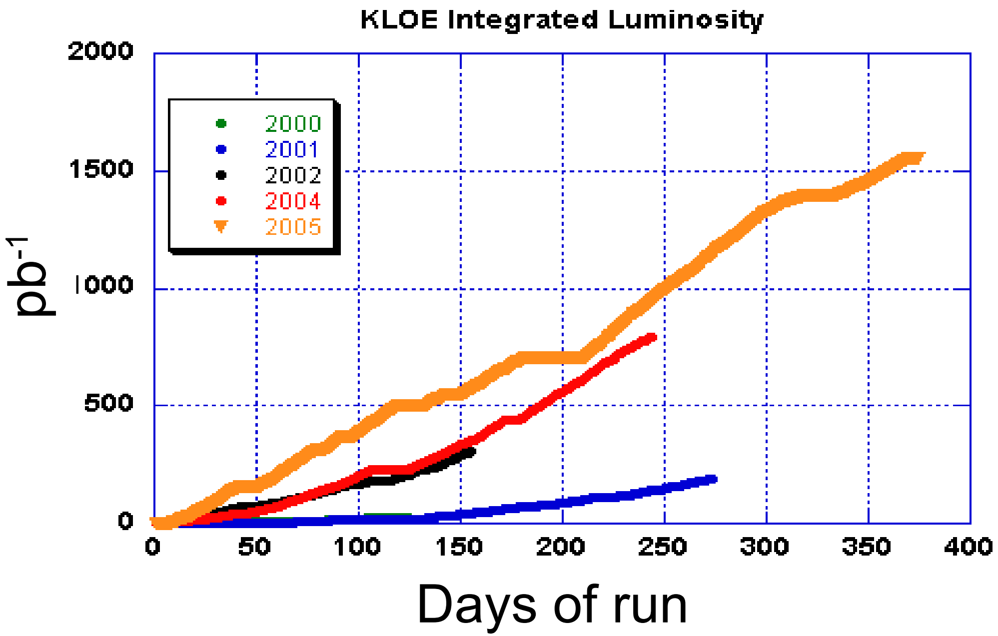
electron-positron collider

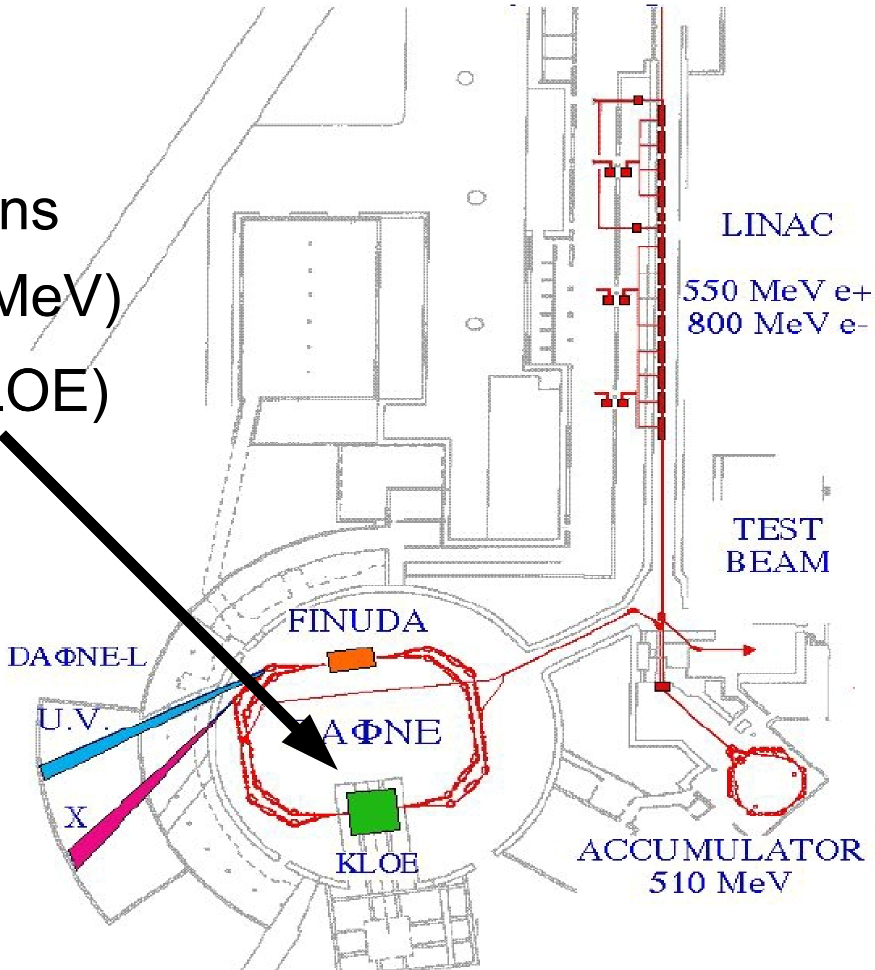
$\sqrt{s} = m_\phi = 1.019$ GeV $\sigma(\phi) \approx 3\ \mu b$

2 rings to minimize beam-beam interactions

2x12.5 mrad crossing angle ($p_x(\phi)$ ~12.5 MeV)

2 interaction regions (one reserved for KLOE)





Double Annular ring For Nice Experiments

The KLOE detector

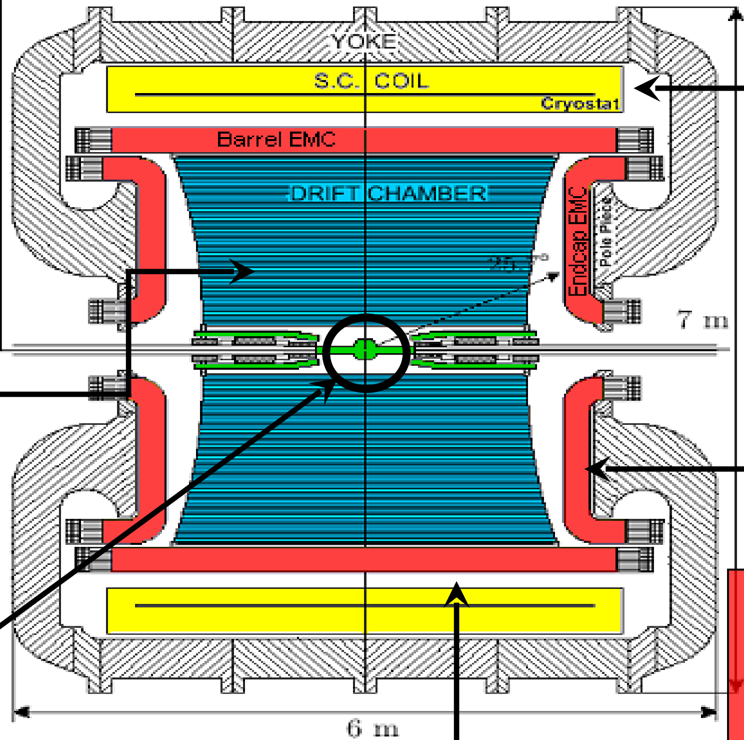
Drift Chamber

$\sigma_p/p \cong 0.4\ \%$

(tracks with $\theta > 45°$)

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

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



SC Magnet

B = 0.52 T

End Cap

Calorimeter e.m.

Both side read-out (PM)

~4π solid angle coverage

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

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

Barrel

Interaction point (IP)

Sphere Al-Be (Ø 10 cm)

V_{us}

Vus, CKM matrix, gauge universality

Standard-model coupling of quarks and leptons to W:

$$\frac{g}{\sqrt{2}} W_\alpha^+ \left(\overline{\mathbf{U}}_L \mathbf{V}_{\text{CKM}} \gamma^\alpha \mathbf{D}_L + \overline{e}_L \gamma^\alpha \nu_{e\,L} + \overline{\mu}_L \gamma^\alpha \nu_{\mu\,L} + \overline{\tau}_L \gamma^\alpha \nu_{\tau\,L} \right) \quad + \quad \text{h.c.}$$

↑ *Single gauge coupling*

↑ *Unitary matrix*

$$|V_{ud}|^2 + |V_{us}|^2 + |V_{ub}|^2 = 1$$

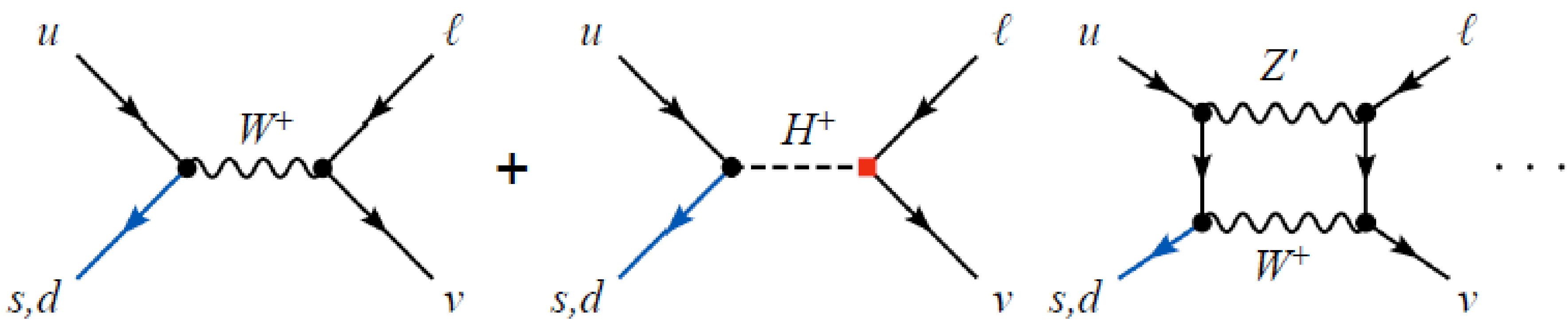
$|V_{ub}|^2 \approx 2\times10^{-5}$

Most precise test of CKM unitarity

Universality: Is G_F from μ decay equal to G_F from π, K, nuclear β decay?

$$G_\mu^2 = (g_\mu g_e)^2 / M_W^4 \quad \stackrel{?}{=} \quad G_{\text{CKM}}^2 = (g_q g_\ell)^2 \left(|V_{ud}|^2 + |V_{us}|^2\right) / M_W^4$$

Physics beyond the Standard Model can break gauge universality:



V_{us} from K_{l3}

$$\Gamma(K_{l3(\gamma)}) = \frac{C_K^2\, G_F^2\, M_K^5}{192\pi^3} S_{EW}\, |V_{us}|^2\, |f_+^{K^0\pi^-}(0)|^2 \times I_{Kl}(\{\lambda\}_{Kl})\,(1 + 2\Delta_K^{SU(2)} + 2\Delta_{Kl}^{EM})$$

with $K \in \{K^+, K^0\}$; $l \in \{e, \mu\}$, and:

C_K^2 1/2 for K^+, 1 for K^0

Inputs from theory:

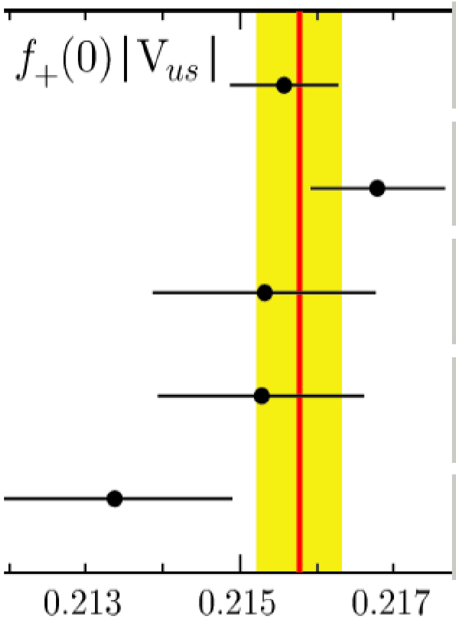
- S_{EW} — Universal short distance EW correction (1.0232)
- $f_+^{K^0\pi^-}(0)$ — Hadronic matrix element at zero momentum transfer (t=0)
- $\Delta_K^{SU(2)}$ — Form factor correction for strong SU(2) breaking
- Δ_{Kl}^{EM} — Long distance EM effects

Inputs from experiment:

- $\Gamma(K_{l3(\gamma)})$ — **Branching ratios** with well determined treatment of radiative decays; **lifetimes**
- $I_{Kl}(\lambda)$ — Phase space integral: λs parameterize form factor dependence on t:
  - K_{e3} : *only* λ_+ (or λ_+' λ_+'')
  - $K_{\mu3}$: *need* λ_+ *and* λ_0

$f_+(0)|V_{us}|$ à la KLOE

All KLOE inputs
but K_S lifetime



		err %
K_Le3	0.2155(7)	0.3
$K_L\mu3$	0.2167(9)	0.4
K_Se3	0.2152(14)	0.7
$K^{\pm}e3$	0.2152(13)	0.6
$K^{\pm}\mu3$	0.2132(15)	0.7

Comparing Ke3 with Kμ3
We can test lepton universality
with kaons

$$r_{\mu e} = \frac{|f_+(0)V_{us}|^2_{\mu 3}}{|f_+(0)V_{us}|^2_{e3}}$$

JHEP04(2008)059

$r_{\mu e} = 1.000(8)$

JHEP04(2008)059

$f_+(0)|V_{us}| = 0.2157(6)$ $\chi^2_{/ndof} = 7/4$ (13%)

$|V_{us}| = 0.2237(13) \Rightarrow 1-|V_{us}|^2-|V_{ud}|^2 = 9(8)\times10^{-4}$

$f_+(0)=0.964(5)$ PRL 100 (2008)

$|V_{ud}| = 0.97418(26)$ PRC 77 (2008)

Constraining CKM unitarity

$|V_{us}/V_{ud}| = 0.2323(15)$ — { BR($K^{\pm} \to \mu^{\pm} \nu$) = 0.6366(17); f_K/f_π = 1.189(7) }

PLB 632 (2006)

PRL 100 (2008)

$|V_{us}| = 0.2237(13)$ from Kl3 decays

$|V_{ud}| = 0.97418(26)$

- Fit to $|V_{ud}|^2$, $|V_{us}|^2$ and $|V_{us}/V_{ud}|^2$

  JHEP 04 (2008)

  $|V_{ud}|^2 = 0.9490(5)$
  $|V_{us}|^2 = 0.0506(4)$
  $\chi^2 = 2.3/1$ (13%)

- Agreement with unitarity

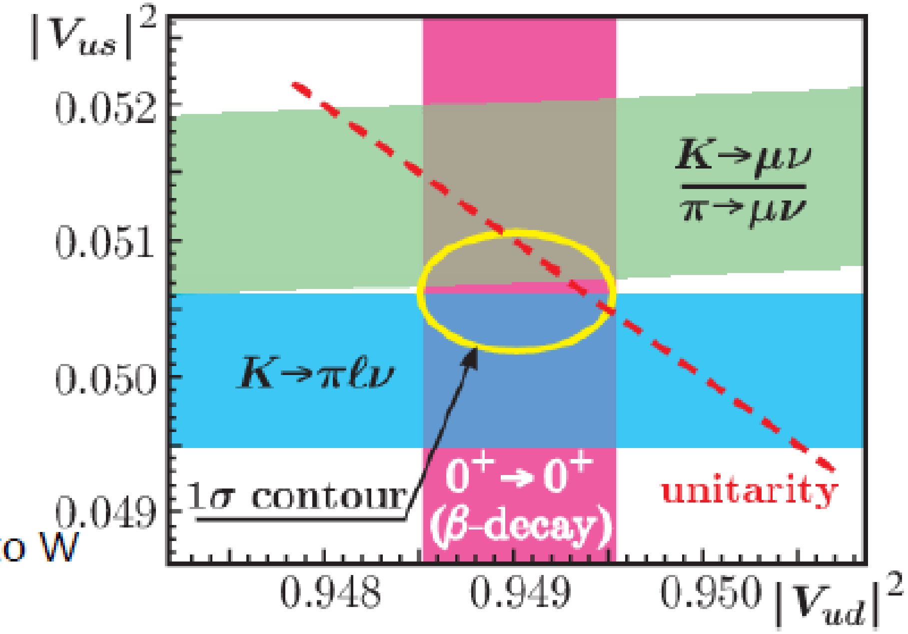
  $1 - V_{ud}^2 - V_{us}^2 = 4(7) \times 10^{-4}$ @0.6σ

- Universality of lepton and quark weak coupling to W

  $G_F = 1.166371(6) \times 10^{-5}$ GeV^{-2}
  $G_{CKM} = 1.16604(40) \times 10^{-5}$ GeV^{-2}
  $G_{ew} = 1.1655(12) \times 10^{-5}$ GeV^{-2}

$$G_F^2 \equiv G_{CKM}^2 = \left(|V_{ud}|^2 + |V_{us}|^2\right) G_F^2$$

from ew precision tests



Sensitivity to new physics: an example

Using the determination of V_{us} from K_{l3} and V_{ud} from superallowed β decay and the ratio $K_{\mu2}/\pi_{\mu2}$ we can explore new physics model.

The observable

$$R_{\ell 23} = \left| \frac{V_{us}(K_{\mu 2})}{V_{us}(K_{\ell 3})} \times \frac{V_{ud}(0^+ \to 0^+)}{V_{ud}(\pi_{\mu 2})} \right|$$

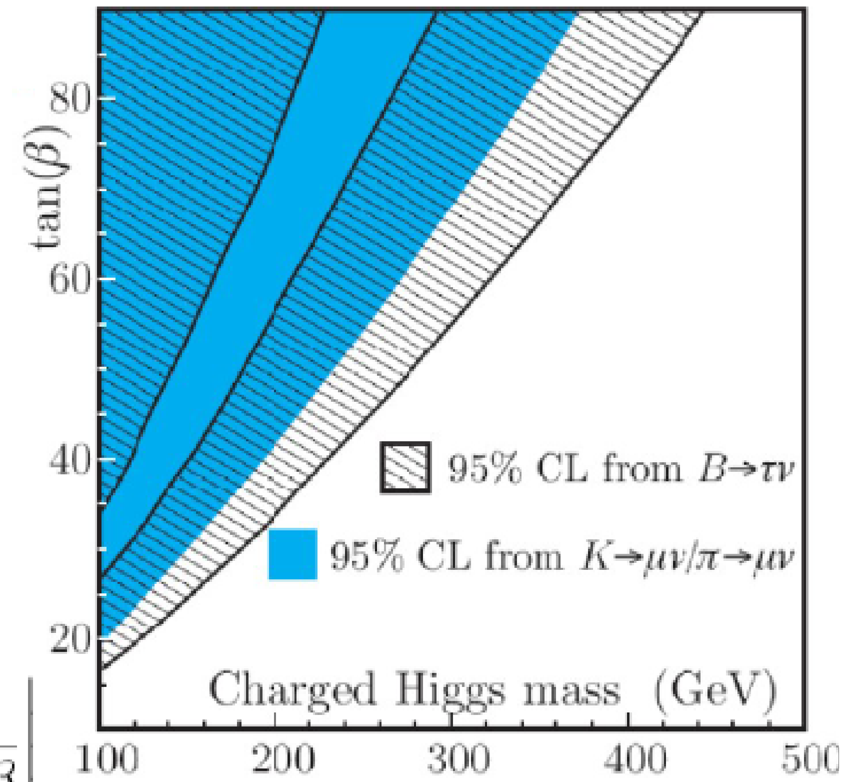
we get:

- R_{l23} **= 1.008(8)**

(unitarity for K_{l3} and β-decays is used)

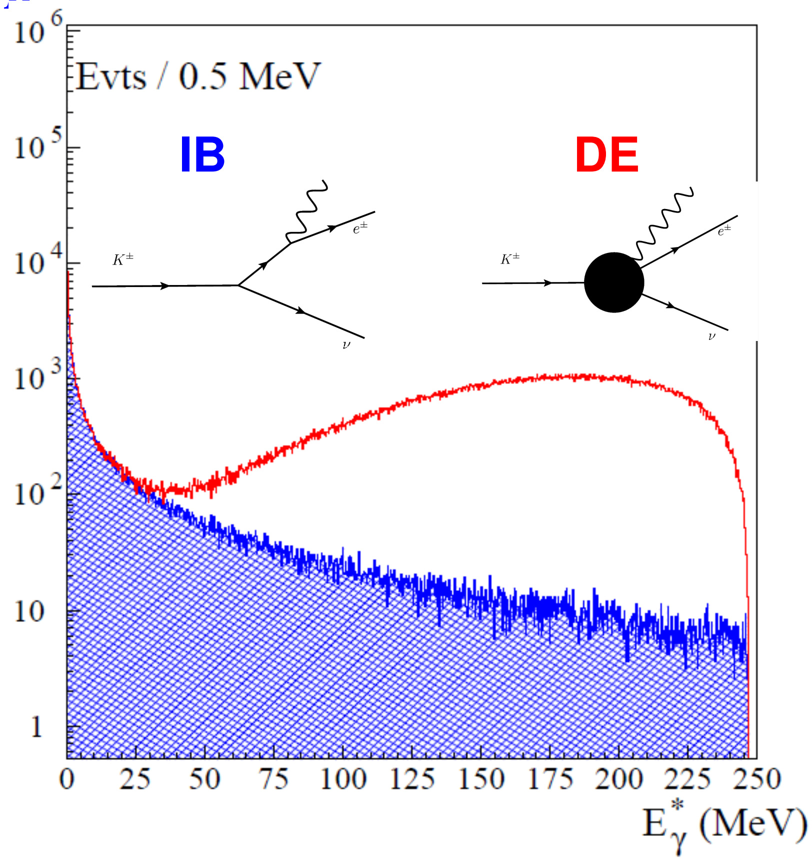
R_{l23} sensitivity to $H^{\pm}$ exchange

$$R_{\ell 23} = \left| 1 - \frac{m^2_{K^+}}{m^2_{H^+}} \left(1 - \frac{m^2_{\pi^+}}{m^2_{K^+}} \right) \frac{\tan^2 \beta}{1 + \epsilon_0 \tan \beta} \right|$$



$K_{e2}/K_{\mu 2}$

R_K: LFV beyond SM



Very high precision prediction in the SM (no hadronic uncertainties)

$R_K^{SM} = 2.477(1)\times10^{-5}$

[JHEP10(2007)005]

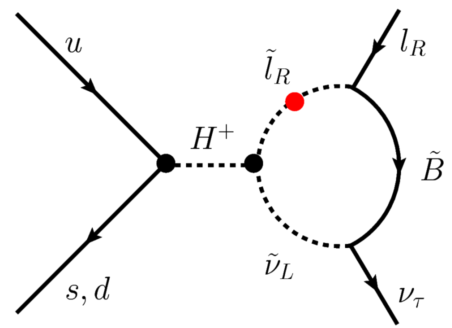
***In SM o*nly IB included**

$R_K^{SM} = (K_{e2}(\gamma_{IB}))/ (K_{\mu2}(\gamma_{IB}))$

LFV in the MSSM would enhance R_K up to 1%

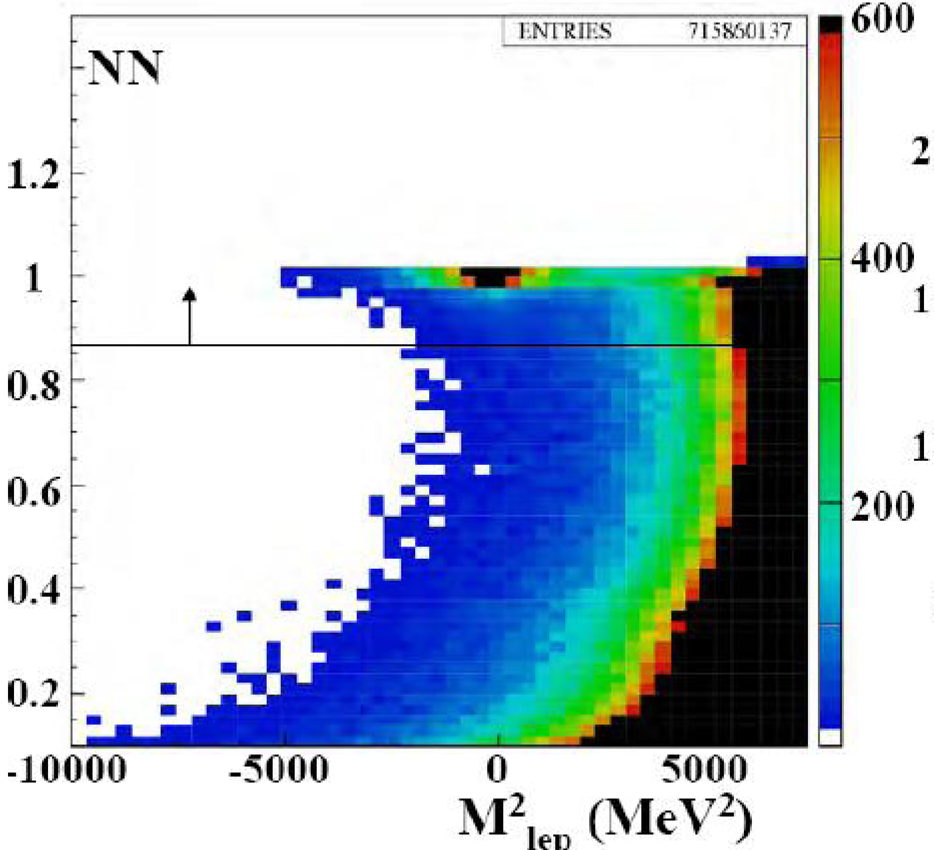
LFV appears at 1-loop level via an effective $H^+\ell\nu_\tau$ Yukawa interaction dominated by $e\nu_\tau$

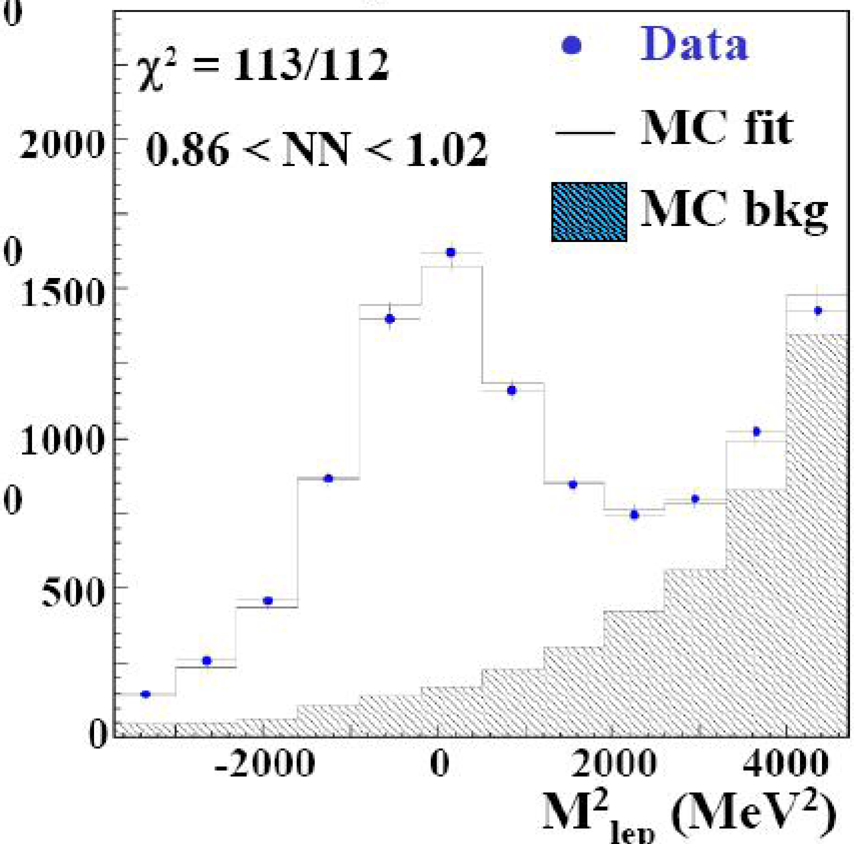
[PRD74(2006)011701]



Signal counting

- Ke2 counts from two-dimensional binned likelihood fit in the NN- M^2_{lep} plane with $0.86 < NN < 1.02$ and $-3700 < M^2_{lep} < 6100$





Using the whole statistics: NKe2(e^+) = 7064(102) , NKe2(e^-) = 6750(101)

- Kμ2 counting from 1-dimensional fit of M^2_{lep} distribution without PID

R_K final result

$R_K = (2.493 \pm 0.025_{stat} \pm 0.019_{syst}) \times 10^{-5}$

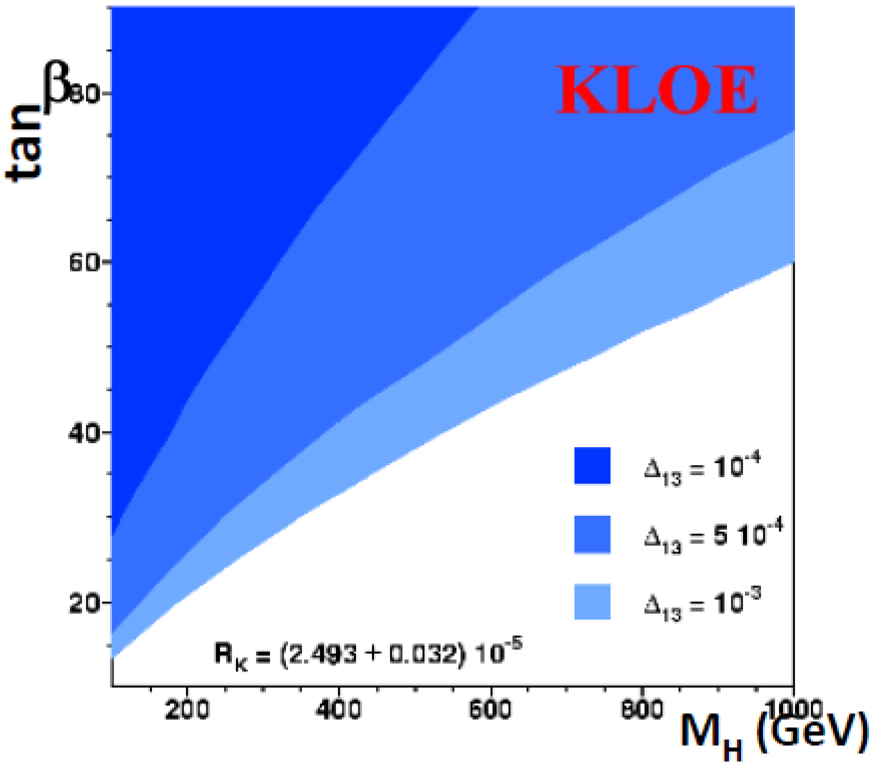
1.0% 0.8%

$R_K^{SM} = (2.477 \pm 0.001)\ 10^{-5}$

Systematic errors %	stat	syst
Reconstruction	0.4	0.4
Trigger efficiency	0.4	-
Background sub	-	0.3
Ke2(DE) comp.	0.2	-
Clustering	0.2	
Total	0.6	0.5

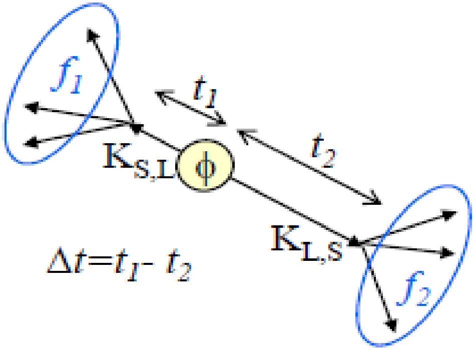
- Main contribution to systematic uncertainty from control-sample statistics (0.6%)

Sensitivity shown as 95%-CL excluded regions in the $\tan\beta$ - M_H plane, for fixed values of the 1-3 slepton-mass matrix element, $\Delta_{13} = 10^{-3}, 0.5\times10^{-3}, 10^{-4}$



Kaon interferometry

Kaon interferometry: basic principles



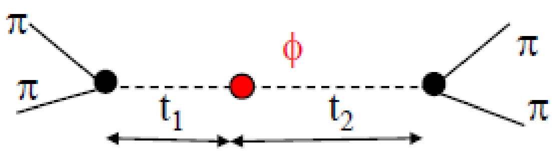
$\Delta t = t_1 - t_2$

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

$$I(f_1, f_2; \Delta t) = \frac{\Gamma_S^1 \Gamma_S^2}{2\Gamma} e^{-\Gamma|\Delta t|}\left[|\eta_1|^2 e^{\frac{\Delta\Gamma}{2}\Delta t} + |\eta_2|^2 e^{-\frac{\Delta\Gamma}{2}\Delta t} - 2\Re e\left(\eta_1 \eta_2 e^{-i\Delta m \Delta t}\right)\right]$$

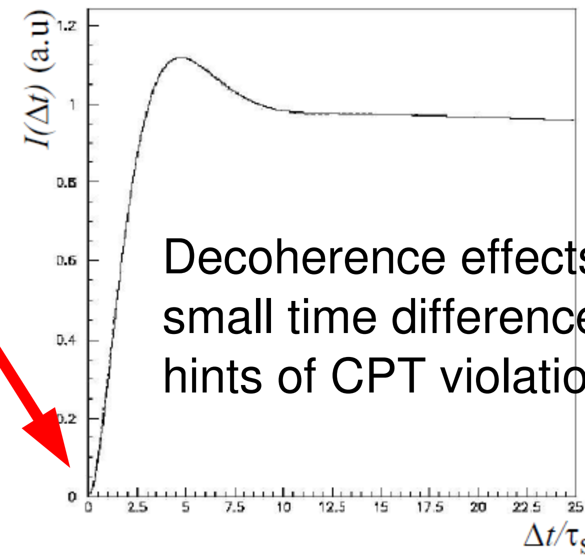
Assuming same final state: $\pi^+\pi^-$

$\Delta t = |t_1 - t_2|$



EPR correlation:

no simultaneous decays (Δt=0) in the same final state due to the destructive quantum interference



Decoherence effects at small time difference are hints of CPT violation.

Decoherence parameter

- Analysed data:
  L=1.5 fb^{-1} (2004-05 data)
- Fit including Δt resolution and efficiency effects + regeneration
- Γ_S, Γ_L, Δm fixed from PDG

KLOE FINAL:

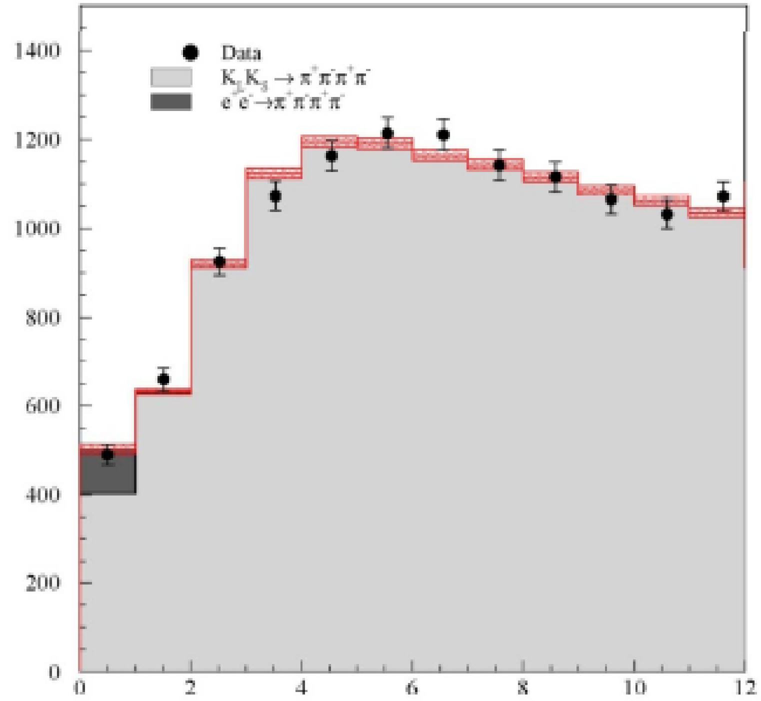
$$\zeta_{0\bar{0}} = (1.4 \pm 9.5_{STAT} \pm 3.8_{SYST}) \times 10^{-7}$$

as CP viol. $O(|\eta_{+-}|^2) \sim 10^{-6}$
=> high sensitivity to $\zeta_{0\bar{0}}$

- Improvement x 2 wrt published KLOE measurement (PLB 642(2006) 315)

- From CPLEAR data $(p\bar{p})_{REST} \to K^0\overline{K}^0$
Bertlmann et al. obtain (PR D60 (1999) 114032):

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



- In the B system, BELLE coll. (PRL 99 (2007) 131802) obtains:

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

- Comparison with quantum optics tests: precision O(10^{-3})

QG induced CPTV in correlated Kaon system

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]:

$$|i\rangle \propto \left(K^0\overline{K}^0 - K^0\overline{K}^0\right) + \omega\left(K^0\overline{K}^0 + K^0\overline{K}^0\right)$$

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

Fit of $I(\pi^+\pi^-,\pi^+\pi^-;\Delta t,\omega)$:

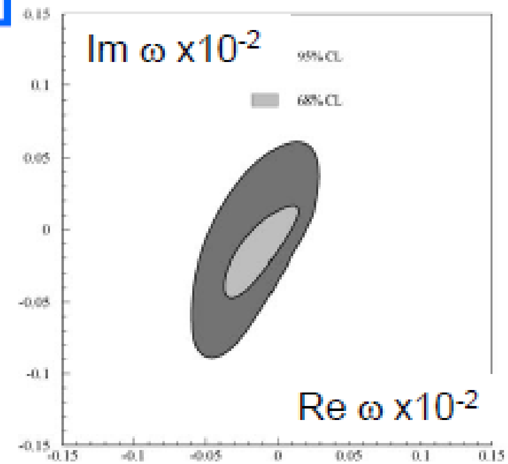
L=1.5 fb^{-1}

KLOE FINAL :

$$\Re\omega = \left(-1.6^{+3.0}_{-2.1\,STAT} \pm 0.4_{SYST}\right)\times 10^{-4}$$

$$\Im\omega = \left(-1.7^{+3.3}_{-3.0\,STAT} \pm 1.2_{SYST}\right)\times 10^{-4}$$

$$|\omega| < 1.0\times 10^{-3} \quad \text{at } 95\%\,\text{C.L.}$$



-Improvement x 2 wrt published KLOE

- In the B system [Alvarez, Bernabeu, Nebot JHEP 0611, 087]

$$-0.0084 \le \Re\omega \le 0.0100 \quad \text{at } 95\%\,\text{C.L.}$$

Scalars

Light scalars in ϕ radiative decays

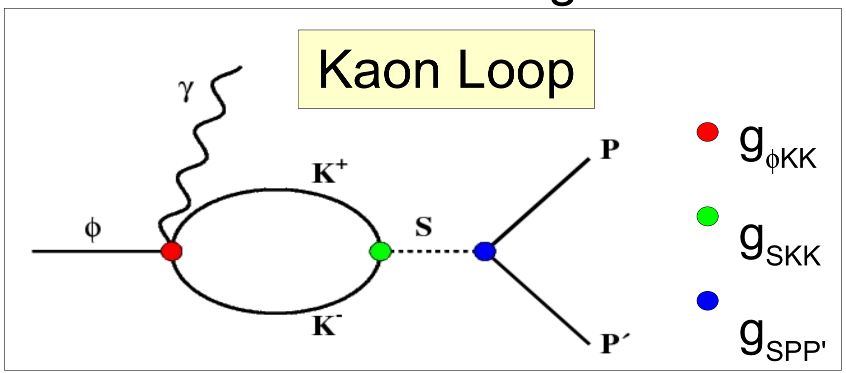
Scalar structure below 1 GeV is an open point: $\bar{q}q$, $\bar{q}\bar{q}qq$, **KK** molecule...

BR and mass spectra of $\phi \rightarrow PP'\gamma$ sensitive to intermediate scalar meson structure

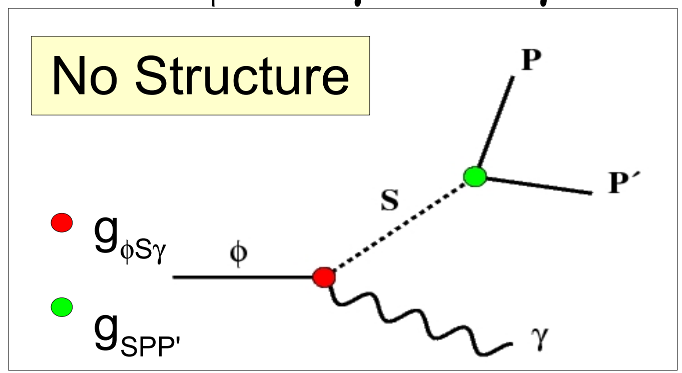
At KLOE PP':

$\pi^0\pi^0$	$\Rightarrow$	$f_0(980)/\sigma(600)$	EPJC49(2007)473, PLB537(2002)21
$\pi^+\pi^-$	$\Rightarrow$	$f_0(980)/\sigma(600)$	PLB634(2006)148
$\eta\pi^0$	$\Rightarrow$	$a_0(980)$	arXiv:0904.2539, PLB536(2002)209
$K_S K_S$	$\Rightarrow$	$f_0(980)/a_0(980)$	PLB679(2009)10

Phenomenological models used to describe $\phi \rightarrow S\gamma \rightarrow PP'\gamma$:

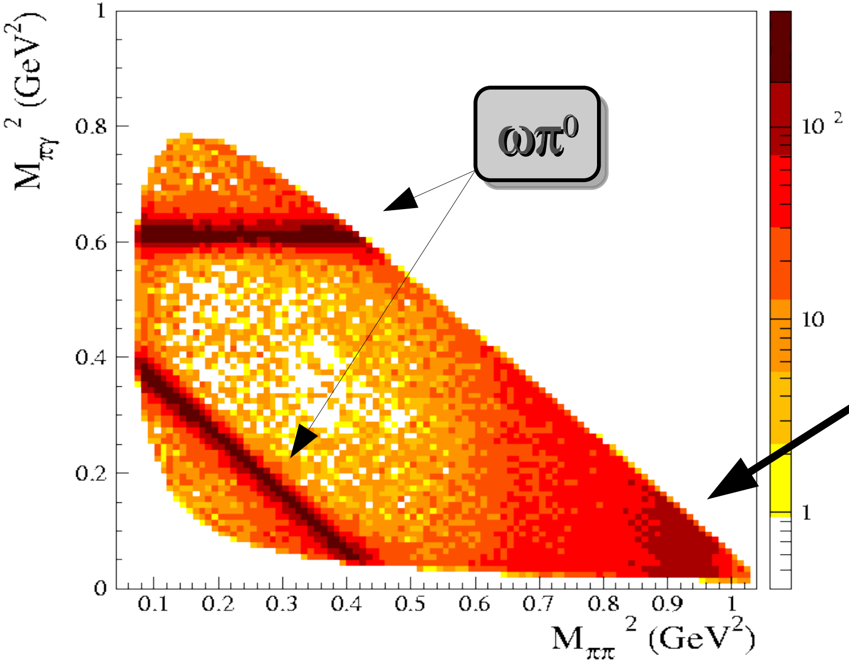


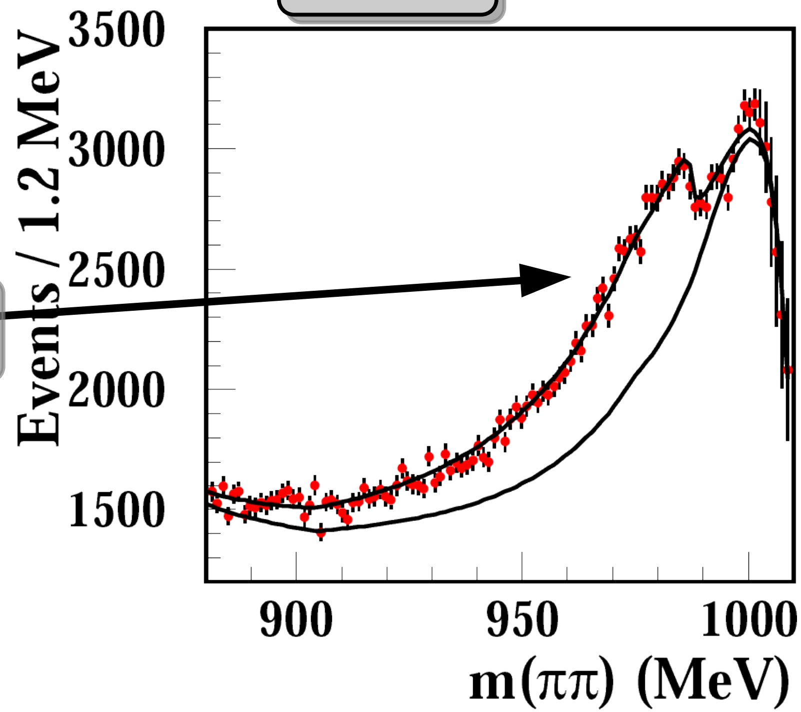
N. Achasov *et al.* NPB315(1989) 465
N. Achasov *et al.* PRD56(1997) 4084
N. Achasov *et al.* PRD68(2003) 014006



G. Isidori *et al.* JHEP 05(2006) 049

f_0 spectrum fit





KAON LOOP
Fit result

Channel	M_{f0} (MeV)	g_{f0KK} (GeV)	$g_{f0\pi\pi}$ (GeV)	$g^2_{f0KK} / g^2_{f0\pi\pi}$
$\pi^0\pi^0\gamma$	984.7 ± 1.9 $_{mod}$	3.97 ± 0.43$_{mod}$	−1.82 ± 0.19 $_{mod}$	~4.8
$\pi^+\pi^-\gamma$	983.7	4.74	−2.22	~4.6

Fit to $\eta\pi^0$ mass distribution

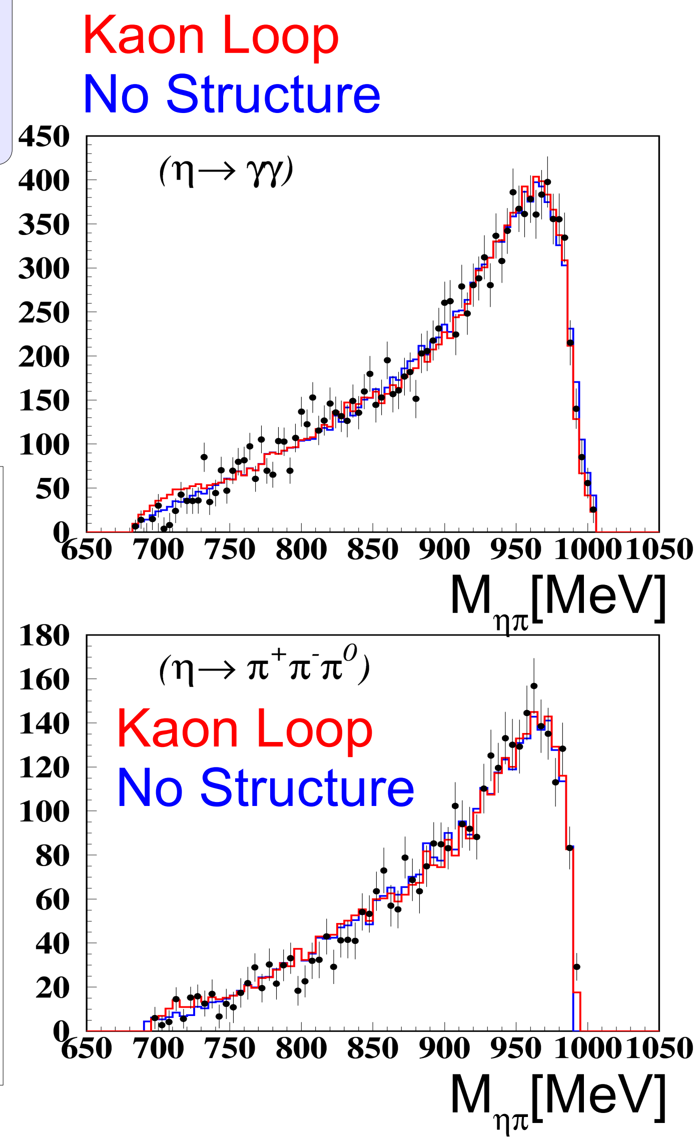
$\eta \to \gamma\gamma$ $BR(\phi \to \eta\pi^0\gamma) = (7.01 \pm 0.10_{sta} \pm 0.20_{sys}) \times 10^{-5}$

$\eta \to \pi^+\pi^-\pi^0$ $BR(\phi \to \eta\pi^0\gamma) = (7.12 \pm 0.13_{sta} \pm 0.22_{sys}) \times 10^{-5}$

Distribution unfolded to account for detector resolution

Fit with both KL and NS models

M_{a0} [MeV]	982.5 ± 1.6 ± 1.1	982.5 (fixed)
g_{a0K+K-}[GeV]	2.15 ± 0.06 ± 0.06	2.01 ± 0.07 ± 0.28
$g_{a0\eta\pi0}$[GeV]	2.82 ± 0.03 ± 0.04	2.46 ± 0.08 ± 0.11
$g_{\phi a0\gamma}$[GeV]	1.58 ± 0.10 ± 0.16	1.83 ± 0.03 ± 0.08
$BR(\phi\to\rho\pi\to\eta\pi\gamma)$	0.92 ± 0.40 ± 0.15	0.05 ± 4 ± 0.07
$BR(\phi\to\rho\pi\to\eta\pi\gamma)$	1.70 ± 0.04 ± 0.03	1.70 ± 0.03 ± 0.01
$P(\chi^2)$	0.104	0.309



Search for $\phi \rightarrow K_S K_S \gamma$

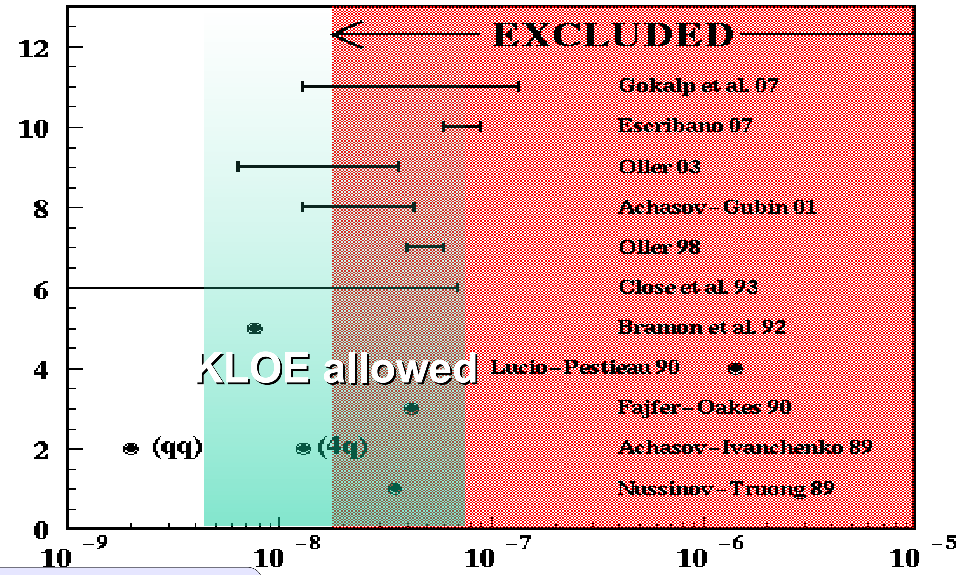
KLOE PLB679(2009)10

After all cuts we are left with 5 events in data and 3.2 in MC

$$BR(\phi \rightarrow (f_0 + a_0)\gamma \rightarrow K^0\bar{K}^0\gamma) < \frac{UL(\mu_{sig}) \text{ at } 90\% \text{ C.L.}}{\int Ldt \cdot \sigma(e^+e^- \rightarrow \phi) \cdot \frac{1}{2} \cdot BR(K_S \rightarrow \pi^+\pi^-)^2 \cdot \varepsilon}$$

Selection efficiency on the signal is (24.8±0.5)%

UL(μ_{sig}) at 90% CL = 6.79
using Unified Approach
by Feldman-Cousins
Phys. Rev. D57 (1998) 3873



BR($\phi \rightarrow K^0\bar{K}^0\gamma$)

$BR(\phi \rightarrow \bar{K}_0 K_0 \gamma) < 1.9 \times 10^{-8}$ @ 90 % C.L.

Pseudoscalars

$\eta \to \pi^+\pi^- e^+ e^-$

Poorly measured (4 events CMD-2, 15 events CELSIUS-WASA)

BR predicted by ChPT and VMD models

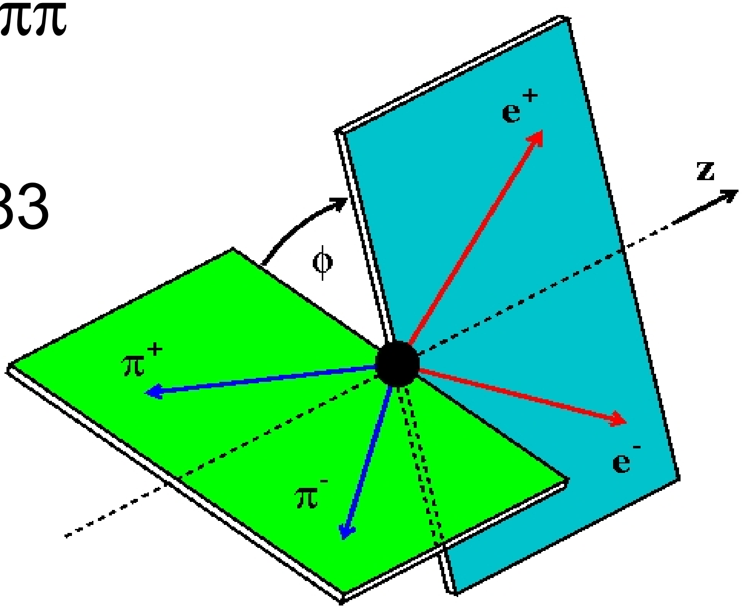
η structure using virtual photon

Angular asymmetry between ee and $\pi\pi$

Test of non-CKM CP violation

Gao, Mod. Phys. Lett. A17(2002) 1583

KLOE PLB675(2009)283



Within SM constrained by BR($\eta \to \pi\pi$):

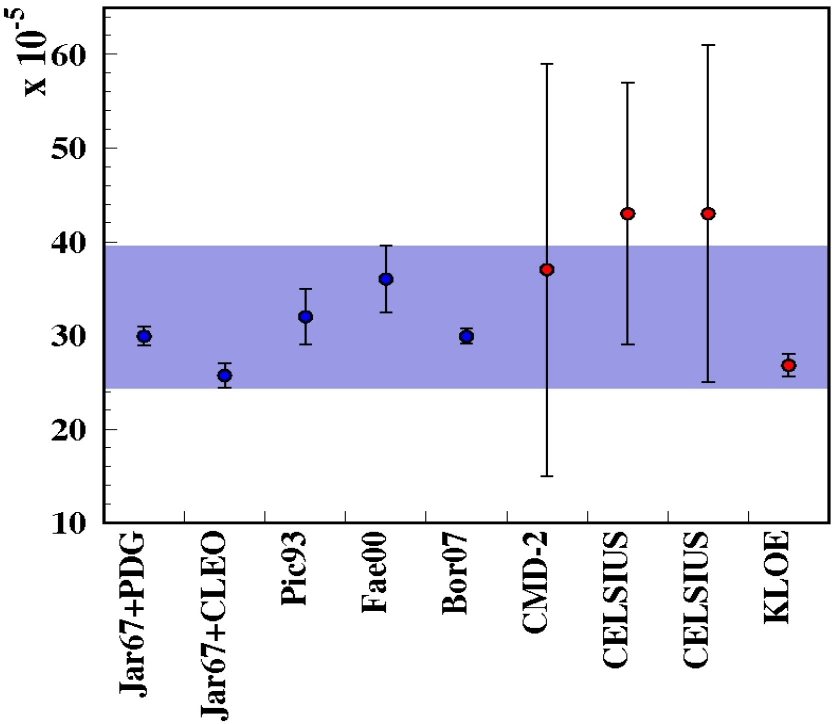
Experiment: $A_\phi < 10^{-4}$

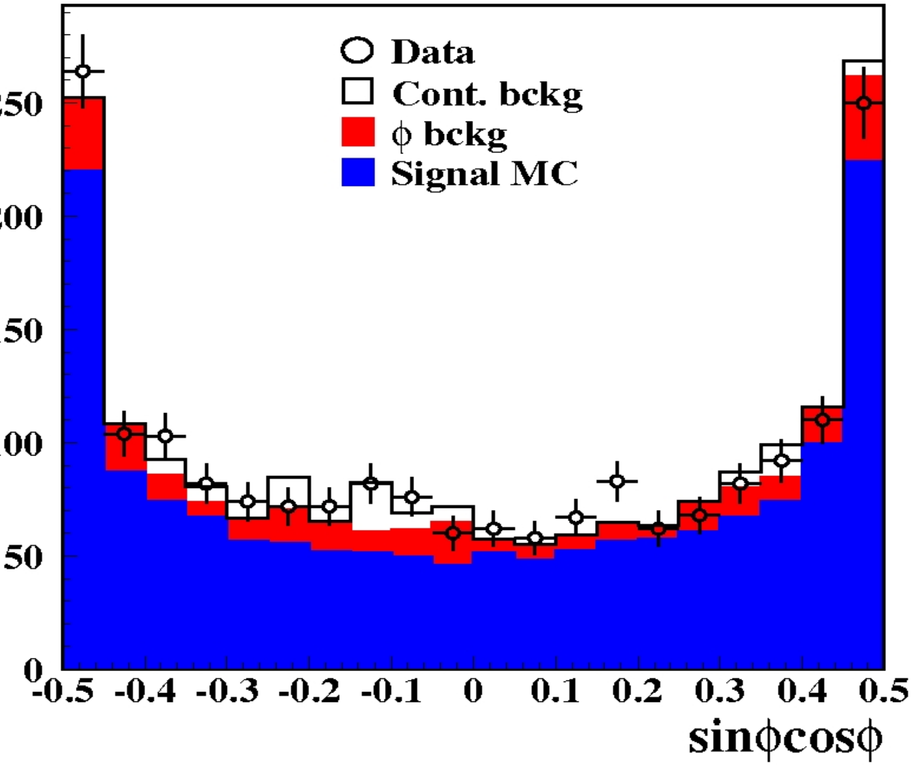
Theory: $A_\phi \sim 10^{-15}$

The unconventional CPV term can increase A_ϕ up to 10^{-2}

BR and Asymmetry

$$BR(\eta \to \pi^+ \pi^- e^+ e^- (\gamma)) = (26.8 \pm 0.9_{Stat.} \pm 0.7_{Syst.}) \cdot 10^{-5}$$





$$A_\phi = (-0.6 \pm 2.5_{Stat.} \pm 1.8_{Syst.}) \cdot 10^{-2}$$

First measurement!

$\eta \to e^+e^- e^+e^-$

Data sample: 1.7 fb^{-1}

Photon conversion on Beam Pipe
and Drift Chamber wall rejected

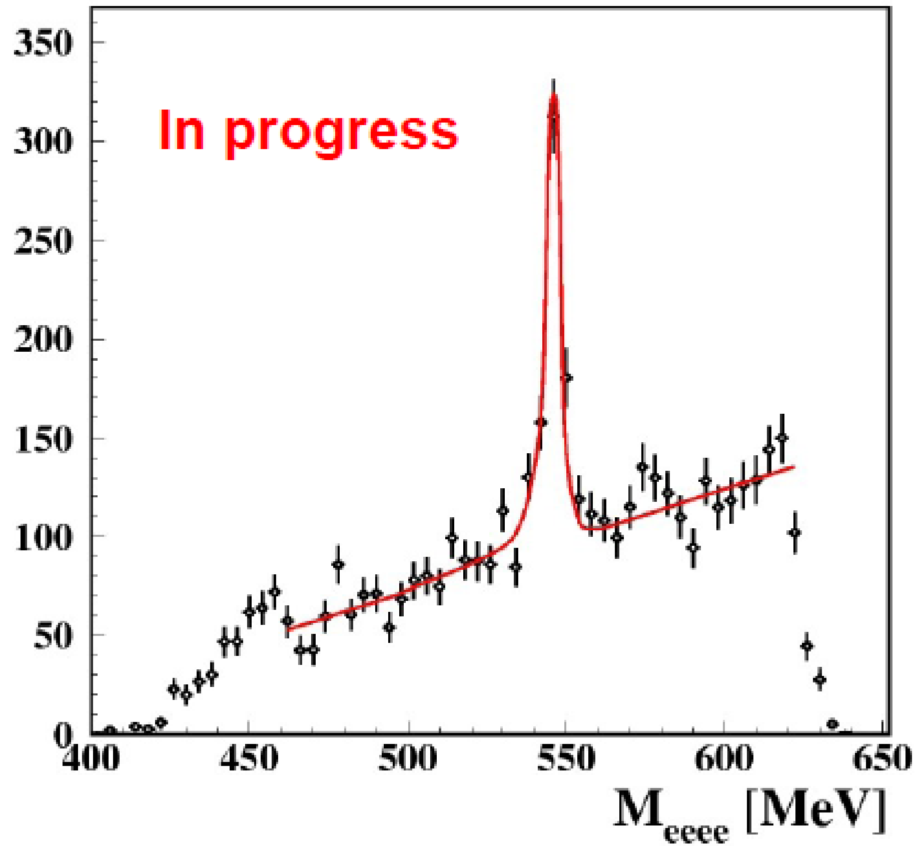
Remaining background from
ϕ decay is subtracted

Fit M_{eeee} distribution for signal
and continuum bckg
to obtain shapes

These are used to fit M_{eeee}
distribution for data

N_{eeee} = 413 ± 31

First observation!



η/η' mixing

- $\phi \to \eta'\gamma \quad \eta' \to \pi^+\pi^-\eta \quad \eta \to 3\pi^0$
- $\phi \to \eta'\gamma \quad \eta' \to \pi^0\pi^0\eta \quad \eta \to \pi^+\pi^-\pi^0$
- $\phi \to \eta\gamma \quad \eta \to 3\pi^0$

Allowing also for gluonium content in η' we fit the following ratios of BR:

KLOE PLB 648 (2007)

$$R_\phi = \frac{BR(\phi\to\eta'\gamma)}{BR(\phi\to\eta\gamma)} = 4.77 \pm 0.09 \pm 0.19$$

$$|\eta'\rangle = X_{\eta'}\frac{1}{\sqrt{2}}|u\bar{u}+d\bar{d}\rangle + Y_{\eta'}|s\bar{s}\rangle + Z_{\eta'}|glue\rangle$$

$$|\eta\rangle = \cos\varphi_P\frac{1}{\sqrt{2}}|u\bar{u}+d\bar{d}\rangle + \sin\varphi_P|s\bar{s}\rangle$$

$$\frac{\Gamma(\eta'\to\rho\gamma)}{\Gamma(\omega\to\pi^0\gamma)} = C_{M2} Z_{NS}\left(\sin(\varphi_G)\cos(\varphi_P)\right)^2$$

$$R_\phi = \cot^2(\varphi_P)\cos^2(\varphi_G)\left(1 - C_V\frac{Z_{NS}}{Z_N}\frac{1}{\sin(2\varphi_P)}\right)^2\left(\frac{p_{\eta'}}{p_\eta}\right)^3$$

$$\frac{\Gamma(\eta'\to\gamma\gamma)}{\Gamma(\pi^0\to\gamma\gamma)} = C_{M1}\left(5\cos(\varphi_G)\sin(\varphi_P) + \sqrt{2}\frac{f_q}{f_s}\cos(\varphi_G)\cos(\varphi_P)\right)^2$$

$$\frac{\Gamma(\eta'\to\omega\gamma)}{\Gamma(\omega\to\pi^0\gamma)} = C_{M3}\left(Z_{NS}\sin(\varphi_G)\cos(\varphi_P) + 2C_V Z_S\sin(\varphi_G)\sin(\varphi_P)\right)^2$$

$$X_{\eta'} = \cos\varphi_G\cos\varphi_P$$

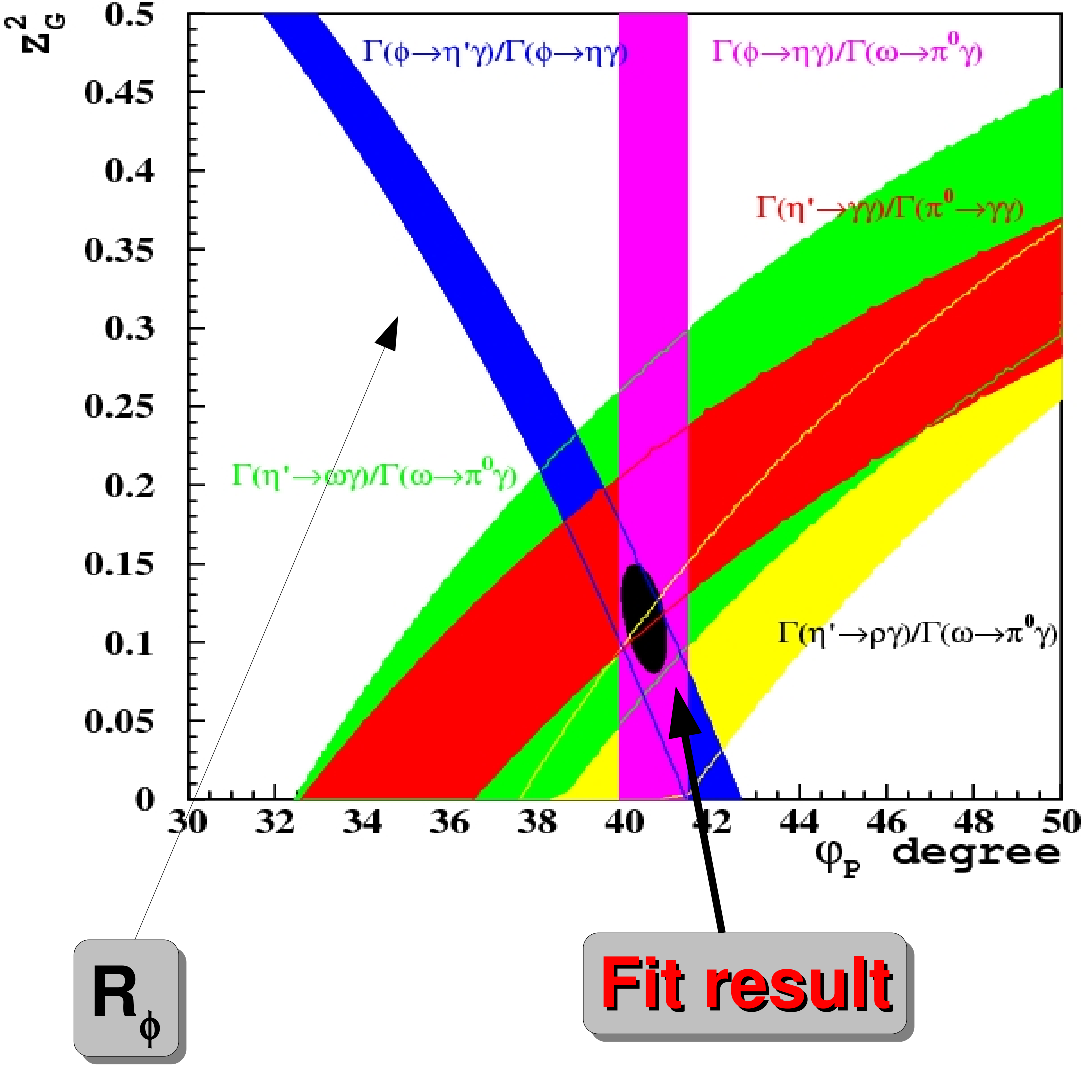
$$Y_{\eta'} = \cos\varphi_G\sin\varphi_P$$

$$Z_{\eta'} = \sin\varphi_G \leftrightarrow$$ **Gluonium content**

Rossner PRD27(1983)1101
Bramon PLB503(2001)271
Escribano JHEP05(2007)6

Gluonium content in η'

KLOE JHEP07(2009)105



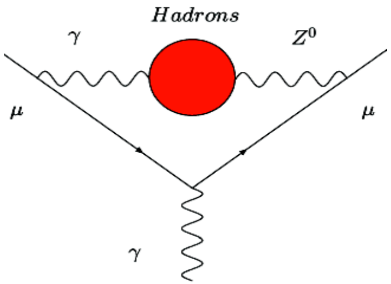
Fit done using:
- updated value from PDG08
- KLOE ω BR
- More experimental inputs

3σ evidence of gluonium content in η'

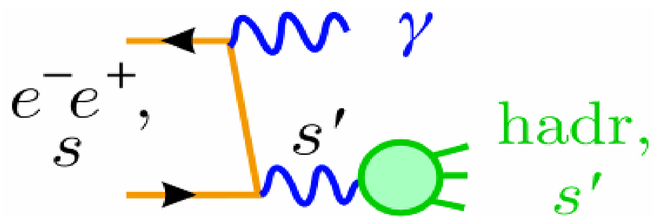
	Gluonium allowed	Gluonium at zero
$\chi^2/n.d.f(Prob)$	4.6/3 (20.5 %)	14.7/4 (.5 %)
Z_G^2	0.115 ± 0.036	0 fixed
φ_P	$(40.4 \pm 0.6)°$	$(41.4 \pm 0.5)°$
Z_{NS}	0.936 ± 0.025	0.927 ± 0.023
Z_S	0.83 ± 0.05	0.82 ± 0.05
φ_V	$(3.32 \pm 0.09)°$	$(3.34 \pm 0.09)°$
$m_s/\bar{m}$	1.24 ± 0.07	1.24 ± 0.07

Cross sections

Hadronic cross section and a_μ



$$a_\mu^{\pi\pi} = \frac{1}{4\pi^3} \int_{0.35\,\mathrm{GeV}^2}^{0.95\,\mathrm{GeV}^2} ds\, \sigma(e^+e^- \to \pi^+\pi^-)\, K(s) \;\rightarrow\; \propto \frac{1}{s}$$



Radiative return

KLOE has shown, for the first time, that it is possible to measure $\sigma(e^+e^- \to \pi^+\pi^-\gamma)$ at fixed $\sqrt{s}$ with high accuracy using ISR to extract $\sigma(e^+e^- \to \pi^+\pi^-)$ for $\sqrt{s'}$ from $2M_\pi$ to $\sqrt{s}$

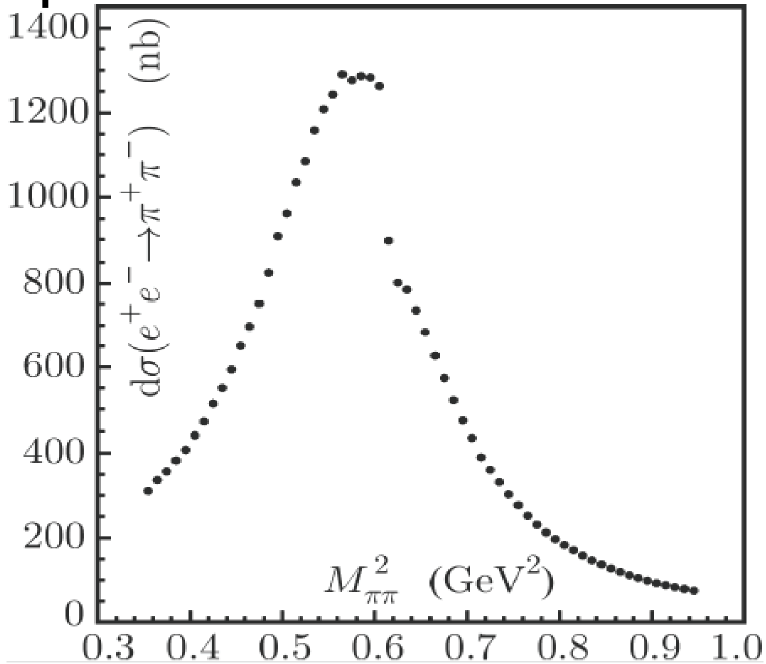
$$s\frac{d\sigma_{\pi\pi}}{dM^2_{\pi\pi}} = \sigma_{\pi\pi}(s) \times H(s)$$

Requires precise calculations of the radiator function $H(s)$
PHOKHARA MC NLO generator
[EPJC27(2003)]

$\sigma\ (e^+e^- \to \pi^+\pi^-)$

KLOE PLB670(2009)285

$\sigma_{\pi\pi}$ *vs* $M^0_{\pi\pi}$, undressed from vacuum polarization and inclusive for FSR



$$a_\mu^{\pi\pi} = \frac{1}{4\pi^3} \int_{0.35\,\mathrm{GeV}^2}^{0.95\,\mathrm{GeV}^2} ds\, \sigma(e^+e^- \to \pi^+\pi^-)\, K(s)$$

Systematic errors on $a_\mu^{\pi\pi}$:

Experimental fractional error = 0.6 %

Reconstruction Filter	negligible
Background	0.3%
Trackmass/Miss. Mass	0.2%
π/e-ID and TCA	negligible
Tracking	0.3%
Trigger	0.1%
Acceptance ($\theta_{\pi\pi}$)	0.1%
Acceptance (θ_π)	negligible
Unfolding	negligible
Software Trigger	0.1%
$\sqrt{s}$ dep. Of H	0.2%
Luminosity ($0.1_{th} \oplus 0.3_{exp}$)%	0.3%
FSR resummation	0.3%
Radiator H	0.5%
Vacuum polarization	0.1%

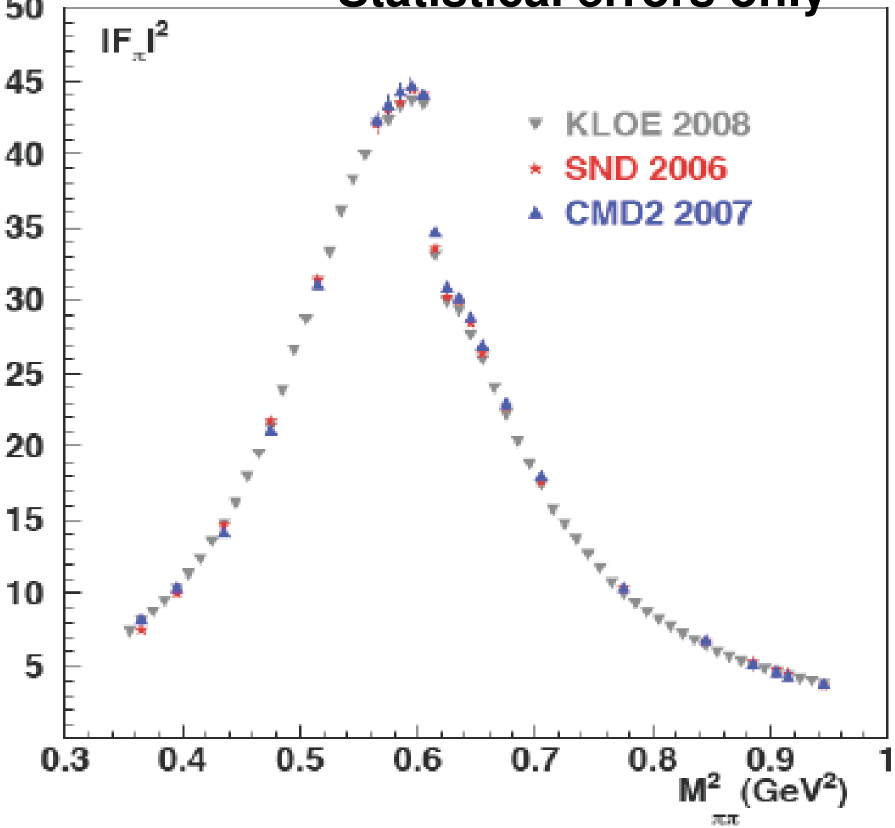
Theoretical fractional error = 0.6 %

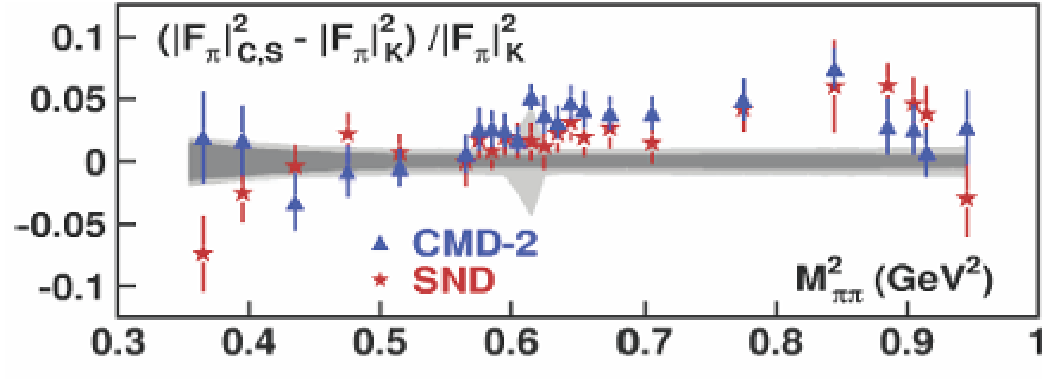
$a_\mu^{\pi\pi}(0.35\text{–}0.95\ \mathrm{GeV}^2) = (387.2 \pm 0.5_{stat} \pm 2.4_{syst} \pm 2.3_{the}) \times 10^{-10}$

Comparison with other measurements

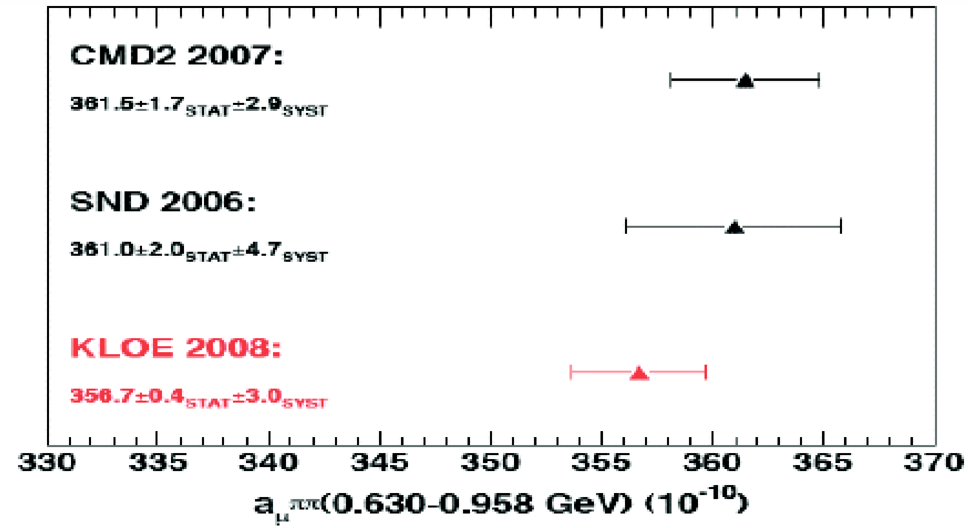
$$|F_\pi|^2 = \frac{3s}{p\,\alpha^2\beta_\pi^3}\,\sigma_{\pi\pi}(s)$$

Statistical errors only





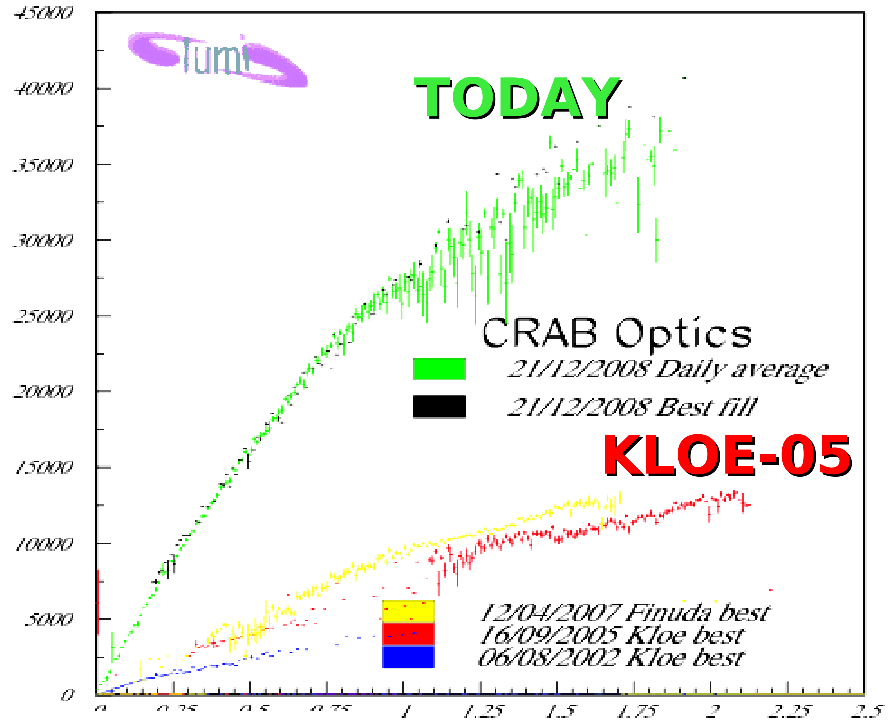
Integrated in the same range of other measurements



Future perspective
KLOE-2

New DAFNE interaction scheme

New machine magnetic scheme:
CRAB WAIST
Big improvement with same beam currents

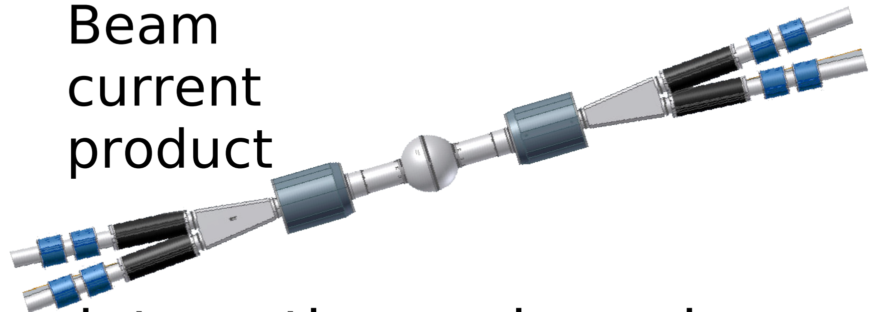


Beam current product

Future **DATA TAKING** plans:

STEP-0[2009]: 5fb^{-1}
- γγ taggers

STEP-1[2011]: >20fb^{-1} with:
- Inner Tracker
- Low Angle Cal
- Quadrupole Cal



New interaction region scheme
Larger crossing angle

For more information:
http://www.lnf.infn.it/kloe2