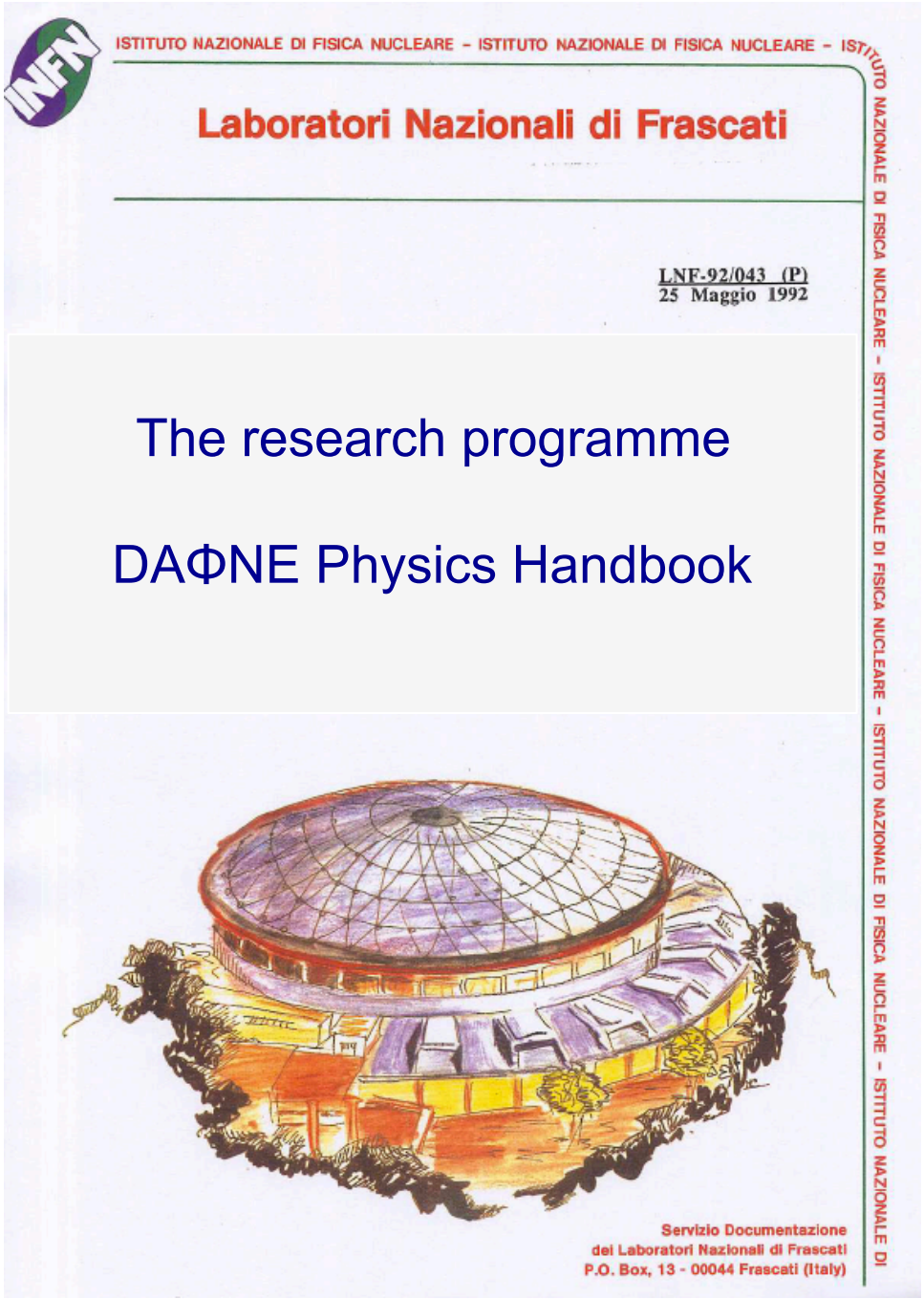
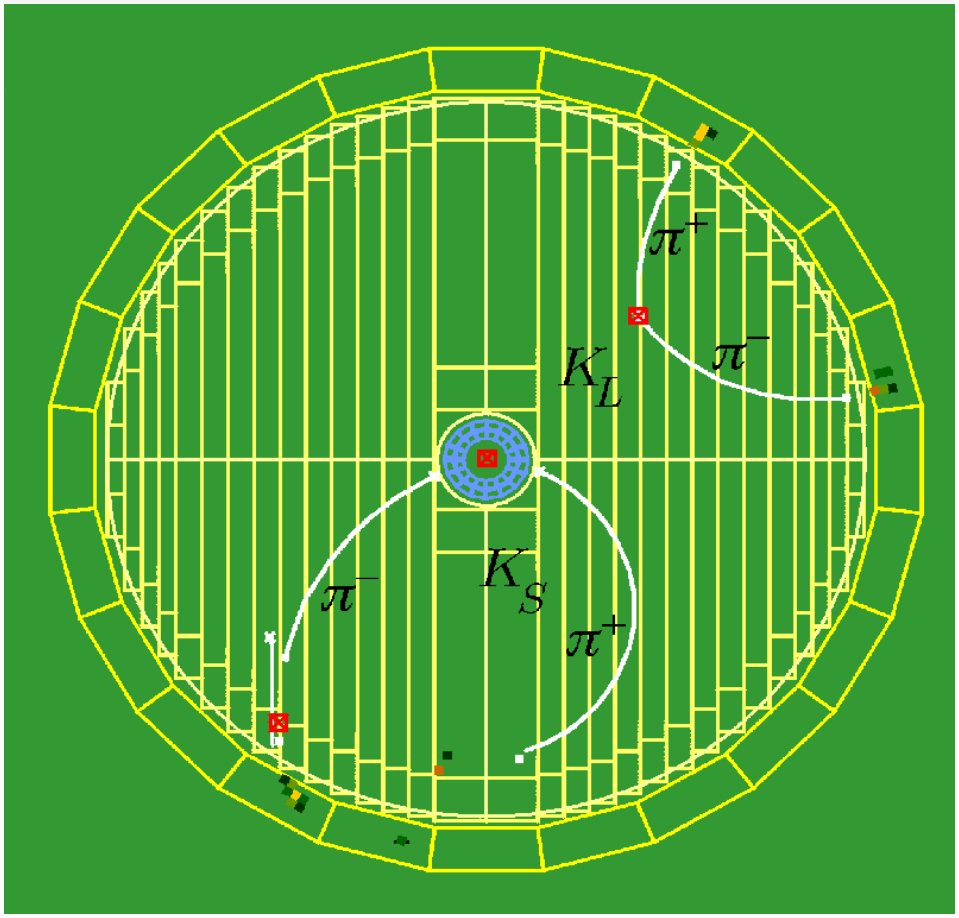
KLOE: what have we learnt



First CP-violating K_L decay

April 20, 1999



in May issue of CERN Courier

The debut: in April 2002 $\int Ldt = 16\ pb^{-1}$ of year 2000

ELSEVIER

Physics Letters B 535 (2002) 37–42

PHYSICS LETTERS B

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$$BR(K_S \to \pi e \nu) = (6.91 \pm 0.37) \times 10^{-4}$$

Measurement of the branching fraction for the decay $K_S \to \pi e \nu$ ⋆

KLOE Collaboration

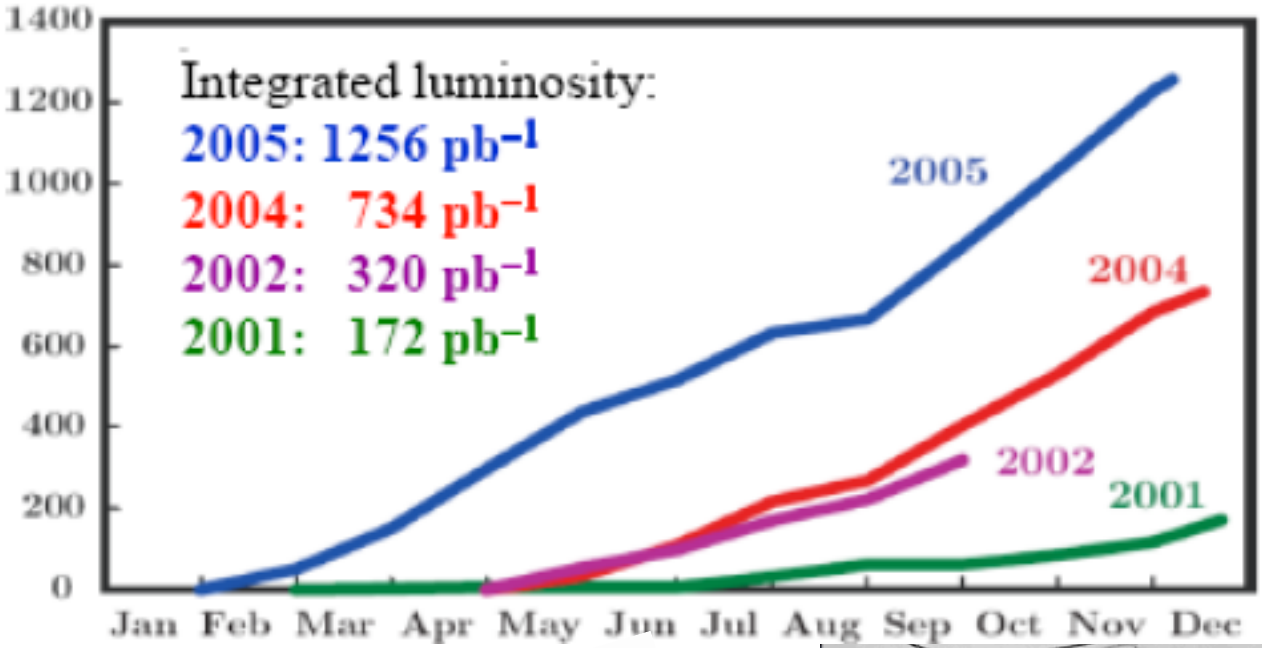
⋆ This paper is dedicated to the memory of Luciano Paoluzi.

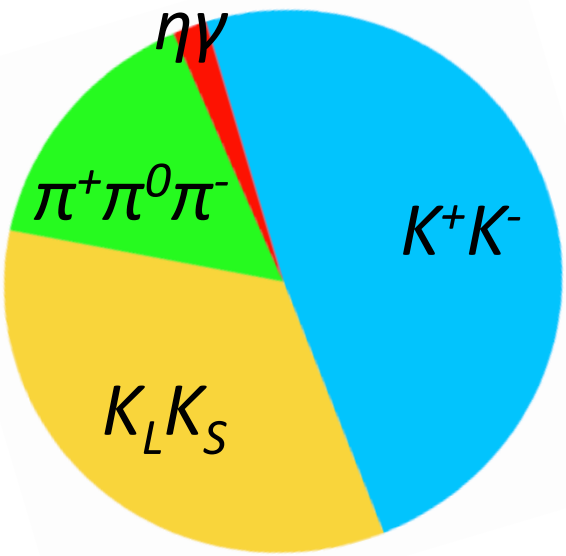
Study of the decay $\phi \to \eta\pi^0\gamma$ with the KLOE detector

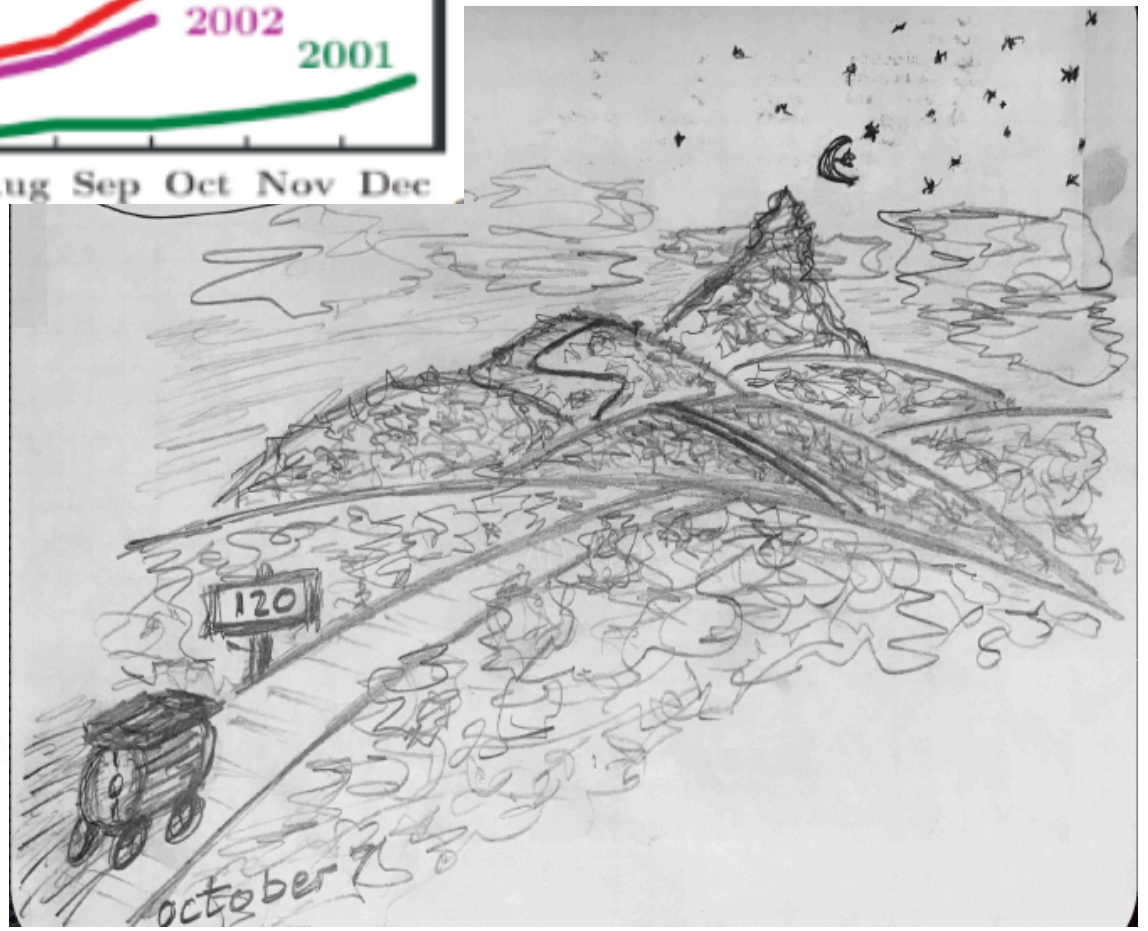
Study of the decay $\phi \to \pi^0\pi^0\gamma$ with the KLOE detector

Measurement of $\Gamma(\phi \to \eta'\gamma)/\Gamma(\phi \to \eta\gamma)$ and the pseudoscalar mixing angle

The intriguing meson octet 0^{++}


Integrated luminosity:
2005: 1256 pb⁻¹
2004: 734 pb⁻¹
2002: 320 pb⁻¹
2001: 172 pb⁻¹
2005
2004
2002
2001
1400
1200
1000
800
600
400
200
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec


ηγ
π⁺π⁰π⁻
K⁺K⁻
K_L K_S


120
october 7

World best for η meson

547.862±0.017 OUR AVERAGE					
547.865±0.031±0.062		NIKOLAEV	14	CRYB	$\gamma p \to p\eta$
547.873±0.005±0.027	1M	GOSLAWSKI	12	SPEC	$dp \to {}^3\mathrm{He}\,\eta$
547.874±0.007±0.029		AMBROSINO	07B	KLOE	$e^+e^- \to \phi \to \eta\gamma$
547.785±0.017±0.057	16k	MILLER	07	CLEO	$\psi(2S) \to J/\psi\eta$
547.843±0.030±0.041	1134	LAI	02	NA48	$\eta \to 3\pi^0$

η mass

0.515±0.018 OUR FIT					
0.516±0.018 OUR AVERAGE					
0.520±0.020±0.013		BABUSCI	13A	KLOE	$e^+e^- \to e^+e^-\eta$
0.51 ±0.12 ±0.05	36	BARU	90	MD1	$e^+e^- \to e^+e^-\eta$
0.490±0.010±0.048	2287	ROE	90	ASP	$e^+e^- \to e^+e^-\eta$
0.514±0.017±0.035	1295	WILLIAMS	88	CBAL	$e^+e^- \to e^+e^-\eta$
0.53 ±0.04 ±0.04		BARTEL	85E	JADE	$e^+e^- \to e^+e^-\eta$

η –> $\gamma\gamma$ decay width from $\gamma\gamma$ –> η

$\Gamma(\pi^+\pi^-)/\Gamma_{total}$ **Γ_{25}/Γ**

Forbidden by *P* and *CP* invariance.

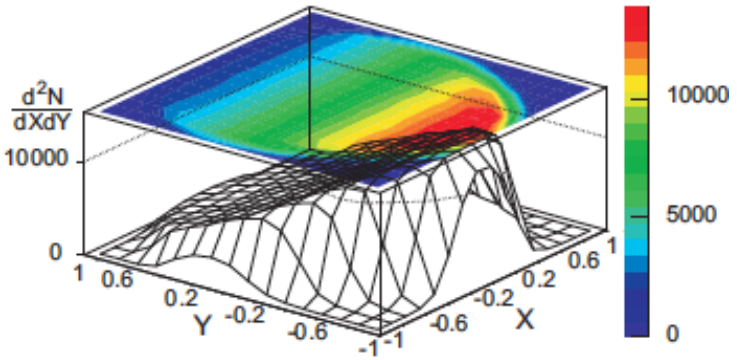
VALUE	*CL%*	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
< 1.3 × 10^{-5}	90	16M	AMBROSINO	05A	KLOE	$e^+e^- \to \phi \to \eta\gamma$

η –> $\pi\pi$ P-violating

$\Gamma(3\gamma)/\Gamma(3\pi^0)$ **Γ_{29}/Γ_3**

VALUE	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
<4.9 × 10^{-5}	90	ALOISIO	04	KLOE	$\phi \to \eta\gamma$

η –> $\gamma\gamma\gamma$ C-violating



η –> $\pi\pi\pi$ Dalitz plot asymmetry parameters

World best for $K^{\pm}$ decays

lifetime

1.2380±0.0020 OUR FIT Error includes scale factor of 1.8.
1.2379±0.0021 OUR AVERAGE Error includes scale factor of 1.9. See the ideogram below.

1.2347±0.0030	15M	[1]	AMBROSINO	08	KLOE	±	$\phi \to K^+K^-$
1.2451±0.0030	250k		KOPTEV	95	CNTR		K at rest, U target
1.2368±0.0041	150k		KOPTEV	95	CNTR		K at rest, Cu target
1.2380±0.0016	3M		OTT	71	CNTR	+	K at rest
1.2272±0.0036			LOBKOWICZ	69	CNTR	+	K in flight
1.2443±0.0038			FITCH	65B	CNTR	+	K at rest

absolute branching fractions

$K^{\pm} \to \mu^{\pm}\nu$

63.56±0.11 OUR FIT Error includes scale factor of 1.2.
63.60±0.16 OUR AVERAGE

63.66±0.09±0.15	865k	[1]	AMBROSINO	06A	KLOE	+	
63.24±0.44	62k		CHIANG	72	OSPK	+	1.84 GeV/c K^+

$K^{\pm} \to \pi^0 e^{\pm}\nu$

5.07 ±0.04 OUR FIT Error includes scale factor of 2.1.
4.94 ±0.05 OUR AVERAGE

4.965±0.038±0.037		[1]	AMBROSINO	08A	KLOE	±	
4.86 ±0.10	3516		CHIANG	72	OSPK	+	1.84 GeV/c K^+

$K^{\pm} \to \pi^0 \mu^{\pm}\nu$

3.352±0.033 OUR FIT Error includes scale factor of 1.9.
3.24 ±0.04 OUR AVERAGE

3.233±0.029±0.026		[1]	AMBROSINO	08A	KLOE	±	
3.33 ±0.16	2345		CHIANG	72	OSPK	+	1.84 GeV/c K^+

$K^{\pm} \to \pi^{\pm}\pi^0$

20.67±0.08 OUR FIT Error includes scale factor of 1.2.
20.70±0.16 OUR AVERAGE Error includes scale factor of 1.8.

20.65±0.05±0.08	1.4M	[1]	AMBROSINO	08E	KLOE	+	$\phi \to K^+K^-$
21.18±0.28	16k		CHIANG	72	OSPK	+	1.84 GeV/c K^+

$K^{\pm} \to \pi^{\pm}\pi^0\pi^0$

1.760±0.023 OUR FIT Error includes scale factor of 1.1.
1.775±0.028 OUR AVERAGE Error includes scale factor of 1.2.

1.763±0.013±0.022			ALOISIO	04A	KLOE	±	
1.84 ±0.06	1307		CHIANG	72	OSPK	+	1.84 GeV/c K^+

$K^{\pm} \to \pi^{\pm}\pi^+\pi^-$

5.583±0.024 OUR FIT

5.565±0.031±0.025	68K	[1]	BABUSCI	14B	KLOE	+	

• • • We do not use the following data for averages, fits, limits, etc. • • •

$\Sigma = 0.998$

K^0_S and K^0_L

K^0 mass = 497.583 ± 0.005 ± 0.020 MeV ★★★

K^0_S rare decays

$B(K^0_S \to \gamma\gamma) = (2.26 \pm 0.12 \pm 0.06)\ 10^{-6}$ ★★

$B(K^0_S \to e^+e^-) < 0.9\ 10^{-8}$ FCNC ★★★

$B(K^0_S \to 3\pi^0) < 2.6\ 10^{-8}$ CP-violating ★★★

K^0_S x K^0_L interference

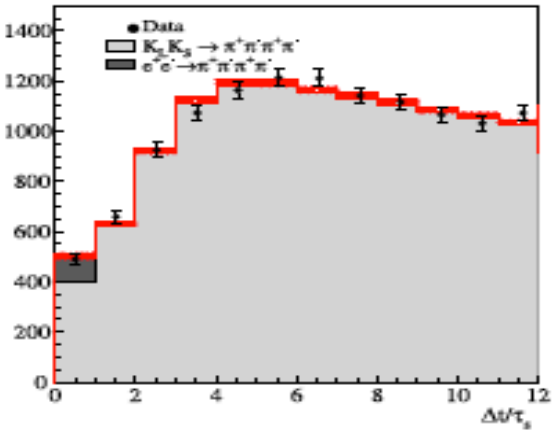
First observation of quantum interference in the process $\phi \to K_S K_L \to \pi^+\pi^-\pi^+\pi^-$: A test of quantum mechanics and CPT symmetry

JHEP PUBLISHED BY INSTITUTE OF PHYSICS PUBLISHING FOR SISSA
RECEIVED: October 12, 2006
ACCEPTED: November 13, 2006
PUBLISHED: December 4, 2006

Determination of CP and CPT violation parameters in the neutral kaon system using the Bell-Steinberger relation and data from the KLOE experiment

$$|K_{S,L}\rangle = \frac{1}{\sqrt{2(1+|\epsilon_{S,L}|^2)}}\left[(1+\epsilon_{S,L})|K^0\rangle \pm (1-\epsilon_{S,L})|\overline{K^0}\rangle\right] \qquad \epsilon_{S,L} = \epsilon \pm \delta$$

$$N(\pi\pi,\pi\pi,\Delta t) \propto e^{-\Gamma_L \Delta t} + e^{-\Gamma_S \Delta t} - 2e^{-(\Gamma_L+\Gamma_S)\Delta t/2}\cos(\Delta m \Delta t)$$



$Re(\varepsilon) = (159.6 \pm 1.3)\ 10^{-5}$ $Im(\delta) = (0.4 \pm 12.1)\ 10^{-5}$ ★★★

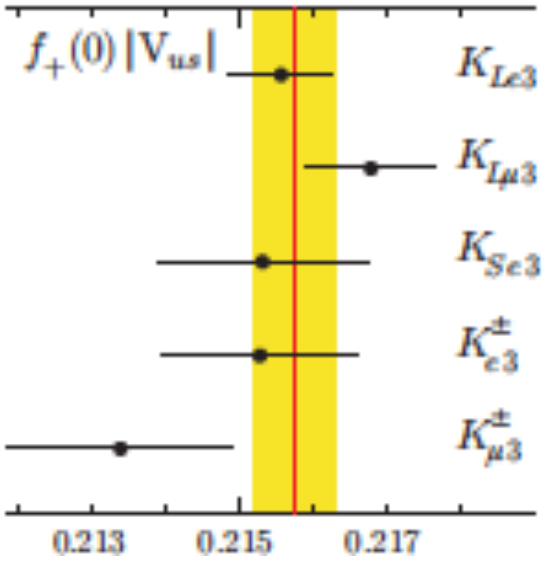
$|m_{K0} - m_{\overline{K0}}| < 6\ 10^{-19}$ GeV ~ 10 × m_K/m_P ★★★

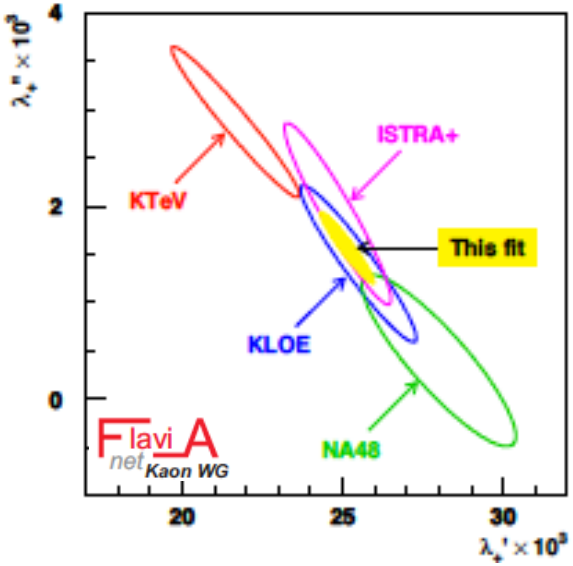
The Cabibbo angle

The decay rate of semileptonic kaon decays and $K^{\pm}$ K^0_L K^0_S form factors

PUBLISHED BY INSTITUTE OF PHYSICS PUBLISHING FOR SISSA
RECEIVED: *February 21, 2008*
ACCEPTED: *March 28, 2008*
PUBLISHED: *April 16, 2008*

$|V_{us}|$ and lepton universality from kaon decays with the KLOE detector



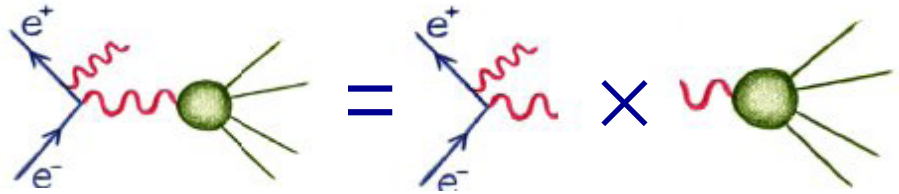


$$|f_+(0)\,V_{us}| = 0.2157 \pm 0.0006$$

$$|V_{us}| = 0.2249 \pm 0.0010$$

Pioneering σ(e⁺e⁻ -> X) via ISR

and very accurate results



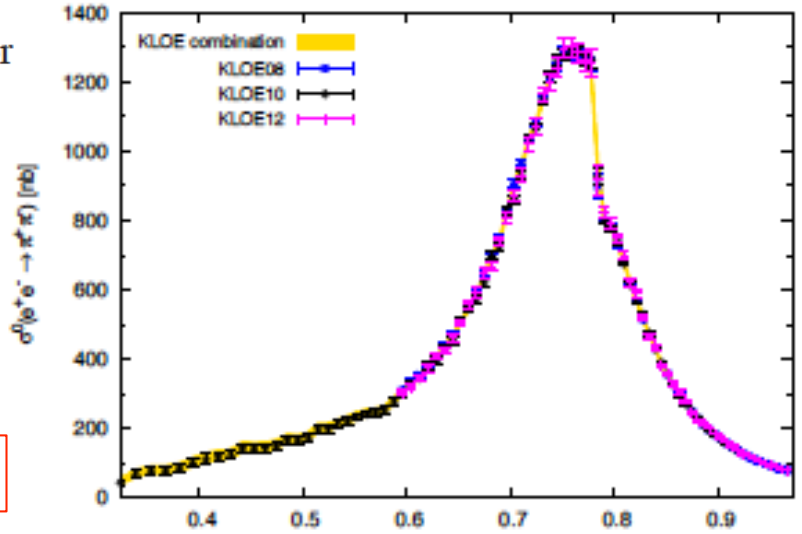
Physics Letters B 606 (2005) 12–24

Measurement of $\sigma(e^+e^- \to \pi^+\pi^-\gamma)$ and extraction of $\sigma(e^+e^- \to \pi^+\pi^-)$ below 1 GeV with the KLOE detector

$\frac{d\sigma}{ds}(e^+e^- \to \pi^+\pi^-\gamma_{out})$ —

$\frac{d\sigma}{ds}(e^+e^- \to \pi^+\pi^-\gamma_{in})$ —

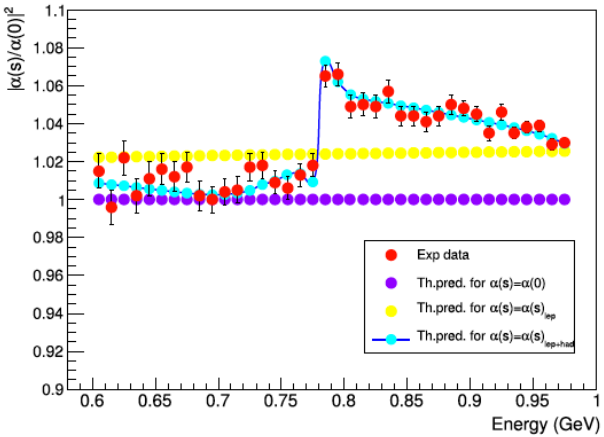
$\frac{d\sigma/ds(e^+e^- \to \pi^+\pi^-\gamma_{out})}{d\sigma/ds(e^+e^- \to \mu^+\mu^-\gamma_{out})}$ —

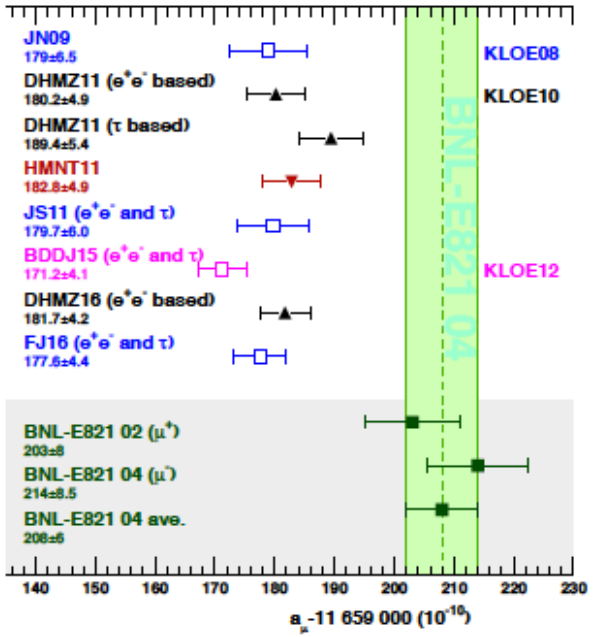


$$\alpha_\mu^{\pi\pi}(0.10 < s < 0.95\ \mathrm{GeV}^2) = (489.8 \pm 5.1)\ 10^{-10}$$

Physics Letters B 767 (2017) 485–492

Measurement of the running of the fine structure constant below 1 GeV with the KLOE detector

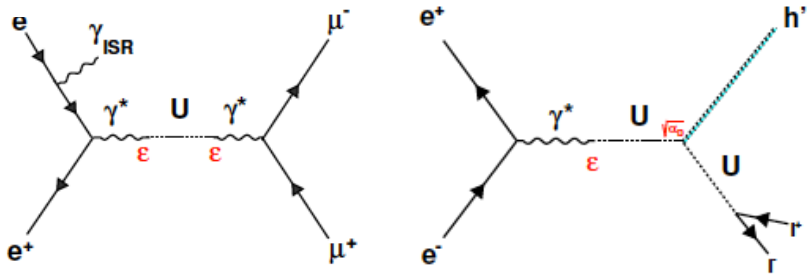




Searching for a dark field

Search for light vector boson production in $e^+e^- \to \mu^+\mu^-\gamma$ interactions with the KLOE experiment ☆

☆ This paper is dedicated to the memory of Juliet Lee-Franzini.



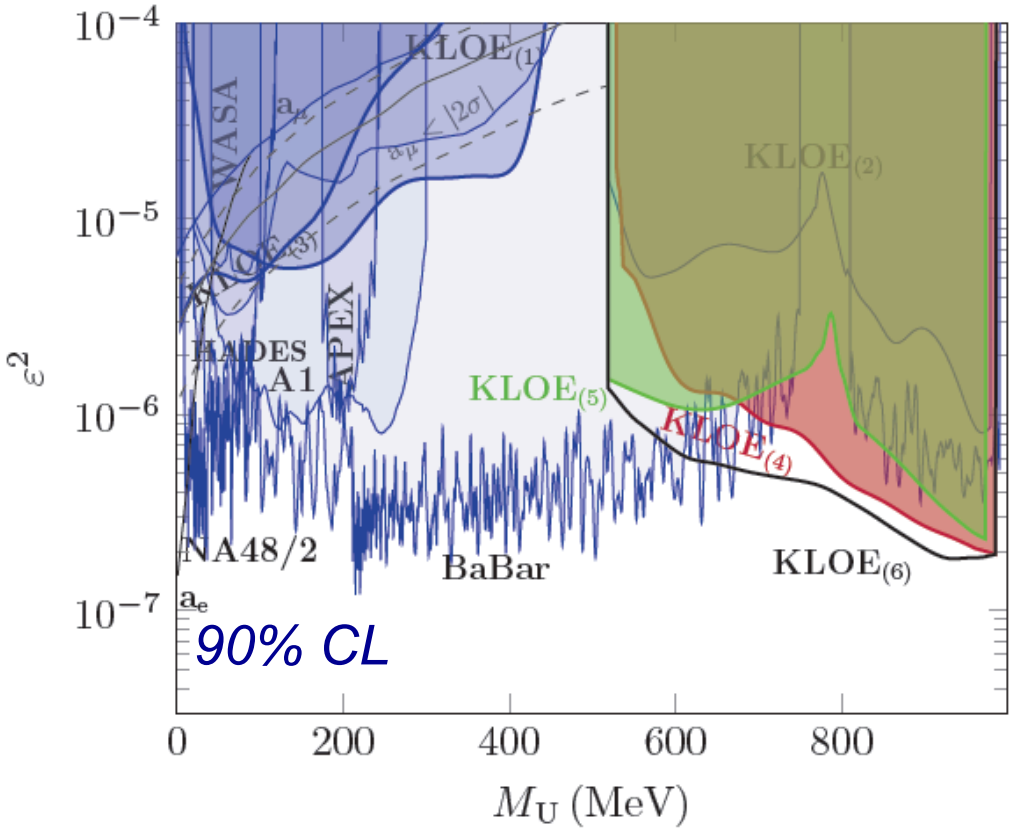
$$e^+e^- \to \phi \to \eta U \quad U \to e^+e^-$$

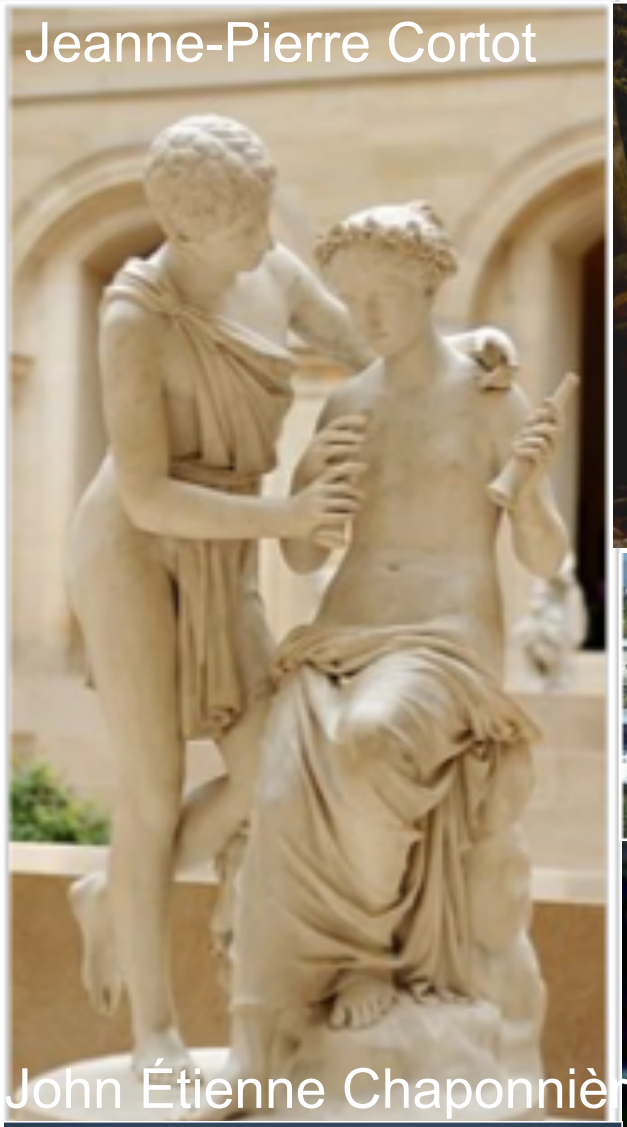
$$e^+e^- \to U\gamma \qquad U \to e^+e^-$$

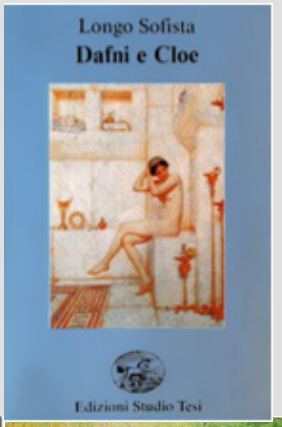
$$e^+e^- \to U\gamma \qquad U \to \pi^+\pi^-$$

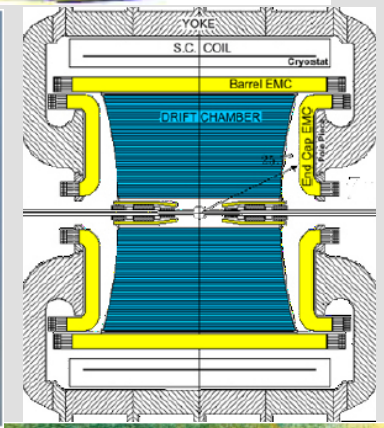
$$e^+e^- \to U\gamma \qquad U \to \mu^+\mu^-$$

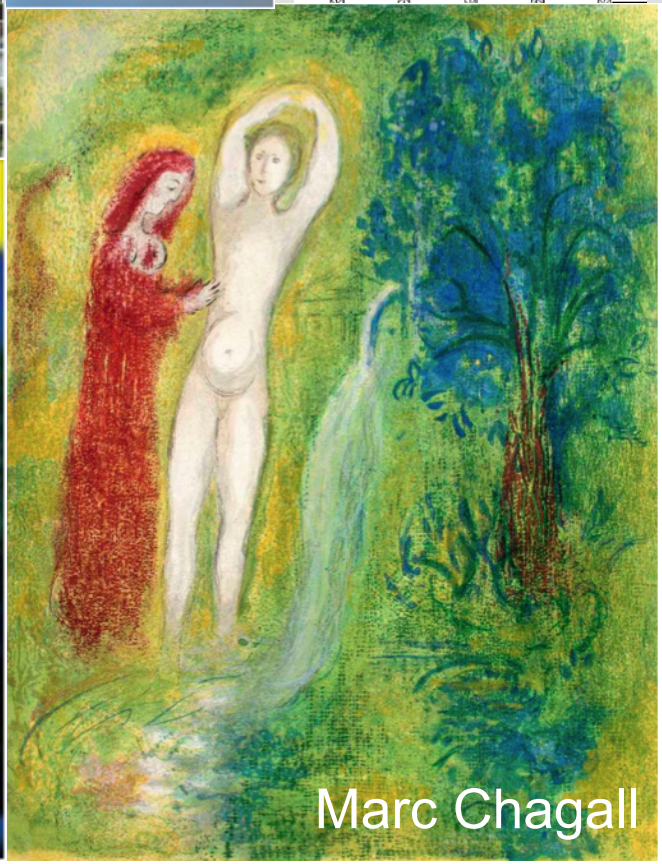
$$e^+e^- \to Uh \to \mu^+\mu^- E_{miss}$$











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Veronica Marek Ivano Francesca

Marcin Lena Michal Izabela Alessandro

Daria Aleksander Andrea

Appendix

A. Aloisio et al., Measurement of the branching fraction for the decay $K_S \to \pi e \nu$, Physics Letters B 535 (2002) 37.

A. Aloisio et al., Study of the decay $\phi \to \eta^0\pi^0\gamma$ with the KLOE detector, Physics Letters B 536 (2002) 209.

A. Aloisio et al., Study of the decay $\phi \to \pi^0\pi^0\gamma$ with the KLOE detector, Physics Letters B 537 (2002) 21.

A. Aloisio et al., Measurement of $\Gamma(K_S \to \pi^+\pi^-(\gamma))/\Gamma(K_S \to \pi^0\pi^0)$, Physics Letters B 538 (2002) 21.

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