DAΦNE2?

Paolo Franzini

Università di Roma, *La Sapienza*

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OUTLINE

1. History
2. 4 Ws
3. KLOE 99-03
4. SM and KAONS
5. KLOE
6. conclusions

History

1947: Rochester and Butler, $K^0 \to \pi^+\pi^-$, $K^+ \to \pi^+\pi^0$

1949: R. Brown *et al.*, "τ" $(K^+ \to \pi^+\pi^+\pi^-)$

1953: Gell-Mann (Nisijima) strangeness

1954-56: Pais; Ledermann. K_1-K_2

1953: Dalitz analysis that lead to $\not{P}$ (1957)

1960's and on: suppression of $K^0 \to \mu\mu$, $\Delta m(K_S, K_L)$

1963: Fitch and Cronin, $\not{C}\not{P}$

1963: Cabibbo, $s - d$ mixing

1964: Gell-Mann – Zweig, quarks

1970: GIM, 2 quark family mixing

1973: Kobayashi and Maskawa, 3 quark family mixing

1999: Direct $\not{C}\not{P}$

19nn – : $\Delta M(K^0, \overline{K}^0)/\langle M \rangle \leq 10^{-18}$

Thus the Standard Model came into being and survives

Trouble with the standard model?

The last three

$$\Re(\epsilon'/\epsilon)$$

$$\sin 2\beta$$

$$a_\mu$$

are mostly gone but. . .

DAΦNE2: WHAT IS IT

A new machine with the present DAΦNE footprint, capable of

1. Reaching a luminosity of about 5×10^{34}, at 1019.456 ± 0.020 MeV – my definition – and
2. With a background level lower than the present one now at DAΦNE – also my definition –
3. Energy could reach ∼2 GeV maximum. Performance at 1019.6^{+5}_{-15} MeV cannot be compromised.

this is tex

WHEN, in which time frame?

Running BEFORE LHC begins *real physics*.

A time window during which in the world:

- TEVATRON. Struggling with bringing up its luminosity. Probably will NOT find the Higgs,
- HERA is winding down its HEP activities, accumulating a large backlog of DIS data that will most likely exhaust their computers and analysis capacities

- B (C) factories are occupied in their microscopic scrutiny of the myriad of B/D decay modes, trying to unravel an unwieldy Gordian knot (bundle?).

That is just the right time for us to bring DAΦNE back to its original goal of measuring all the parameters in the kaon sector, but also beyond it, in its ultimate accuracy, as appropriate for 10 years later.

Remember that while

$$\frac{\Gamma(K_L \to \pi^+\pi^-)}{\Gamma(K_S \to \pi^+\pi^-)} \Bigg/ \frac{\Gamma(K_L \to \pi^0\pi^0)}{\Gamma(K_S \to \pi^0\pi^0)}$$

is well measured, partial widths and amplitude ratios are much more poorly known.

WHERE should it be built?

A new generation of particle and machine physicists has emerged from the junior staff of LNF-RM and the collaborating institutions (like the travelling minstrels). They can THINK, DO, ANALYZE, be RESPONSIBLE, on their own AND, even more importantly, work devotedly as a COHERENT team towards a COMMON end.

They are, without any doubt, world class in their skills and motivation, and I'm extremely proud of them. Let's give them an equally worthy instrument to work with!

WHY should it be done?

1. It has a challenging, though yet to be proven feasible design.
2. It is complete and self contained, not a piece of some international humongous project in which INFN functions mainly as a donor.
3. When built, it will have international visibility, as the present KLOE result are beginning to have. DAΦNE2 certainly would have the UNIQUENESS of being the only BRIGHT phi factory (VEPP-2000's goal luminosity is orders of magnitude lower).

4. The project fits well in the temporal period indicated above including KLOE completing its present physics program and preparing a realistic machine and detector design
5. The upgraded KLOE would still have the largest chamber, the fastest calorimeter, plus more tracking close to the interaction point and a good Q-cal.

Why: PHYSICS!!!

The original DAΦNE-KLOE proposal was centered around proving the existence or otherwise of direct $\not{C}\not{P}$. While we proposed to do this by measuring the four rates

$$\Gamma(K_{S,\,L} \to \pi^+\pi^-, \pi^0\pi^0)$$

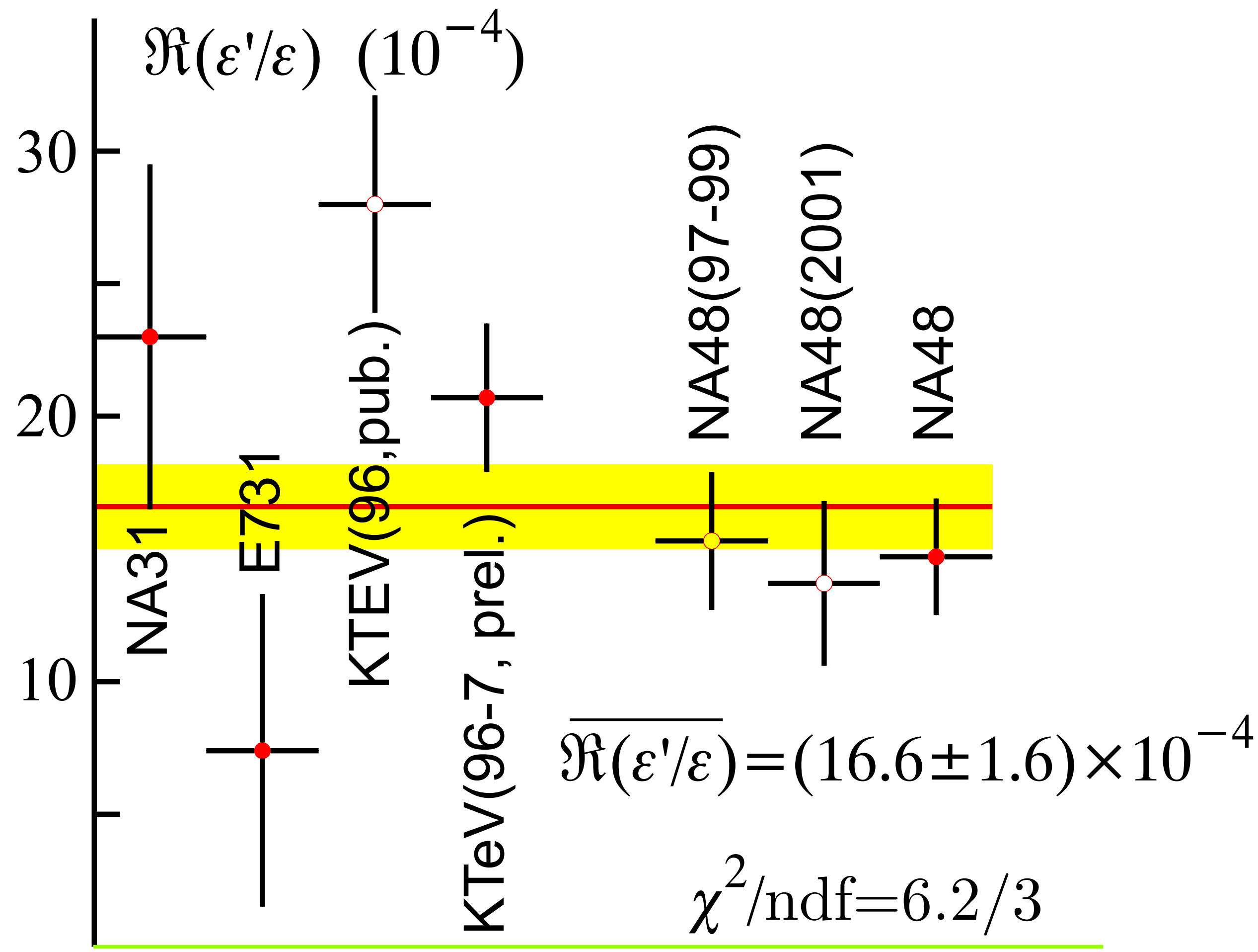
we did emphasize the uniqueness of a ϕ–factory in providing interferometry, thus allowing the measuring of phase and magnitude of the amplitude ratios

$$\eta_i = \frac{A(K_L \to i)}{A(K_S \to i)}$$

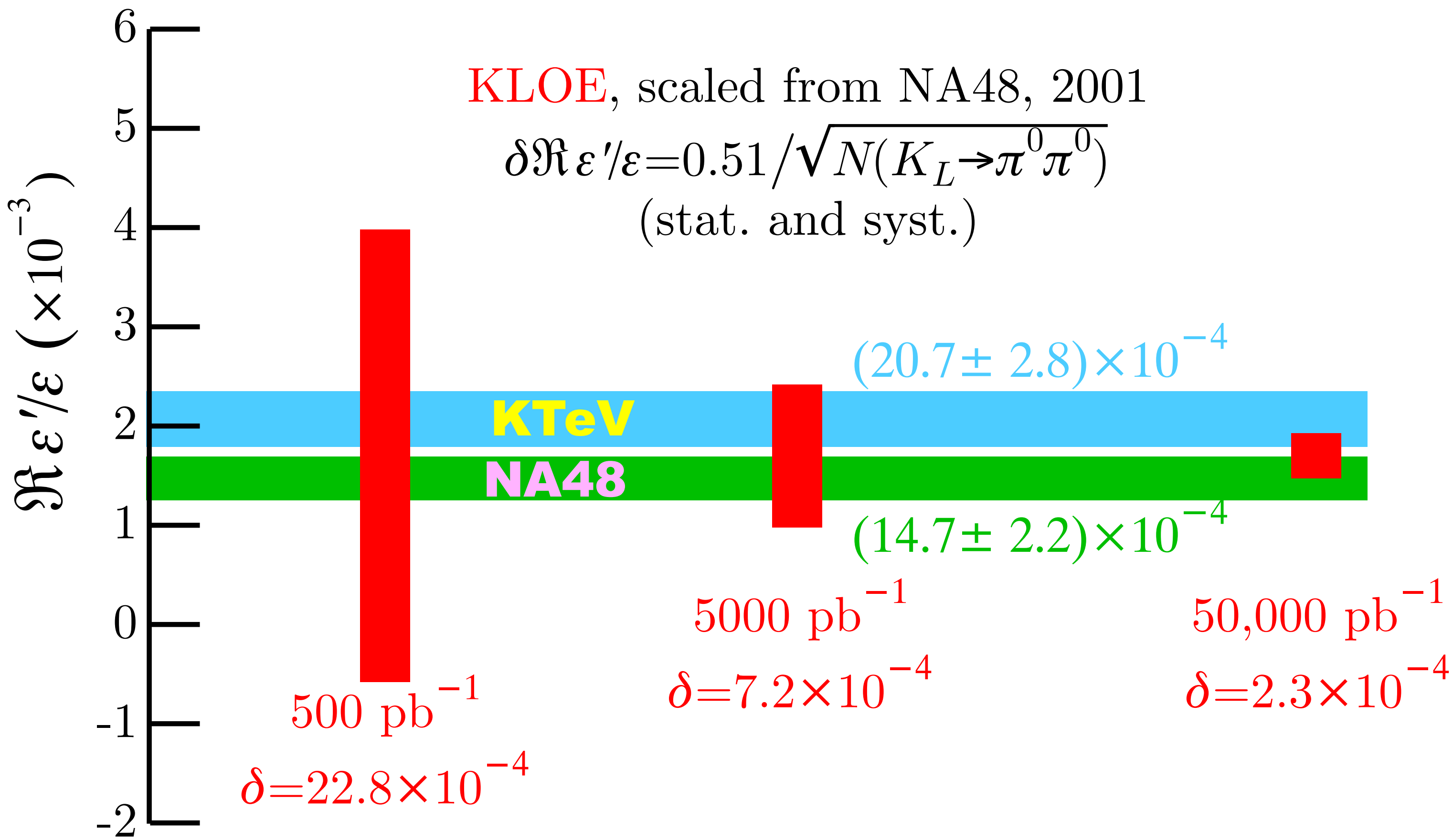
as well as *kinematical* properties such as $\Gamma_{S,\,L}$ and Δm.

Direct CP̸ has been proven by NA48 and KTeV, but KLOE has yet not much to say.

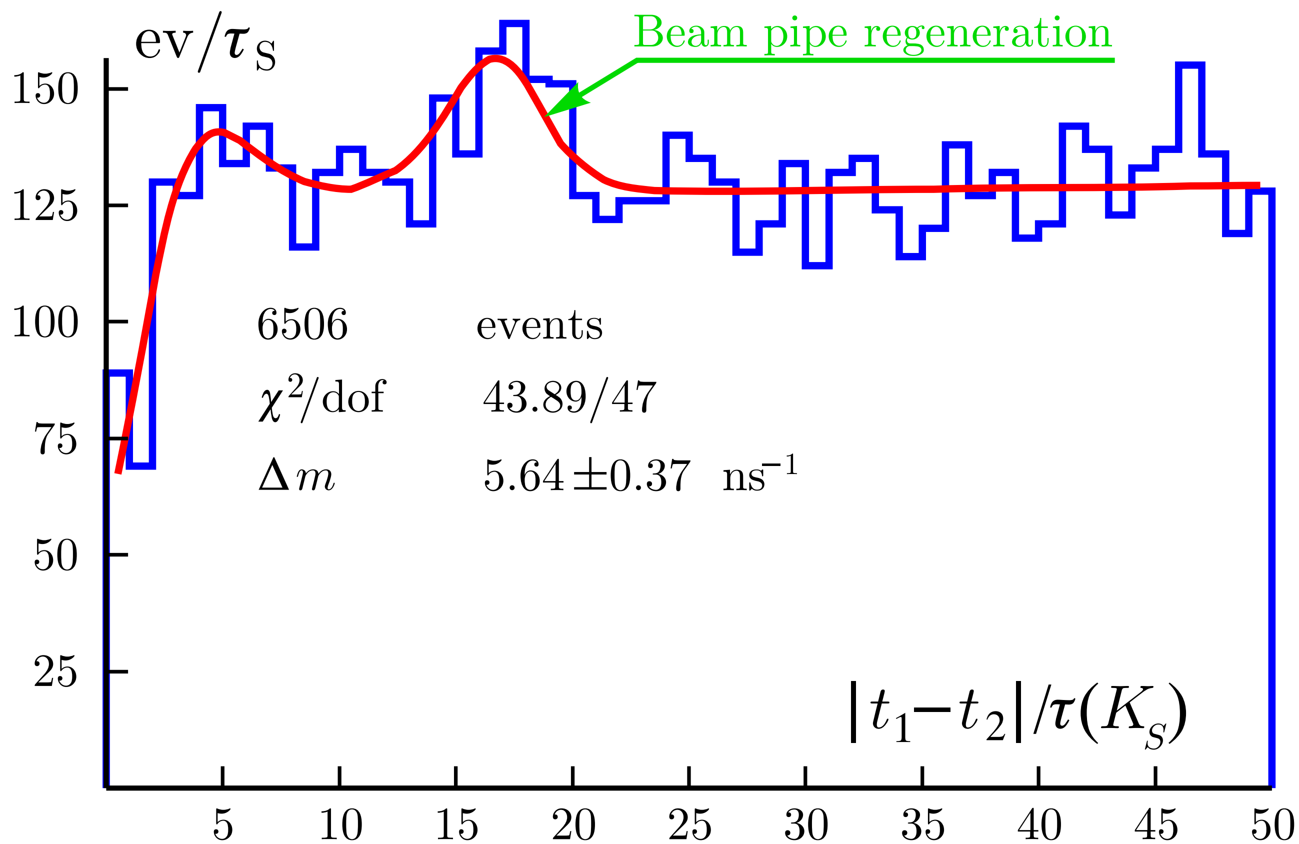
Since there appears to be no way to connect $\Re(\epsilon'/\epsilon)$ and the CKM parameters, there is little reason for spending time and money in trying to perform a third measurement.

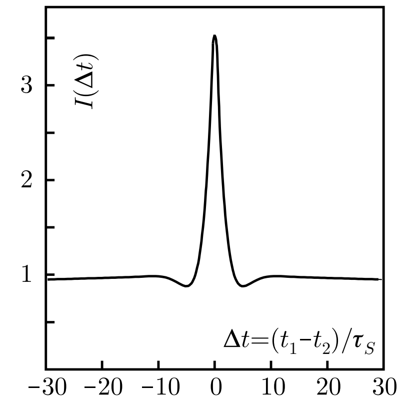


from Lenti, CERN Seminar

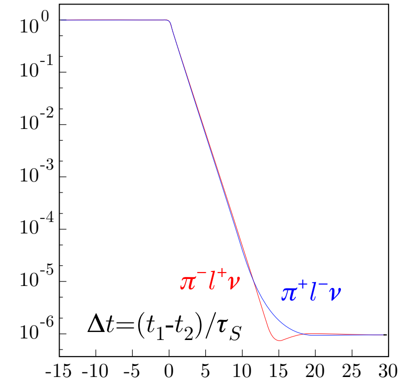


HOWEVER, measuring the η_i parameters (and Γ's and more) remains a fundamental job to be performed to complete our knowledge of the parameters of the neutral kaon system. And this is already quite a justification for DAΦNE2-KLOE.





$\phi \to K_S K_L$
$\to \pi e^+ \nu$
$+ \pi e^- \nu$



$\phi \to K_S K_L$
$\to \pi^+ \pi^-$
$+ \pi e \nu$

The first observed example of interference. KLOE.

$$e^+e^- \to \phi \to K_S K_L \to \pi^+\pi^- + \pi^+\pi^-$$

$$\Rightarrow \Gamma_S,\ \Gamma_L,\ \Delta m,\ [\Re, \Im(\eta_i,\ \delta \ldots)]$$

$$I(f_1, f_2, \Delta t) = ..2|\eta_1||\eta_2| e^{-\Gamma \Delta t/2} \cos(\Delta m \Delta t + \phi_1 - \phi_2)$$

this is tex

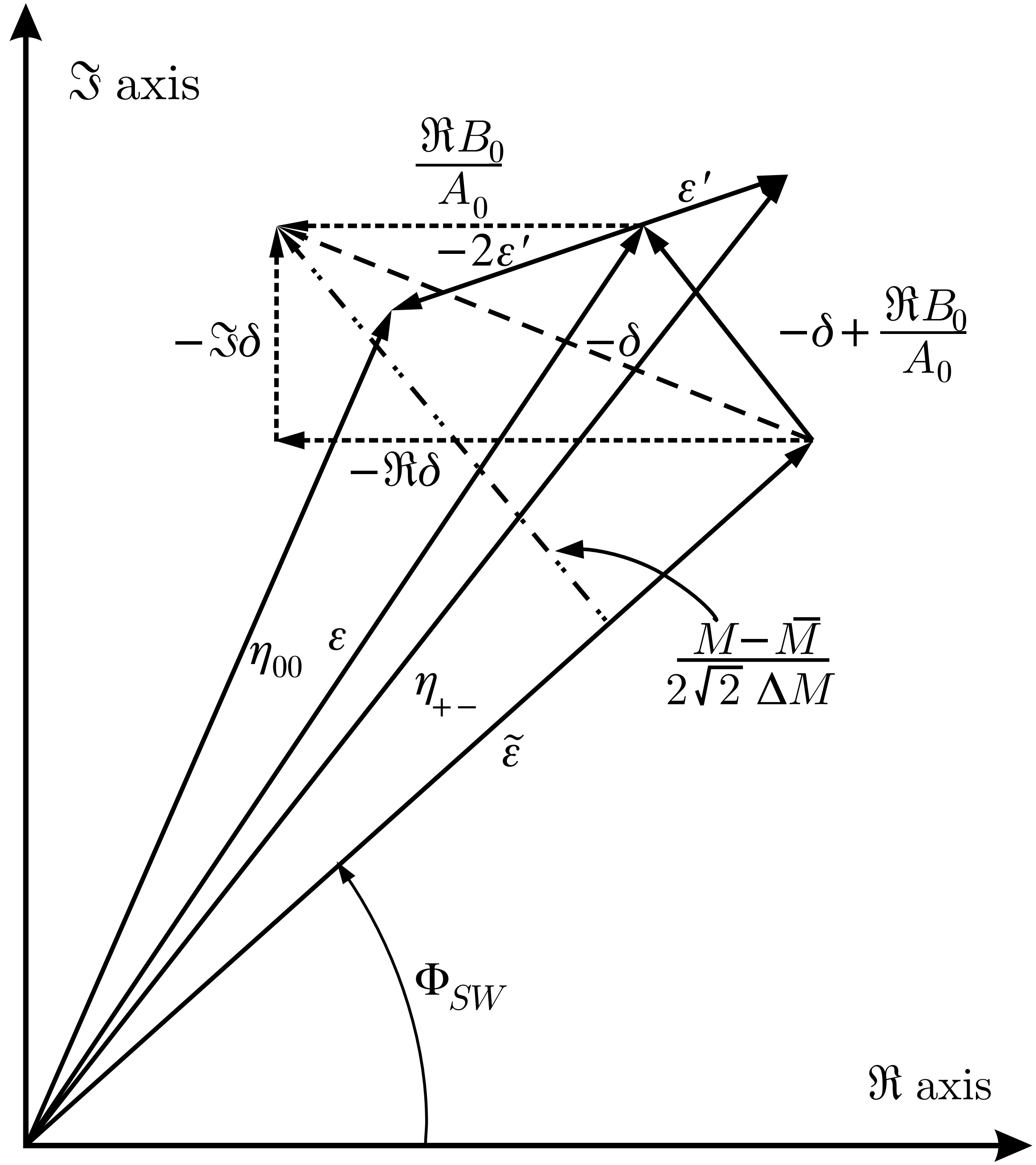
I do not have to remind you that measuring the complex amplitude ratios η_i means measuring $\Re(\epsilon'/\epsilon)$ and much more. From the relations

$$\eta_{\pi^+\pi^-} = \epsilon + \epsilon'$$
$$\eta_{\pi^0\pi^0} = \epsilon - 2\epsilon'$$

(which could be taken as the definition of ϵ and ϵ')

$$\epsilon = (2\eta_{+-} + \eta_{00})/3$$
$$\epsilon' = (2\eta_{+-} - \eta_{00})/3$$

providing much more information than just $\Re(\epsilon'/\epsilon)$, as indicated in figure. This is not clear to UD and others.



An aside: KLOE, 99-03

In spite of a large amount of frustration, KLOE has made fundamental contributions to:

1. K_S decays, rare and not
2. Scalar mesons
3. $\sigma(e^+e^-\to\pi^+\pi^-)$

A ϕ–factory is unique for K_S study. Only from ϕ-decays we can get pure K_S (and K_L and K^+ and K^-) beams.

Yields are $\mathcal{O}(10^6)$/pb^{-1} kaons of any kind. After tag and fiducial volume one is left with 10-50% of them. Purity is unsurpassed and (not often appreciated) an absolute count is automatic.

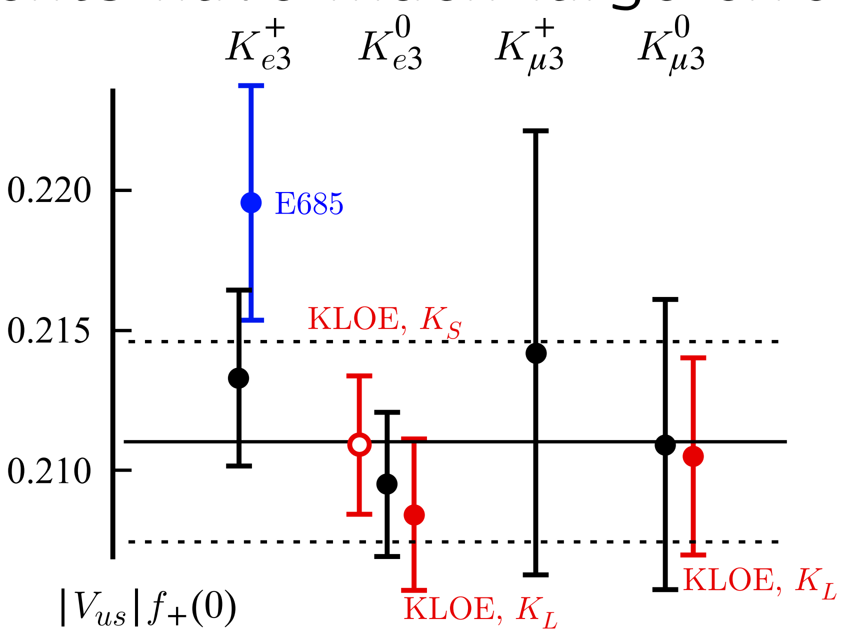
In the 2002-3 edition of PDG, KLOE appears for the first time, with 11 entries. All of which are the most accurate and already surpassed by our newer results. By the end of 2003 we will provide the basis for the first improvement, in a long time, >30 years, of the $|V_{us}|$ value.

And, for the first time, our data will allow critical checks of chiral perturbation calculations.

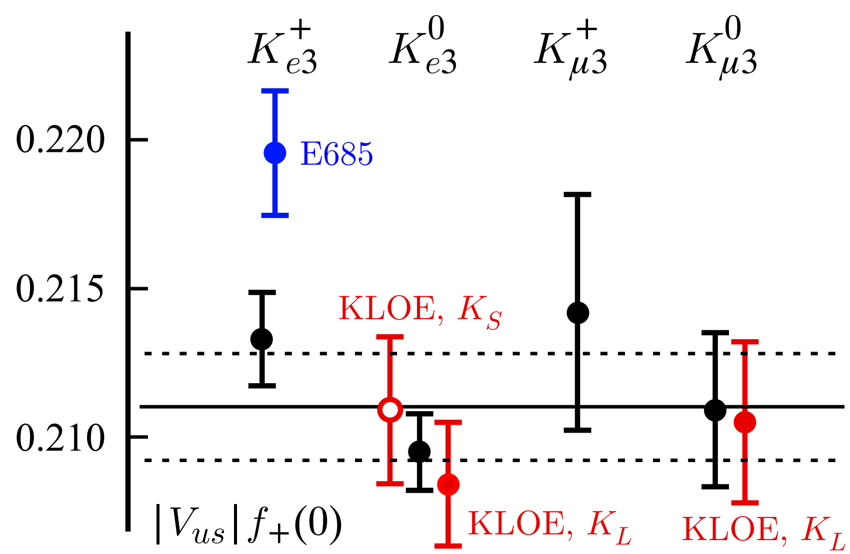
Still the best product of KLOE are all the young people who have had the opportunity to struggle and solve lots of problems to get to final results.

Aside on errors

If you look in PDG for the data used to get $|V_{us}|$ you first realize that they come mostly from 1972 and earlier. One exception is $\tau(K^{\pm})$ which was last measured in 95, with poor agreement between the two results of the same experiment. Given the existing data, I would conclude that the lifetime error is 0.8%, rather then the quoted 0.2%. Second you notice that the error on the branching ratios come from the PDG fit, the actual measurements have much large errors. So things really look more like



than



A problem with the PDG fits (with all fits) is that they give smaller errors and many, large, correlations.

K. Hagiwara *et al.* (Particle Data Group), Phys. Rev. D **66**, 010001 (2002) and 2003 partial update

K^0_L — 1965 result in 03 — $I(J^P) = \frac{1}{2}(0^-)$

$$x = A(\overline{K}^0 \to \pi^- \ell^+ \nu)/A(K^0 \to \pi^- \ell^+ \nu) = A(\Delta S{=}-\Delta Q)/A(\Delta S{=}\Delta Q)$$

REAL PART OF x

VALUE	*EVTS*	*DOCUMENT ID*	*TECN*	*COMMENT*
$-0.08\ {}^{+0.16}_{-0.28}$	109	[122] FRANZINI 65	HBC	$\overline{p}p$

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CP-Lear (90's) with 640,000 events gave
$\Re x = -0.0018 \pm 0.006$ or $\Re x < 1.2\%$ at 95% CL. Same idea.

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KLOE 2002: 7,700 K_{Se3} decays (170 pb^{-1}), $\Re x = 0.003 \pm 0.0065$, or $\Re x < 1.3\%$. All 02 data: 0.5% – A better idea.

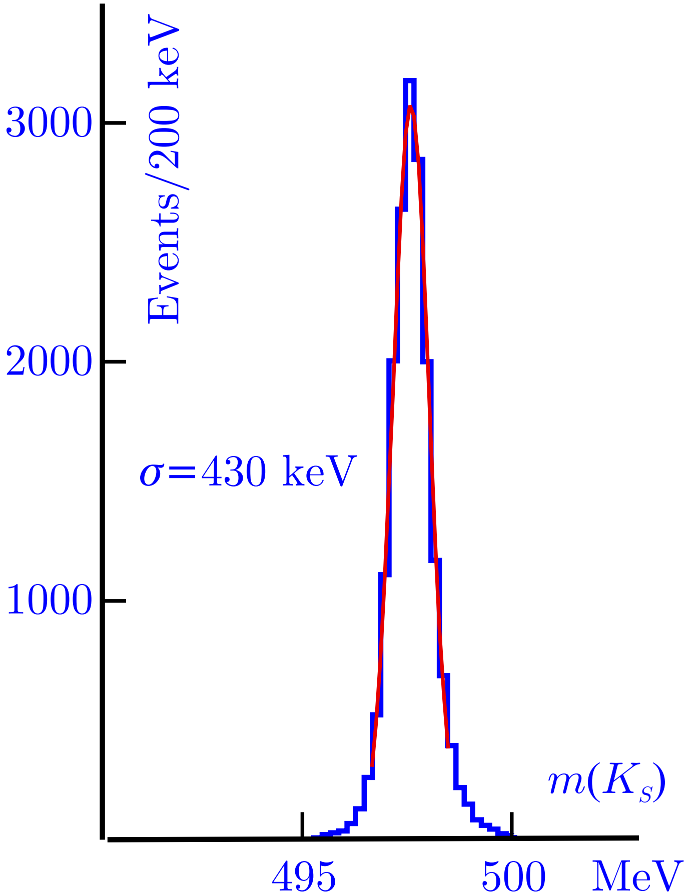
Uniqueness of a ϕ–factory and KLOE results

Purity - 1	$\sigma(e^+e^-\to\phi)\gg$cont., $\gg$Bhabha, large θ.
Purity - 2	$\psi(0)=(K_SK_L-K_LK_S)/\sqrt{2}$. – $K^\pm$!!
Yield	see table below
$\delta p/p$	0.5%, from machine δE
$\beta(K^0)$	$\sim$0.2; $\delta\beta/\beta\sim$0.5%, from machine δE

Yield:

K^+K^-	50%
K_SK_L	34%
$\rho\pi$	15%

KLOE Results: Masses



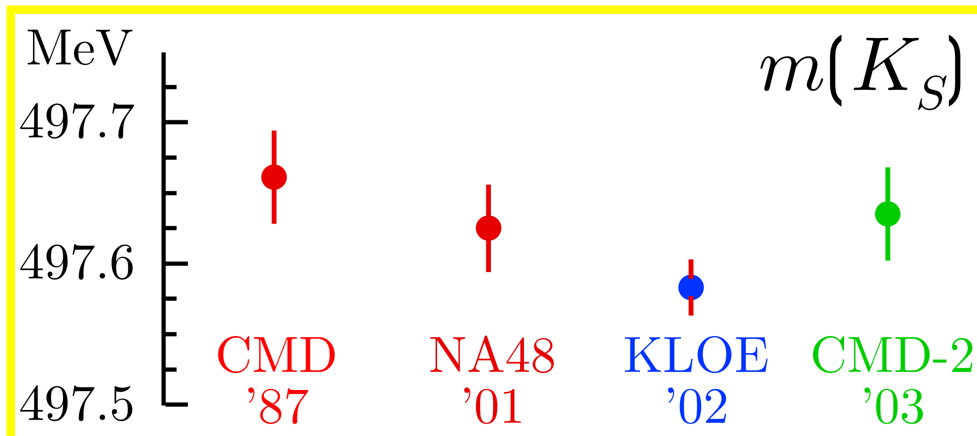
$m(\phi) - 2m(K_S) = 26$ MeV

$(1/2m(\phi))^2 \cong m^2(K_S) + p^2_{K_S}$

$\delta M_{KLOE} \sim 270$ keV

$\delta M_{DA\Phi NE} \sim 220$ keV

$\delta M_{RadCor} \sim 20$ keV



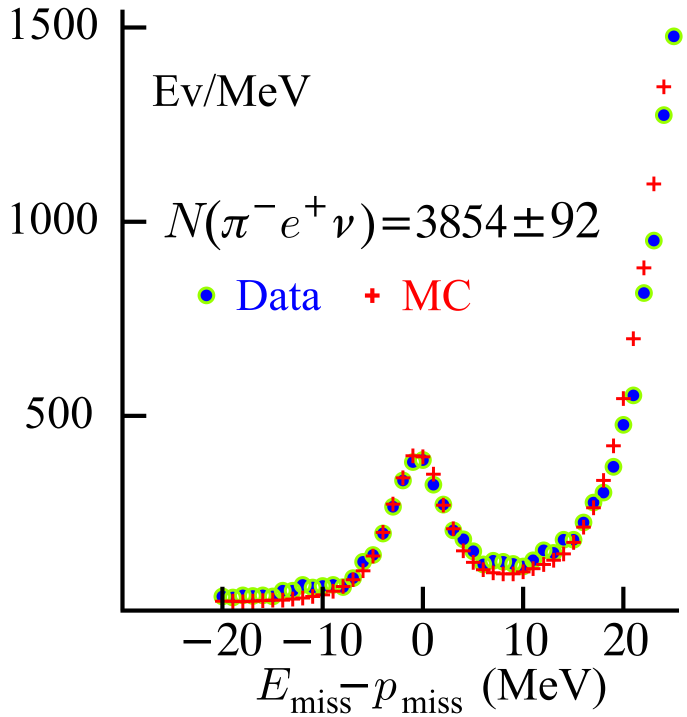
$m(K_S) = 497.583 \pm 0.005 \pm 0.020$ MeV, KLOE

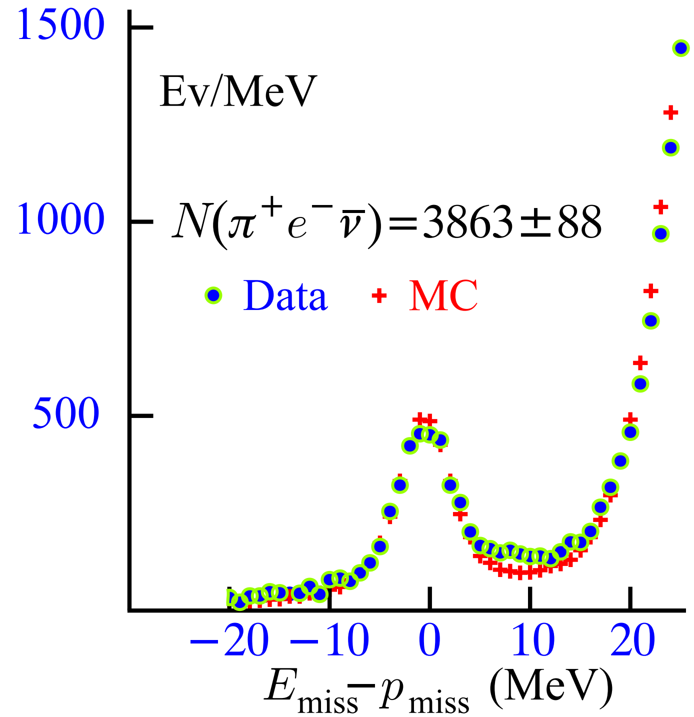
$m(K_S) = 497.609 \pm 0.017$ MeV, WA, χ^2=2.8/2 dof

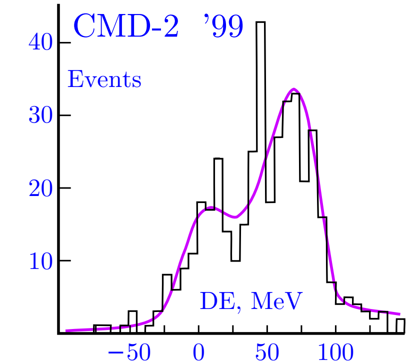
Who is right? Are QED rad corr site dependent?

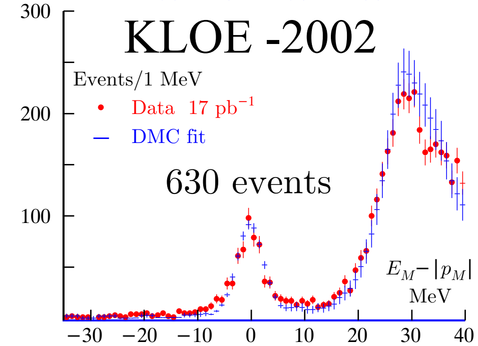
Momentum scale + accuracy. RADIATIVE corrections

KLOE Results: K_S-semileptonic









$$\text{BR}(K_S \to \pi e \nu) = (6.9 \pm 0.15) \times 10^{-4};\ \delta\Gamma/\Gamma = 2.2\%$$

$$\mathcal{A}_S^e = (19 \pm 18) \times 10^{-3}$$

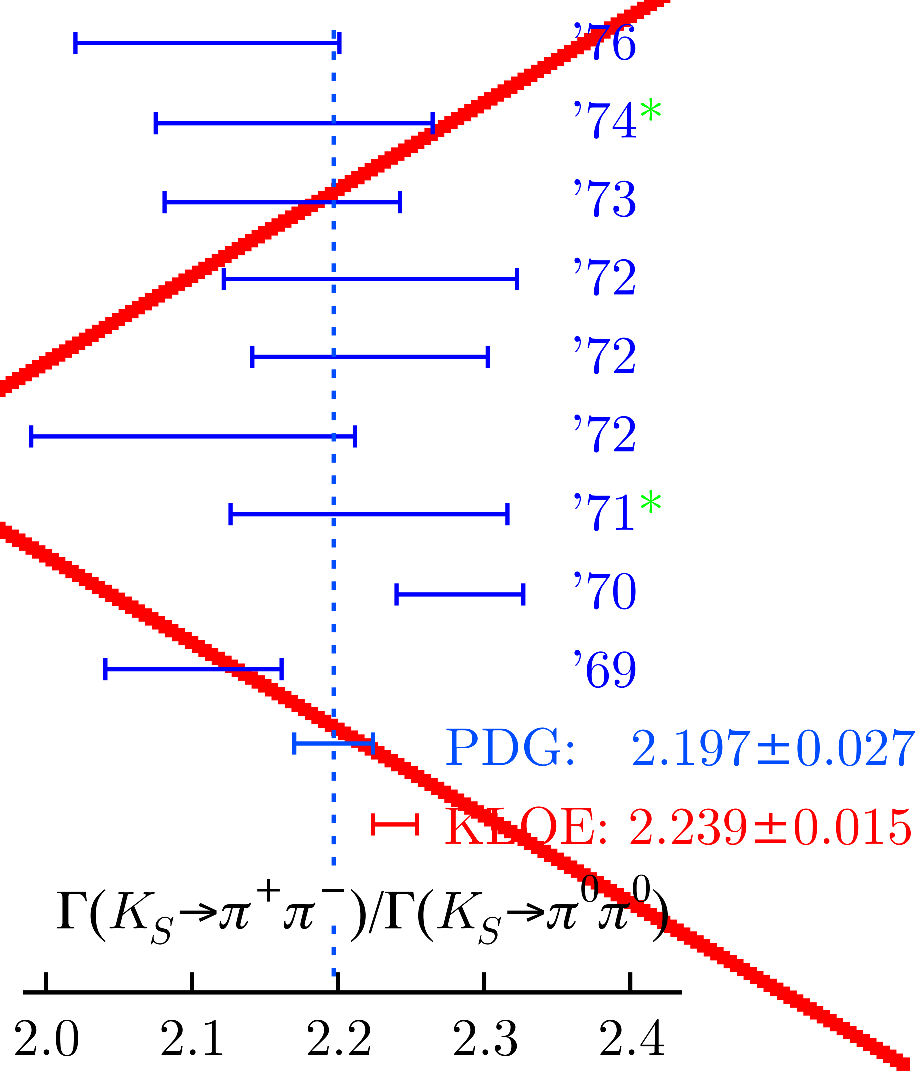
$$K_L:\ \delta\Gamma/\Gamma = 1\%,\ \delta\mathcal{A}_L^e = 7.4 \times 10^{-5}$$

Tagging, particle ID

this is tex

KLOE Results: $K_S \to \pi^+\pi^-(\gamma)/K_S \to \pi^0\pi^0$

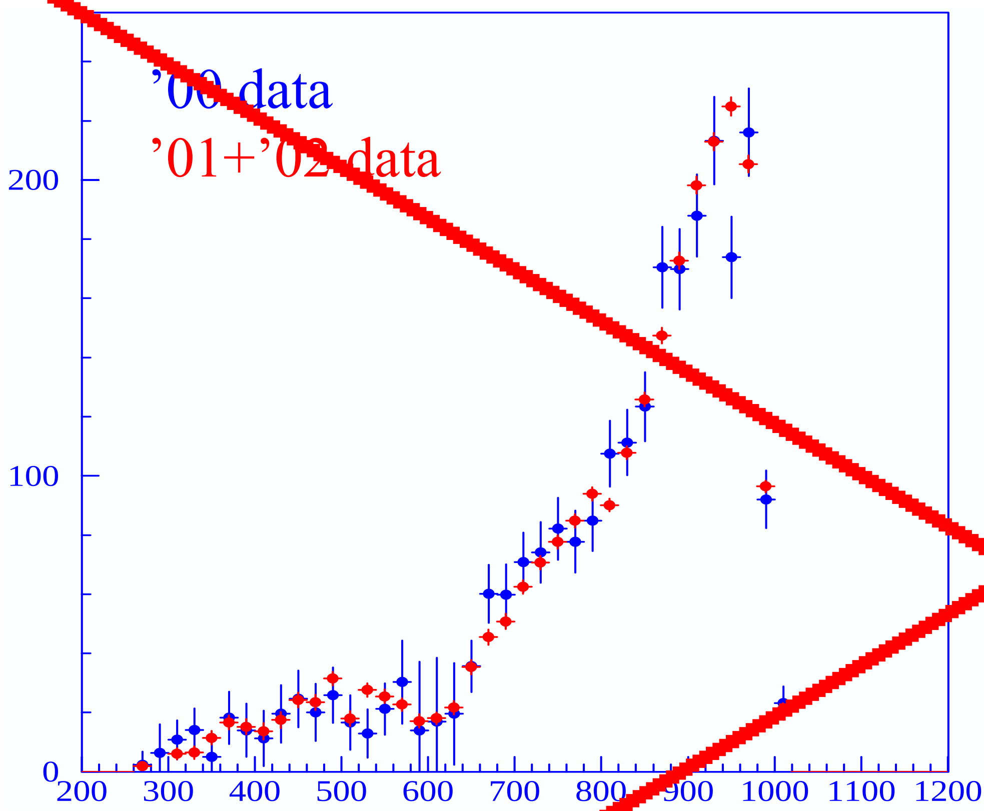
Trigger eff $>$96.5%
Overall accept. $\sim$57%
ALL FROM DATA
$R = 2.239 \pm 0.003(\text{stat.}) \pm 0.015(\text{syst.})$
KLOE includes all $K_S \to \pi^+\pi^-\gamma$, others inc. unknown fraction.

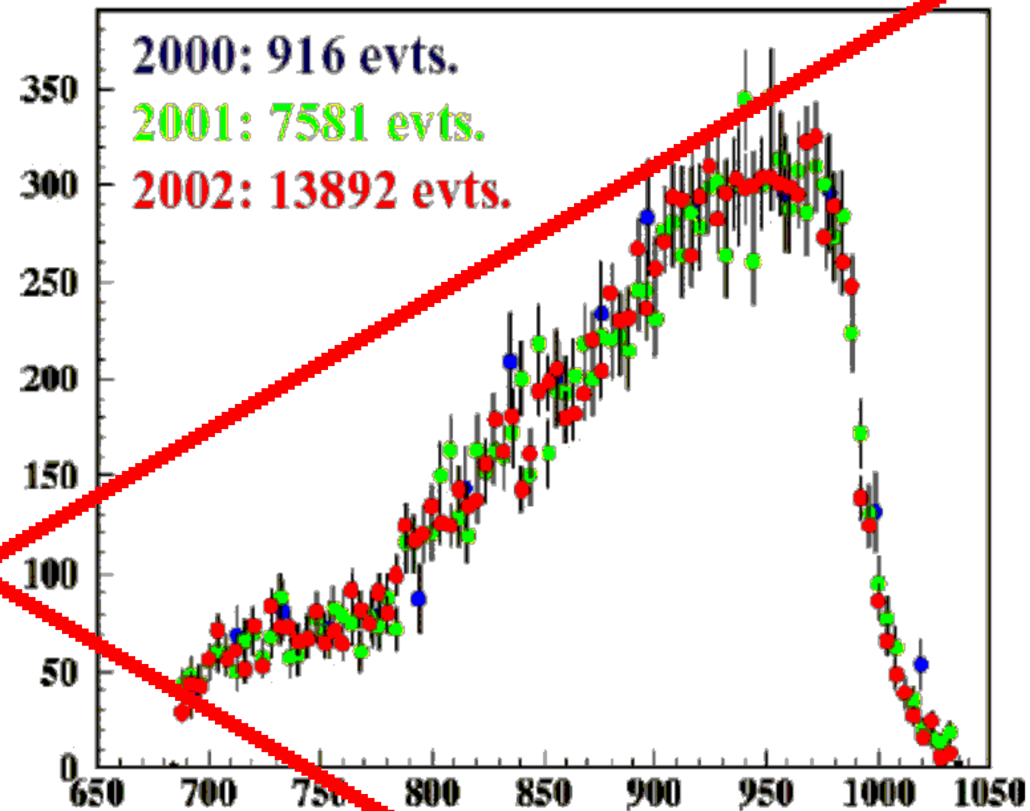


$\delta R/R = 0.1\%$ contributes 1.6×10^{-4} to error on $\Re(\epsilon'/\epsilon)$.
Coming soon

Do not take seriously PDG!

KLOE Results: Scalars



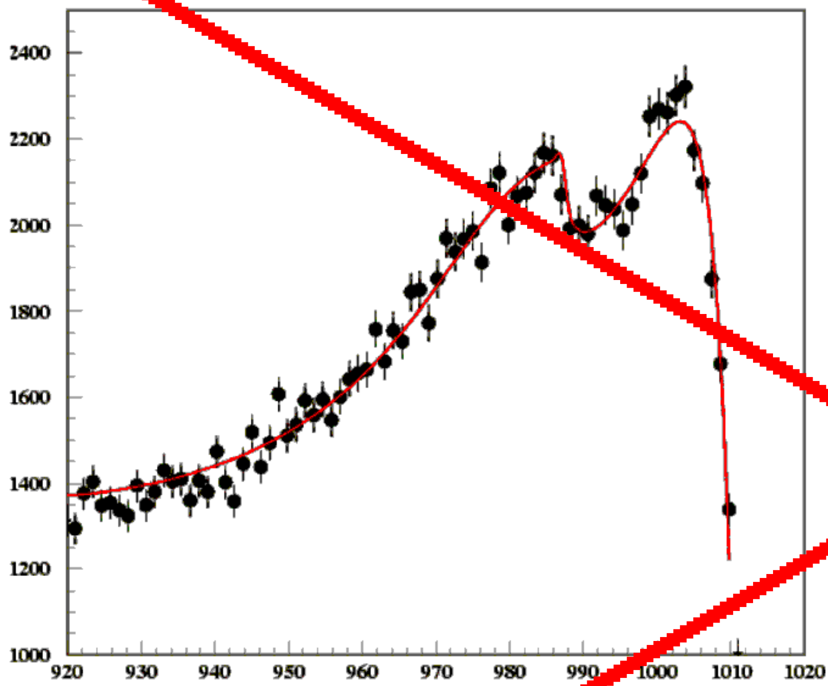


$BR(\phi \to \pi^0 \pi^0 \gamma) = (1.09 \pm 0.06) \times 10^{-4}$

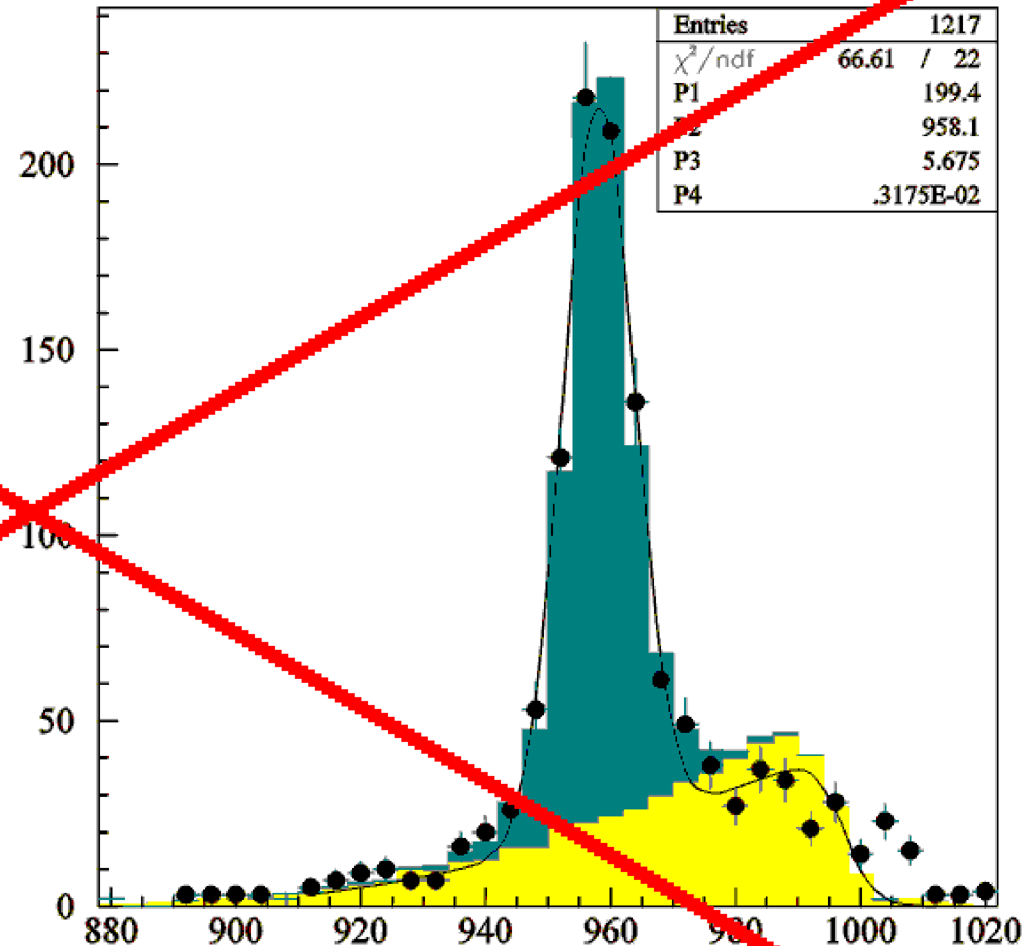
$BR(\phi \to \eta \pi^0 \gamma) = (0.85 \pm 0.08) \times 10^{-4}$

First clean look at structure of scalars

KLOE Results: Pseudoscalars



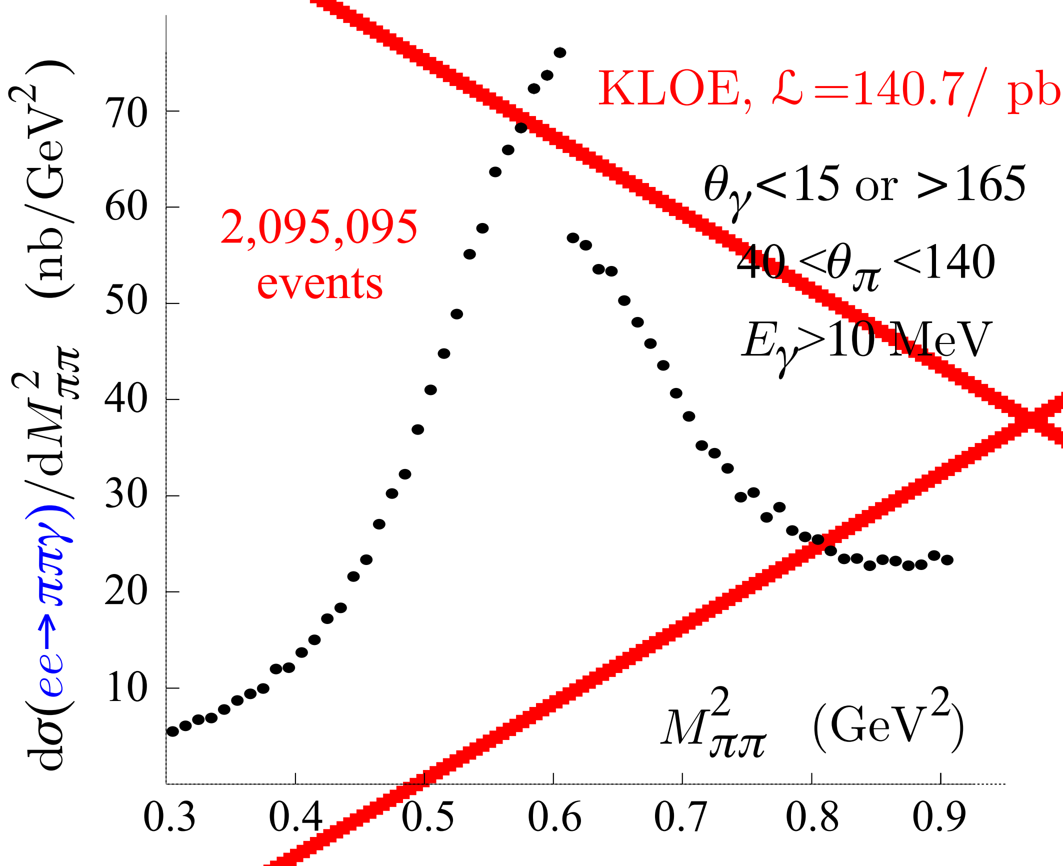
First evidence for
$\phi \to f_0 \gamma \to \pi^+ \pi^- \gamma$
really $f_0 \to \pi^+ \pi^-$

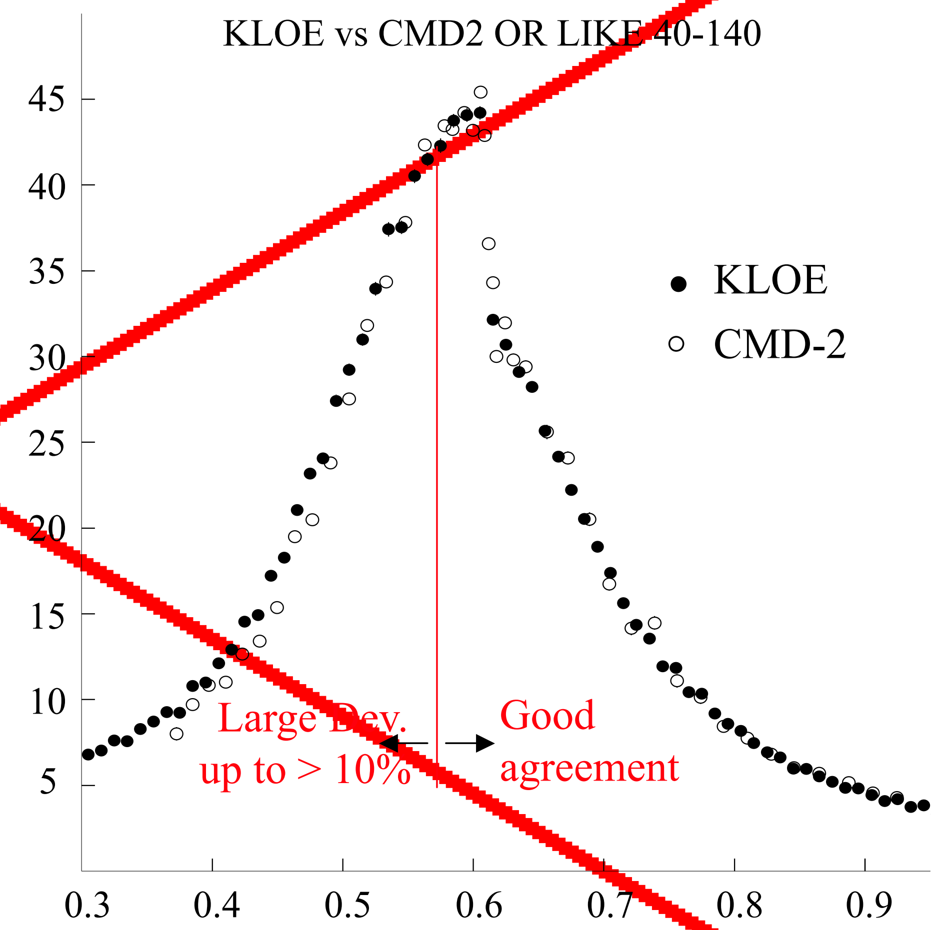


BR($\phi \to \eta' \gamma$)=$6.10 \pm 0.7 \times 10^{-5}$

Mixing, gluon contents

KLOE Results: $\sigma(e^+e^-\to\pi^+\pi^-)$





ISR instead of scan, radiative corrections

All of the above was just to prove that

1. A ϕ–factory is a good source of physics, even with low $\mathcal{L}$ and very large background
2. DAΦNE, with KLOE, has been a valuable venture, producing many highly skilled young people
3. LNF-RM have profited from it and, for another couple of years will continue to do so, in a world which is becoming less and less sympathetic to research in fields remote from everyday connections. Which should never be a consideration. . .

But the end is close, very close. We should find a way to go further.

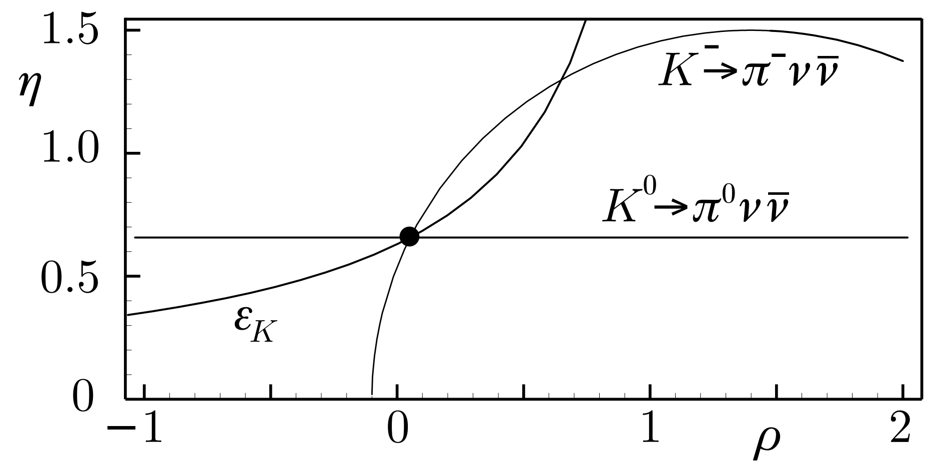
DAΦNE provides pure, monochromatic, low β K_S (. . .) beam with absolute count

IF ONE CAN DO EXCEPTIONAL PHYSICS WITH THE ABOVE BOUNDARY CONDITIONS WE SHOULD HAVE DAΦNE2

And that is what we have to ask

Probing the SM with kaons

1. V_{us}
2. $\Delta S = \Delta Q$, which is really a triviality
3. Mixing: a unitary matrix, 4 real numbers. K^0-$\overline{K}^0$ mixing vs $K^{\pm 0} \to \pi^{\pm 0} \nu \bar{\nu}$ Is it consistent?



4. CPT-invariance, best tested with kaons

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

mode	ev/(10^{12} μb^{-1})†	BR	ev
$K^\pm$	3×10^{12}	7.7×10^{-11}	231
K_L	10^{12}	2.6×10^{-11}	26

mode	geom losses‡	fc losses‡	ev	bckgnd§
$\pi^\pm$	2.5	5	18	10^N
π^0	6.8	5	.8	10^N

† 10^{12} μb^{-1}=10^5 μb^{-1} s^{-1}$\times$$10^7$ s=10^{35} cm $^{-2}$ s^{-1}$\times$$10^7$ s

‡ The efficiency of E787 ($K^+ \to \pi^= \nu\bar{\nu}$) is 2×10^{-3} compared to the above optimistic values of 8×10^{-2} and 3×10^{-2}

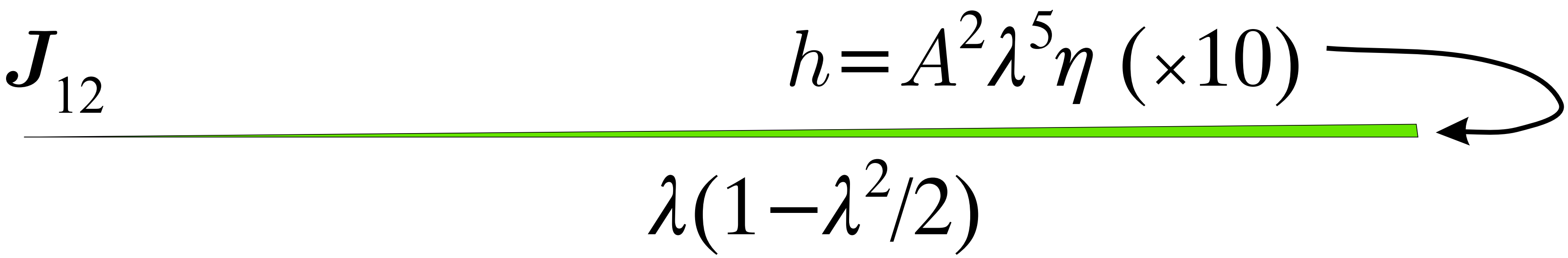
§ Various arguments argue for N large in present KLOE.

$K^{\pm 0} \rightarrow \pi^{\pm 0}\nu\bar{\nu}$ cannot be measured

1. Cannot compete with hadron machines. KAMI: $4 - 7 \times 10^{13}$ K_L decays/y in detector. ϕ–factory @ $\mathcal{L}$=10^{35} cm^{-2} s^{-1} ; $2 - 3 \times 10^{11}$ K_L dec/y.
2. E787 (2 ev) has collected 6×10^{12} K^{+} decays. E949 should improve by a factor 5, but no AGS. CKM improve by another factor 10, but recently put on hold.
3. $K^{\pm}$ experiments need strong pion ID or muon rejection. Efficiencies of few % are conceivable at higher p_{μ}. Still need $\mathcal{L}>10^{36}$.
4. A new limit has little value. Must measure BR.

5. 8 years ago, I did believe $K \to \pi\nu\nu$ was fundamental. Today I do not think so.

6. Too bad



To get η need λ and A!

$\delta(A^2\lambda^5)/(A^2\lambda^5) \sim$ 5.6%, K. Schubert, LP03.

Optimistic?

K_S RARE DECAYS?

While $\mathcal{L}$=1000 nb^{-1}/s is out, $\mathcal{L}$=50 nb^{-1}/s is conceivable. It is a pity that a series of circumstances did not allow DAΦNE to resume running, after the major improvements of Jan-June.

With 50 nb^{-1}/s, the K_S yield is 5×10^{11} per year. Many things become interesting. In the SM $K_S\to\pi^0\pi^0\pi^0$, $\to\pi^0 e^\pm\nu$ or the semileptonic asymmetry are trivially calculable from K_L BR's and ϵ:

1. $\mathrm{BR}(K_S\to\pi^0\pi^0\pi^0)=1.9\times10^{-9}$ ($\pm$2.4%)
2. $\mathrm{BR}(K_S\to\pi^\pm e^\mp\nu)=6.7\times10^{-4}$ ($\pm$1.5%)
3. $\mathcal{A}_S^\ell=2\Re\epsilon=3.323\times10^{-3}$ ($\pm$1.7%)

...

When something is so precisely predicted, it sort becomes a must to measure it. Ignoring the usual comment of how much discovery range is possible. . .

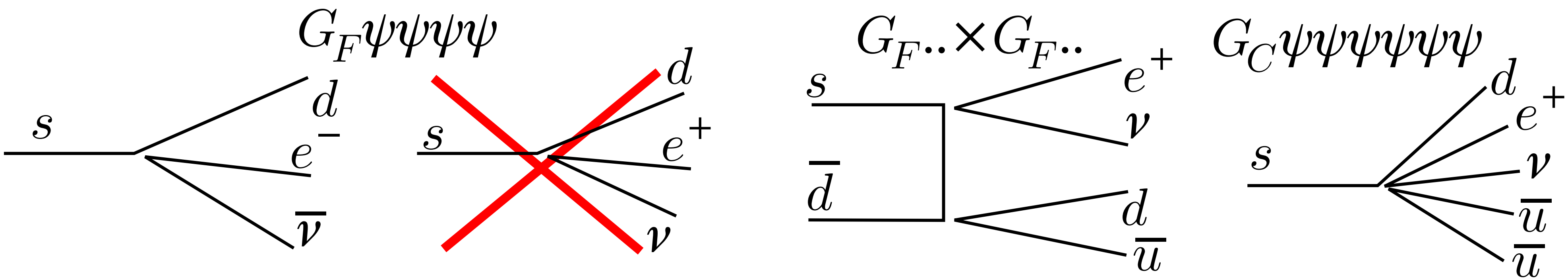
The above ideal ϕ–factory with the given BR's means

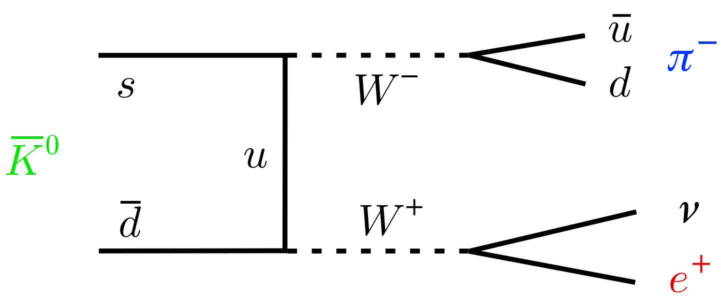
$N(K_S \to \pi^0\pi^0\pi^0)$	950/y
$N(K_S \to \pi^\pm e^\mp \nu)$	3.3×10^8/y

Not all decays can be collected, but at least all K_S's decay in the detector.

For comparison, NA48 collected 5×10^6 $K_L \to \pi^0\pi^0$ decays between 1997 and 2001, the original proposal having been submitted in 1990.

$\Delta S = \Delta Q$





$x = A(K^0 \to e^+)/A(\overline{K^0} \to e^+) \sim Gm^2 \sim 10^{-6..-7}$. Or from compositeness, $x = 10^{-10} \times (1\ \text{GeV}/\Lambda)^6$, or. . . . But no loops, no SS. There are in general two x's: x^+, x^-.

Must do better.

CKM Unitarity

Strongest constraints from ΔM_K and $BR(K_L \to \mu\mu)$

$|V_{ud}| = 0.9737 \pm 0.0007$

$\lambda = 0.2235 \pm 0.0033$ ($\pm$ 1.5 %)	scandalous
$A\lambda^2 = 0.0415 \pm 0.0011$ ($\pm$ 2.7 %)	optimist
$A\lambda^3 \sqrt{\rho^2 + \eta^2} = 0.0038 \pm 0.0004$ ($\pm$ 10 %)	same
atan $(\eta/\rho) = (58 \pm 19)^o$ ($\pm$ 5 % of 360°)	needs work

$|V_{ud}|^2 + |V_{us}|^2 + |V_{ub}|^2 = 0.9969 \pm 0.0017$ $\quad -1.8\ \sigma$

$|V_{cd}|^2 + |V_{cs}|^2 + |V_{cb}|^2 = 1.042 \pm 0.029$ $\quad +1.5\ \sigma$

$|V_{ud}V_{cd}| - |V_{us}V_{cs}| \pm |V_{ub}V_{cb}| = -0.002 \pm 0.016$ $\quad 0.1\ \sigma$

12 Aug 2003 K. R. Schubert (TU Dresden), Lepton Photon 2003

Measuring angles and/or η is a hard way to go about it. Still it is important. And do not forget that $K_L \to \pi^0 \nu\bar{\nu}$ measures $A^2\lambda^5\eta$, not η. In some sense this mode has lost some luster today, at least wrt to measuring η. But we must check "J" everywhere we can and what if Belle is right?

BR($K^+ \to \pi^+ \nu\bar{\nu}$ and $K_L \to \pi^0 \nu\bar{\nu}$) are not coming soon.

Remember that it took 40 years to get from the discovery of $\not{C}\not{P}$ to the present firm value for $\Re(\epsilon'/\epsilon)$. It was done by NA48-KTeV – but – after the experience of NA31-E731. So it took 20 years!

The same was true for those two $K^+ \to \pi^+ \nu\bar{\nu}$ events

Also, direct $\not{C}\not{P}$ can be searched for in $K^{\pm}$decays. The NA48/2 effort could continue at a new ϕ–factory, possibly reaching better sensitivity.

Remember $A_g \sim 10^{-6}$ and $A_{\Gamma} \sim 10^{-8}$ and not even the authors, GGG, like the SS enhancement via a CMO (*possible only if... several conditions... conspire*) they propose.

CPT

In 1957-64 we saw the demise of P, C and CP what about CPT? This is a most important reason for studying K_S decays. Let me notice right away that we must aim for $\mathcal{O}(10^{-5})$ sensitivity or 10^9 semileptonic K_S decays.

CPT. The kaon system does provide the strongest upper bound on $\Delta M/\langle M\rangle$ for CPT conjugate states. Of course since we do not really know what to expect, we do not know when we have achieved a significant –null– result.

At the Plank scale, we might contemplate loss of QM coherence or non flat space, thus losing the bases for the Pauli-Lüders theorem.
This means comparing the dimensionless ratio $\Delta M_K/M_K$ with another dimensionless ratio $M_K/M_{\mathrm{Plank}}{=}0.5/1.2\times10^{19}{\sim}4\times10^{-20}$.

So we should aim for $\Delta M_K{\sim}2\times10^{-11}$ eV.

Without assuming CPT invariance, to l.o. in "ϵ":

$$|\,K_S\,\rangle=[(1+\epsilon_S)|\,K^0\,\rangle+(1-\epsilon_S)|\,\overline{K^0}\,\rangle]/\sqrt{2}$$
$$|\,K_L\,\rangle=[(1+\epsilon_L)|\,K^0\,\rangle+(1-\epsilon_L)|\,\overline{K^0}\,\rangle]/\sqrt{2}$$

Define $\tilde{\epsilon}$ and δ through the identities

$$\epsilon_S \equiv \tilde{\epsilon} + \delta \qquad \epsilon_L \equiv \tilde{\epsilon} - \delta.$$

Using unitarity, $\mathcal{A}^e_L$, etc. and assuming no $\not{C}\not{P}\not{T}$ in the decay amplitudes leads to limits on δ and

$$\frac{|M(K^0) - M(\overline{K^0})|}{\langle M \rangle} = \frac{\Delta M}{M} = (2 \pm 9) \times 10^{-19}$$

2 ± 4

Without any assumption about $\not{C}\not{P}\not{T}$ or $\Gamma(K^0) = \Gamma(\overline{K^0})$, the result is considerably weaker, $\sim$few$\times 10^{-18}$.

To get to the Plank scale must measure δ to 0.7×10^{-5}.

In general, but with $\Delta S = \Delta Q$, $\Re\delta = (\mathcal{A}^e_L - \mathcal{A}^e_S)/4$. Thus need $\mathcal{A}$ to $\sim 3 \times 10^{-5}$ or 10^9 events. And 10^8 events is already within a factor of 3.

KLOE at DAΦNE2

- $\Delta S = \Delta Q$, use charge exchange, $K^+ \Rightarrow K^0$, $K^- \Rightarrow \overline{K}^0$ to tag strangeness.
- Use interference to measure $\Re\eta_{+-} \ldots \Im\eta_{00}$, $\Im\delta$
- K_S, and K_L, leptonic asymmetry$\rightarrow\Re\delta$. This would be the first look at the Plank scale in particle physics.
- Push all modes to the limit, $\sim 10^{-(10-11)}$

It is a long program, especially since the overall efficiency is not 1, but it is not 0.01 either.

We should think in terms of a decade of continuous access, just like NA48 wishes.

HOW should it be built?

- Machine: you heard
- KLOE: upgrade emcal and chamber, instrument IR

Is KLOE OK? Its mission was $\Re(\epsilon'/\epsilon)$ which needs many $K_L \to \pi^+\pi^-$ and $K_L \to \pi^0\pi^0$ decays. Hence a large detector. If you can afford it, larger is better, mostly.

But now we are talking of K_S decays, with a mean decay path of 5.6 mm. We could reduce the outer chamber radius (good for $K^\pm$), still the best chamber around, and add to the calorimeter, gaining energy resolution and timing accuracy.

A new chamber could have $(1.5/2)^2 \sim 1/2$ or 50% less wires, but more sense wires in a 1:1 sense to field ratio. A vertex chamber would help a lot.

Also a better Q-cal!!. Pt-Si is best but W-Si will do.

Finally, luminosity must come together with low background, less than now, absolute, not bckgnd to lumi ratio!

Higher $\mathcal{L}$ and lower background should not be mutually exclusive

CONCLUSIONS

KLOE still hopes to collect $\int \mathcal{L}\mathrm{d}t >$1 fb^{-1} in 2004, to complete the first phase of a successful program.

Beyond that, the DAΦNE2 collider discussed could give a $\times$100 increase in $\mathcal{L}$. At lower $\mathcal{L}$, variable energy allows other programs. This guarantees very exciting physics, to be well underway before the end of this decade.

The SM fares extremely well at LEP, SLAC, the Tevatron and even at BNL $(g-2)$, but we do not know about $\Delta S=\Delta Q$, CKM unitarity, CPT...

We need DAΦNE2!!!

We need DAΦNE2!!!

We need DAΦNE2!!!

We need DAΦNE2!!!

Losses for $K_L \rightarrow \pi^0 \nu \bar{\nu}$

	loss	tot loss
$K_S K_L/\phi$	0.34	0.3400
decay	0.25	0.0850
K_L tag	0.50	0.0425
Fid. cuts	0.25	0.0106

see, ∼1%!!!! − − as in transp. no. 30

$\mathcal{L}$	50,000, μb^{-1}/s
$\int_{1y}\mathcal{L}$	5×10^{11}, μb^{-1}
K_S sl	3.5×10^{8}
$\delta\mathcal{A}$	5.3×10^{-5}
$\delta\delta$	1.3×10^{-5}
ΔM	4×10^{-11} eV
$\Delta M/M$	8×10^{-20}

Mnemonic help for $e^+e^-\to\phi\to KK$

$N(K_S)=N(K_L)=N(K^+)\sim N(K^-)=\int\mathcal{L}$ in μb^{-1}

From Gino Isidori

Highlights of the kaon–physics program @ Φ–factory vs. luminosity:

10^0 fb^{-1} [≈ 10^9 $K\bar{K}$]

≈ KLOE now

V_{us} from K_{l3} @ 10^{-3} (CKM);
rare K_S decays down to BR~10^{-8} (CHPT/CPT);
10^{-2} bounds on $K_S \to \pi l \nu$ charge asym. (CPT)
⋮

10× 10^1 fb^{-1} [≈ 10^{10} $K\bar{K}$]

original KLOE program

Re(ε'/ε) @ 10^{-4} (direct CPV);
$K_{L,S}$ interf. ⇒ Im(ε'/ε) @10^{-2} (CPT);
ππ phases from K_{l4} @ % level (QCD vacuum)
⋮

10× 10^2 fb^{-1} [≈ 10^{11} $K\bar{K}$]

CPT tests @ uprecedented level of precision via
rare K_S & $K_{L,S}$ interferences;
search for exotic direct CPV in $K^\pm$ asym. and rare K_L decays
⋮

10× 10^3 fb^{-1} [≈ 10^{12} $K\bar{K}$]

frontier of flavor physics

sensitivity to $K_L \to \pi^0 \nu\nu$ (& $K_L \to \pi^0 ee$) at the SM level:

region of high discovery potential for non−standard sources
of CPV via new tests of the CKM mech. in the kaon system

⇒very interesting also in a long−term perspective⇐

10× 10^4 fb^{-1}

From Gino Isidori

- Conclusions

BUT SCALE OFF BY 10

I'm strongly in favor of the high−luminosity option!

and if the option is realistic

I'm ready to defend it...