# RECENT RESULTS FROM KLOE AT DAΦNE

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Abstract

The KLOE experiment at DAΦNE has collected data for an integrated luminosity of $\sim 450\,\mathrm{pb}^{-1}$ from $e^+e^-$ collisions at center of mass energy around the $\Phi$ peak, $W \sim 1.02$ GeV. Studying tagged $K_S$-mesons produced in the reaction $e^+e^- \to \phi \to K_S K_L$, we obtained preliminary measurements of the branching ratios for the two charged modes of the decay $K_S \to \pi e \nu$ and an upper limit for the decay $K_S \to \pi^0\pi^0\pi^0$. Exploiting the initial state radiation contribution to the reaction $e^+e^- \to \pi^+\pi^-\gamma$, we measured the hadronic cross section as a function of the squared center of mass energy $s_\pi$ of the $\pi\pi$ system, in the range $0.35 < s_\pi < 0.95$ GeV$^2$.

## 1 Introduction

The KLOE [1] experiment [1, 2] operates at DAΦNE [3], an $e^+e^-$ collider working at a center of mass energy $W \sim m_\phi \sim 1.02$ GeV. $\phi$-mesons are produced with a visible cross section of $\sim 3.2\mu$b, in small angle (25 mrad) collisions of equal energy electrons and positrons, giving the $\phi$ a small transverse momentum component in the horizontal plane, $p_\phi \sim 13\,\mathrm{MeV}/c$. Data for an integrated luminosity of $450\,\mathrm{pb}^{-1}$ at the $\phi$ peak have been collected during two distinct data-taking periods in the years 2001 and 2002, corresponding to $\sim 1.4 \times 10^9$ $\phi$-mesons produced.

A $\phi$ meson decays $\sim 34\%$ of the times into $K^0\overline{K}^0$ pairs. Neutral kaons get a momentum of $\sim 110$ MeV/c which translates into a low velocity, $\beta_K \sim 0.22$. $K_S$ and $K_L$ can therefore be distinguished by their mean decay lengths: $\lambda_S \sim 0.6$ cm and $\lambda_L \sim 340$ cm.

The KLOE detector consists essentially of a drift chamber, DCH, surrounded by an electromagnetic calorimeter, EMC. The DCH [4] is a cylinder of 4 m diameter and 3.3 m in length which constitutes a large fiducial volume for $K_L$ decays (1/2 of $\lambda_L$). The momentum resolution for tracks at large polar angle is $\sigma_p/p \leq 0.4\%$. The EMC [5] is a lead-scintillating fiber calorimeter consisting of a barrel and two endcaps, which cover 98% of the solid angle. The energy resolution is $\sigma_E/E \sim 5.7\%/\sqrt{\mathrm{E(\ GeV)}}$. The intrinsic time resolution is $\sigma_T = 54\,\mathrm{ps}/\sqrt{\mathrm{E(\ GeV)}} \oplus 50\,\mathrm{ps}$. A superconducting coil surrounding the barrel provides a 0.52 T magnetic field.

The main advantage of studying kaons at a $\phi$–factory is that $K_L$'s and

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$K_S$'s are produced in a pure $J^{PC} = 1^{--}$ quantum state and nearly back-to-back in the laboratory so that detection of a $K_{L(S)}$ tags the production of a $K_{S(L)}$-meson and gives its direction and momentum. The contamination from $K_L K_L$ and $K_S K_S$ final states is negligible [6, 7]. Highly pure and nearly monochromatic $K_S$ and $K_L$ "beams" can then be obtained. Recent results on the study of the $K_S$ beam are discussed in the following section.

## 2 $K_S$ physics

About half of the $K_L$-mesons reach the calorimeter, where most interact. Such a $K_L$ interaction is called a "$K_L$-*crash*" in the following. A $K_L$-crash is identified as a local energy deposit (cluster) in the EMC with energy above 100 MeV and a time of flight indicating low velocity: $\beta_{\rm cl} \sim 0.218$. The cluster coordinates determine the $K_L$'s direction to $\sim$20 mrad and its momentum $\mathbf{p}_L$, which is weakly dependent on the $K_L$ direction because of the motion of the $\phi$-meson. A $K_L$-crash thus tags the production of a $K_S$ of momentum $\mathbf{p}_S = \mathbf{p}_\phi - \mathbf{p}_L$. $K_S$-mesons are tagged with an overall efficiency of $\sim$30%. Both the $K_S$ analyses described below start from this tagged sample.

### 2.1 Direct search for $K_S \to \pi^0\pi^0\pi^0$

Observation of this decay signals $\mathcal{CP}$ violation in kaon mixing and/or in decay. In the Standard Model (SM) the transition width for $K_L \to \pi^0\pi^0\pi^0$ is related to that of $K_S \to \pi^0\pi^0\pi^0$, giving a predicted branching ratio of $1.9\times10^{-9}$, well below the present upper limit by SND [8], BR$(K_S \to \pi^0\pi^0\pi^0) < 1.4\times10^{-5}$ with 90% of confidence level (CL). With the present statistics collected, we are able to reach a sensitivity in the branching ratio of $\sim10^{-7}$. Moreover, the present uncertainty on the amplitude for $K_S \to \pi^0\pi^0\pi^0$ limits the precision of a $\mathcal{CPT}$ invariance test via the unitarity relation for the kaon system: a limit on BR$(K_S \to \pi^0\pi^0\pi^0)$ at the level of $10^{-7}$ would translate into a 2.5-fold improvement on the accuracy of the difference between $K^0$ and $\overline{K}^0$ masses, going from $10^{-18}$ GeV to $4\times10^{-19}$ GeV.

Signal selection starts by requiring a $K_L$-crash tag in an event with no charged track coming from the interaction point. A cluster in the EMC due to a photon is identified using the cluster time, $t_{\rm cl}$, and the distance with respect to the origin, $R_{\rm cl}$: the cluster has to be not connected with any charged track; the velocity $\beta_{\rm cl} = ct_{\rm cl}/R_{\rm cl}$ has to be around 1; moderate requirements on the minimum cluster energy and angular distance with respect to the beam axis are applied in order to reject clusters produced by machine background. Events with 6 "photon" clusters are retained.

To reduce the background from non-$K_S K_L$ events, a kinematic fit which imposes $K_S$ mass, $K_L$ 4-momentum conservation and $\beta = 1$ for each $\gamma$ cluster

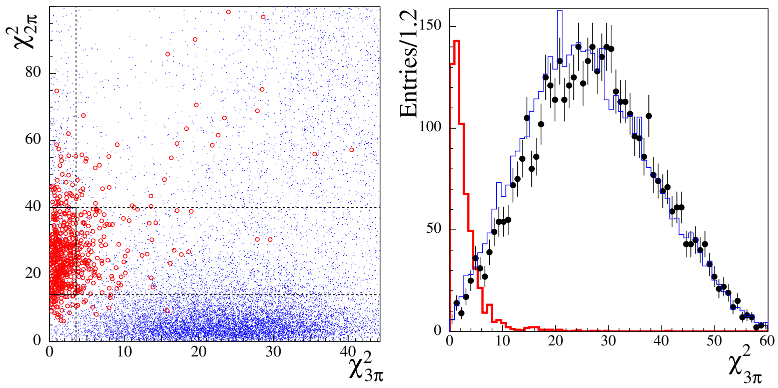


Figure 1: *Left panel: scatter plot* $\chi^2_{2\pi}$ *vs* $\chi^2_{3\pi}$ *for selected candidate events; (blue) points and (red) open dots represent data and the signal from a MC with* $\mathrm{BR}(K_S \to \pi^0\pi^0\pi^0) = 10^{-5}$*, respectively. Right panel: distribution of* $\chi^2_{3\pi}$ *for events lying in the band* $14 < \chi^2_{2\pi} < 40$*; black dots, (blue) solid thinner line, and (red) solid thicker line represent data, MC background, and the signal from a MC with* $\mathrm{BR}(K_S \to \pi^0\pi^0\pi^0) = 10^{-5}$*, respectively.*

is applied. Only the events with $\chi^2_{\rm fit}/\mathrm{ndf} < 3$ are retained for further analysis. This cut improves the rejection power of the selection by a factor $\sim 3$.

The surviving background events are dominated by $K_S \to \pi^0\pi^0$ decays, where two selected $\gamma$ clusters are fakes, due either to shower fragments or to accidental overlap, in the same event, of clusters produced by machine background. To better discriminate $2\pi^0$ vs $3\pi^0$ final state, two pseudo-$\chi^2$ variables have been defined: $\chi^2_{3\pi}$, which is based on the 3 best $\pi^0$ mass estimates among all the possible $\gamma$-$\gamma$ pairs and $\chi^2_{2\pi}$, which selects 4 out of the 6 photons providing the best kinematic agreement with a $K_S \to \pi^0\pi^0$ decay. The scatter plot $\chi^2_{2\pi}$ vs $\chi^2_{3\pi}$ is shown for data (blue points) and a Monte Carlo simulation of $K_S \to \pi^0\pi^0\pi^0$ decays with a branching ratio of $10^{-5}$ (red filled dots) in the left panel of fig 1. The distribution of $\chi^2_{3\pi}$ projected in the band $14 < \chi^2_{2\pi} < 40$ is shown in the right panel, where data (black dots) is compared with the expectations from Monte Carlo simulations of the background (solid blue line) and of the signal (solid red line).

A signal box region in the $\chi^2_{2\pi}$ vs $\chi^2_{3\pi}$ plane has been defined by optimizing the upper limit in the MC sample. With an efficiency $\varepsilon_{3\pi} = (22.6 \pm 0.8)\%$, we count 4 events for an expected background $N_b = 3{\pm}1.4{\pm}0.2$. Folding the proper background uncertainty, we quote the number of $K_S \to \pi^0\pi^0\pi^0$ decays to be below 5.8 at 90% CL. In the same tagged sample, we count $38.4{\times}10^6$ $K_S \to \pi^0\pi^0$ events used for normalization. We finally derive $\mathrm{BR}(K_S \to \pi^0\pi^0\pi^0) \leq 2.1{\times}10^{-7}$

at 90 % CL, which improves by a factor of $\sim 100$ the present upper limit.

### 2.2 Measurement of BR($K_S \to \pi e \nu$)

The measurement of the kaon semileptonic decay widths provides several tests of many fundamental aspects of the SM. The most precise test of unitarity of the CKM matrix comes from its first row. Defining $1-\Delta \simeq |V_{\rm ud}|^2 + |V_{\rm us}|^2$, we expect $\Delta = 0$ at $\mathcal{O}(10^{-5})$. Using $|V_{\rm ud}|$ as extracted from superallowed nuclear decays and the measured neutron lifetime [9], and $|V_{\rm us}|$ as extracted from the semileptonic decay width of the $K_L$, a precision test on $\Delta$ to better than 1% can be performed. We are able to test if $\Delta$ is zero with a comparable precision extracting $V_{\rm us}$ from the measurement of the $K_S$ semileptonic decay width.

The knowledge of both the $K_L$ and the $K_S$ semileptonic decay branching ratios and lifetimes allows the validity of the $\Delta S = \Delta Q$ rule to be tested through the quantity

$$Re(x_+) = \frac{1}{2} \times \frac{\mathrm{BR}(K_S \to \pi e \nu)/\tau_S - \mathrm{BR}(K_L \to \pi e \nu)/\tau_L}{\mathrm{BR}(K_S \to \pi e \nu)/\tau_S + \mathrm{BR}(K_L \to \pi e \nu)/\tau_L} \tag{1}$$

In the SM, $Re(x_+)$ is expected to be of the order of $10^{-7}$, receiving contribution from second order weak transitions [10, 11]. At present, the most precise test of the $\Delta S = \Delta Q$ rule comes from analysis of the time distribution of semileptonic strangeness-tagged kaon decays at CPLEAR [12]. The CPLEAR collaboration finds $Re(x_+)$ to be compatible with zero with an error of $6 \times 10^{-3}$.

Finally, discrete symmetries are tested through the measurement of the charge asymmetries for $K_L$ and $K_S$ decays, $A_{L,S}$, defined as

$$A_{L,S} = \frac{\Gamma\left(\mathrm{K_{L,S}} \to \pi^- \mathrm{e}^+ \nu\right) - \Gamma\left(\mathrm{K_{L,S}} \to \pi^+ \mathrm{e}^- \bar{\nu}\right)}{\Gamma\left(\mathrm{K_{L,S}} \to \pi^- \mathrm{e}^+ \nu\right) + \Gamma\left(\mathrm{K_{L,S}} \to \pi^+ \mathrm{e}^- \bar{\nu}\right)}$$

If $\mathcal{CPT}$ invariance holds, each of the two charge asymmetries are expected to be equal to $2 \times Re(\epsilon) \simeq 3 \times 10^{-3}$, where $\epsilon$ is the parameter describing $\mathcal{CP}$ violation in the $K^0 - \bar{K}^0$ mass matrix. A difference between $A_S$ and $A_L$ signals $\mathcal{CPT}$ violation either in the mass matrix, or in the decay amplitudes. The value of $A_L$ is known at present with a precision of $10^{-4}$ [13, 14], while $A_S$ has never yet been measured. The most precise test of $\mathcal{CPT}$ conservation in the mixing to date has been performed using interferometry technique at the CPLEAR experiment [15] and has a precision of $3 \times 10^{-4}$.

Our event selection starts again requiring a $K_L$-crash and it consists of fiducial cuts, particle identification by time of flight, and kinematic closure. Two tracks of opposite curvature are required, which must extrapolate *and form a vertex* close to the interaction point. The invariant mass $M_{\pi\pi}$ of the pair, calculated assuming that both tracks are pions, must be smaller than 490 MeV. This rejects $\sim$95% of the $\pi^+\pi^-$ decays.

Electrons and pions are then discriminated by time of flight (TOF). Tracks are therefore required to be associated with calorimeter energy clusters. For each track, we compute the difference $\delta_t(m) = t_{\rm cl} - L/c\beta(m)$ using the cluster time $t_{\rm cl}$ and the track length $L$. The velocity $\beta$ is computed from the track momentum for each mass hypothesis, $m = m_e$ and $m = m_\pi$. In order to avoid uncertainties due to the determination of $T_0$ (the time of the bunch crossing producing the event), we make cuts on the two-track difference $d\delta_{t,\rm ab} = \delta_t(m_a)_1 - \delta_t(m_b)_2$, which is zero if the correct mass assignments $m_{a(b)}$ are used for the track 1(2). We require $|d\delta_{t,\pi\pi}| > 1.7$ ns and $|d\delta_{t,\pi{\rm e}({\rm e}\pi)}| < 1.4$ ns, with $d\delta_{t,{\rm e}\pi(\pi{\rm e})} > 3.2$ ns. After the TOF requirements, particle types and charges for signal events can be assigned very precisely: the probability of misidentifying a $\pi^+e^-\bar{\nu}$ ($\pi^-e^+\nu$) event as a $\pi^-e^+\nu$ ($\pi^+e^-\bar{\nu}$) is less than $10^{-4}$.

Finally, we compute the missing energy and momentum $E_{\rm miss}$, $p_{\rm miss}$. For $\pi^\pm e^\mp\bar{\nu}(\nu)$ decays, these variables are the neutrino energy and momentum, and satisfy $E_{\rm miss} = cp_{\rm miss}$. The distribution of $E_{\rm miss} - cp_{\rm miss}$ is shown in Fig. 2 after the time-of-flight cuts are imposed, for $\pi^+e^-\bar{\nu}$ (left panel) and for $\pi^-e^+\nu$ (right panel) candidate events. A clear peak at $E_{\rm miss} - cp_{\rm miss} = 0$ is evident and corresponds to a clean signal for $K_S \to \pi e\nu$. Events with $E_{\rm miss} - cp_{\rm miss} >$ 10 MeV are mostly due to $K_S \to \pi^+\pi^-$ decays in which a pion decays to a muon before reaching the tracking volume or in which one of the two pion tracks is badly reconstructed. The fit of the data to the sum of the signal and background spectra simulated using the Monte Carlo (MC) is also shown. The MC simulation of $K_S \to \pi e\nu$ decays includes an infrared-finite treatment of radiative corrections. The kinematics of the decay $K_S \to \pi e\nu$ has been sampled from a four-body differential decay width which includes a photon in the final state [16]. The free fit parameters are the signal and background normalizations. Three independent fits are performed: one for each charge state and one in which we do not distinguish by charge.

The methods used to estimate the selection efficiency are described in detail elsewhere [17, 18, 19]. Three efficiencies are estimated: one for each charge state and one for events in which we do not distinguish by charge. The value for BR($K_S \to \pi e\nu$) is obtained by normalizing the number of signal events to the number of $K_S \to \pi^+\pi^-$ events in the same data set, correcting for the total selection efficiencies, and using the present experimental value for BR($K_S \to \pi^+\pi^-$) [20]. This allows cancellation of the uncertainties arising from the integrated luminosity, the $\phi$ production cross section, and the tagging efficiency. We obtain the following preliminary results for the branching ratios:

$$\mathrm{BR}(K_S \to \pi^-e^+\nu) \quad = \quad (3.54 \pm 0.05_{\rm stat} \pm 0.05_{\rm syst}) \times 10^{-4},$$

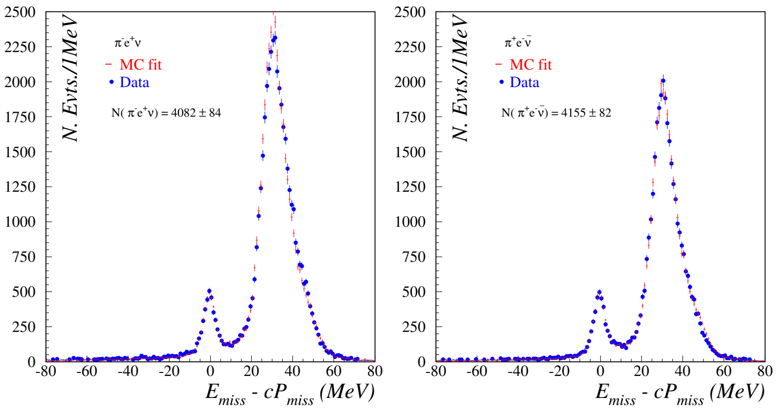


Figure 2: $E_{\rm miss} - cp_{\rm miss}$ *spectrum for* $\pi^- e^+ \nu$ *(left panel) and for* $\pi^+ e^- \bar{\nu}$ *(right panel) candidate events. Filled dots represent data from year-2001 data set; the crosses are the result of a fit varying the normalization of MC distributions for signal and background.*

$$
\begin{aligned}
{\rm BR}(K_S \to \pi^+ e^- \bar{\nu}) &= (3.54 \pm 0.05_{\rm stat} \pm 0.04_{\rm syst}) \times 10^{-4}, \\
{\rm BR}(K_S \to \pi^\pm e^\mp \bar{\nu}(\nu)) &= (7.09 \pm 0.07_{\rm stat} \pm 0.08_{\rm syst}) \times 10^{-4}.
\end{aligned}
$$

The value of $V_{\rm us}$ can then be extracted from the measurement of ${\rm BR}(K_S \to \pi^\pm e^\mp \bar{\nu}(\nu))$ and from the $K_S$ lifetime, $\tau_S$:

$$
V_{\rm us} \times f_+^{K^0\pi^-}(0) = \left[ \frac{128\pi^3 {\rm BR}(K_S \to \pi^\pm e^\mp \bar{\nu}(\nu))}{\tau_S G_\mu^2 M_K^5 S_{\rm ew} I_K^e(\lambda_+)} \right]^{1/2} \frac{1}{1+\delta_{\rm em}^{Ke}},
$$

where $f_+^{K^0\pi^-}(0)$ is the vector form factor at zero momentum transfer and $I_K^e(\lambda_+)$ is the result of the phase space integration after factorizing out $f_+^{K^0\pi^-}(0)$. In the above expression, long-distance radiative corrections for both the form factor $f_+^{K^0\pi^-}$ and the phase space integral have been factorized out and are included in the parameter $\delta_{\rm em}^{Ke} = 0.55 \pm 0.10$ [21, 22]. The short-distance electroweak corrections are included in the parameter $S_{\rm ew} = 1.0232$ [23].

The parameter $\lambda_+$ describes the dependence of the vector and scalar form factor on the momentum transferred, $t$. Recently, ISTRA+ [24] and KTeV [25] experiments measured the dependence of $f_+^{K^0\pi^-}$ on $t$, using $K^+ \to \pi^0 e^+ \nu$ and $K_L \to \pi^\pm e^\mp \bar{\nu}(\nu), \pi^\pm \mu^\mp \bar{\nu}(\nu)$ decays, respectively. A visible non linear contribution was observed by both experiments. In the extraction of $V_{\rm us}$ we use the values obtained by KTeV experiment from a quadratic fit:

$$f_+(t) = f_+(0)\left[1 + \lambda'_+ \frac{t}{m_{\pi^2_+}} + \frac{\lambda''_+}{2}\frac{t^2}{m^4_{\pi^+}}\right], \quad \begin{array}{rcl} \lambda'_+ & = & 0.0206 \pm 0.0018 \\ \lambda''_+ & = & 0.0032 \pm 0.0007 \end{array}$$

With this parametrization, the integration over the phase space yields $I^e_K = 0.1024 \pm 0.0007$. We obtain:

$$f_+^{K^0\pi^-}(0) \times V_{\rm us} = 0.2171 \pm 0.0017$$

Using $V_{\rm ud} = 0.9740 \pm 0.0005$ from [9] and $f_+^{K^0\pi^-}(0) = 0.961 \pm 0.008$ from [26], also in agreement with a recent lattice calculation [27], the unitarity band is:

$$f_+^{K^0\pi^-}(0) \times V_{\rm us} = 0.2177 \pm 0.0028$$

in agreement with our preliminary result.

From BR($K_S \to \pi^\pm e^\mp \bar{\nu}(\nu)$) we can also extract the parameter $Re(x_+)$, Eq. 1, which is related to violations of the $\Delta S = \Delta Q$ rule for $\mathcal{CPT}$-conserving transitions. Using the PDG-fit result of the $K_S$ lifetime, $\tau_S = (89.58 \pm 0.06)$ ps [20], BR($K_L \to \pi e \nu$) = $(38.81 \pm 0.27)\%$ from PDG-fit, and $\tau_L = (51.5 \pm 0.4)$ ns averaged by PDG, we obtain $Re(x_+) = (12.6 \pm 3.1_{\rm stat} \pm 2.9_{\rm syst}) \times 10^{-3}$. This is $\sim 3\sigma$ away from zero and not compatible with the measurement by CPLEAR $Re(x_+) = (-1.8 \pm 4.1_{\rm stat} \pm 4.5_{\rm syst}) \times 10^{-3}$.

The preliminary value for the charge asymmetry is $A_S = (-2 \pm 9_{\rm stat} \pm 6_{\rm syst}) \times 10^{-3}$, a result which is compatible with that for $K_L$ semileptonic decays and with the expectation obtained assuming $\mathcal{CPT}$ symmetry, $A_S = 2Re(\epsilon)$.

## 3 Measurement of the hadronic cross section

Other than producing kaons, $\phi$-meson decays $\sim 15\%$ of the time via $\rho\pi$ into 3 pions. The remaining $\sim 1\%$ of the decays are radiative modes, which makes the $\phi$–factory a good source of pseudoscalar $(\eta, \eta')$ and scalar $(f_0, a_0)$ mesons. A lot of interesting analyses have been published on these items [28, 29, 30, 31] and their findings are being improved with the larger statistical sample available, but they will not be discussed here.

The recent updated measurement by the E-821 collaboration [32] of the anomalous magnetic moment of the muon, $a_\mu = (11\,659\,208 \pm 6)10^{-10}$, has led to renewed interest in accurate theoretical estimates of this quantity. The SM prediction is the sum of QED, weak, and hadronic contributions: $a_\mu^{QED} = 11\,658\,470.4 \pm 0.3$, $a_\mu^{weak} = 15.4 \pm 0.2$, and $a_\mu^{had} \sim 700$, in $10^{-10}$ units. The uncertainty on lowest-order hadronic vacuum polarization dominates the accuracy of the prediction. The correction to the photon propagator cannot be

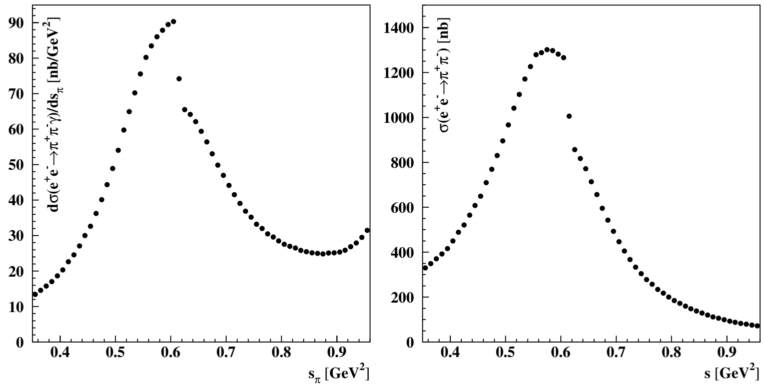


Figure 3: *Left panel: cross section for the process* $e^+e^- \to \pi^+\pi^-\gamma$*, inclusive in pion emission angles and with* $\sin\theta_\gamma < \sin 15^o$*, where* $\theta_\gamma$ *is the photon emission angle with respect to the beam axis. Right panel: bare cross section for* $e^+e^- \to \pi^+\pi^-$.

calculated by perturbative QCD for low $q^2$, but the lowest-order hadronic contribution to $a_\mu$ can be expressed as a dispersion integral on the center of mass energy, in which the hadronic cross section, $\sigma(e^+e^- \to \text{hadrons})$, is multiplied by an appropriate kernel function.

The process $e^+e^- \to \pi^+\pi^-$ below 1 GeV accounts for $\sim 70\%$ to the value of (and error on) $a_\mu^{had}$. The most recent measurement of $\sigma(e^+e^- \to \pi^+\pi^-)$ by CMD-2 [33] has been done with an energy-scan of $e^+e^-$ collisions and claims a total relative uncertainty of 0.9%. The final SM prediction for $a_\mu$ differs by $-2.7\sigma$ with the measurement by E821. Moreover, there is also a rather strong disagreement with the value of $a_\mu^{had}$ obtained using $\tau$-data [34] after isospin correction.

KLOE is determining, in an original way, this cross section as a function of $s_\pi$, the squared center of mass energy of the $\pi\pi$ system, in the region $0.3 < s_\pi < 1$ GeV$^2$. Although DAΦNE operates at fixed energy $W \sim m_\phi$, Initial State Radiation (ISR) lowers the available beam energy for the di-pion system. Therefore, measuring the cross section for the process $e^+e^- \to \pi^+\pi^-\gamma$ and exploiting ISR, we can relate $\mathrm{d}\sigma(\pi^+\pi^-\gamma, s_\pi)/\mathrm{d}s_\pi$ to $\sigma(\pi^+\pi^-, s_\pi)$ with $s_\pi$ from $2m_\pi$ to $W$. The ratio of the two quantities is a radiator function obtained including radiative effects from a QED Monte Carlo calculation (PHOKHARA generator, Karlsruhe Theory Group [35]).

Complications from processes with Final State Radiation (FSR) are avoided by restricting the selection to events with low-angle photons ($\theta_\gamma < 15^o$): in this region, ISR is the dominant contribution and FSR accounts for less than 1%

over the entire $s_\pi$ spectrum. In each event, the radiated photon is not detected, but $s_\pi$ and $\theta_\gamma$ are reconstructed using DCH information from the pion tracks. A description of the analysis method used can be found elsewhere [36, 37].

KLOE data are shown in Fig. 3. Calculating the dispersion integral, we obtain the following result:

$$a_\mu^{had-\pi\pi}(0.35 < s_\pi < 0.95 \text{ GeV}^2) = (388.7 \pm 0.8_{\rm stat} \pm 3.5_{\rm syst} \pm 3.5_{\rm th}) \times 10^{-10}.$$

Integrating in the same region used by CMD-2, we get

$$a_\mu^{had-\pi\pi}(0.37 < s_\pi < 0.93 \text{ GeV}^2) = (375.6 \pm 0.8_{\rm stat} \pm 4.8_{\rm syst+th}) \times 10^{-10}.$$

This result is in good agreement with that from CMD-2,

$$a_\mu^{had-\pi\pi}(0.37 < s_\pi < 0.93 \text{ GeV}^2) = (378.6 \pm 2.7_{\rm stat} \pm 2.3_{\rm syst+th}) \times 10^{-10},$$

and confirms the discrepancy with what is obtained from the analysis of $\tau$-data.

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