Results from KLOE at DAΦNE

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Abstract.
The KLOE experiment at the Frascati ϕ factory, DaΦne, has collected ∼500 pb $^{-1}$, i.e. 1.5× 10^9 ϕ decays. At the ϕ factory it is possible to select pure K_L and K_S beams. Although the integrated luminosity is insufficient for precision tests of the CP, T symmetries in kaon decays, a wide number of topics in kaon and hadronic physics are accessible from the largest sample of Φ decays at rest collected so far. The cross section $\sigma(e^+e^- \to \pi^+\pi^-\gamma)$ below 1 GeV, relevant for the precise evaluation of the muon magnetic moment, has been measured with a statistical accuracy better than 1%. For the K_S, we obtained the ratio of the branching fractions $\Gamma(K_S \to \pi^+\pi^-(\gamma))/\Gamma(K_S \to \pi^0\pi^0) = (2.239 \pm 0.003_{stat} \pm 0.015_{syst})$, fully inclusive of the $\pi\pi\gamma$ final state. The analysis of the ∼20,000 K_S semileptonic decays $K_S \to \pi e \nu$ is being finalized providing precise measurements of both, the K_S semileptonic branching ratio, and Re x_+, i.e. the ΔS = ΔQ rule violation parameter. For the K_L, we obtained the ratio $\Gamma(K_L \to \gamma\gamma)/\Gamma(K_L \to \pi^0\pi^0\pi^0) = (2.80 \pm 0.02_{stat} \pm 0.02_{syst}) \times 10^{-3}$, of interest to Chiral Perturbation Theory (ChPT), as well as preliminary results on the branching ratios to other decay modes. In particular, our measurements of the semileptonic decays of both, neutral, and charged kaons will improve the precision of the CKM matrix element $|V_{us}|$, clarifying the present disagreement between different experiments. The ϕ radiative decays, both in scalar and pseudo-scalar mesons, have been analyzed giving new measurements of the $\eta - \eta'$ mixing angle, and of the $\phi \to a_0(980)\gamma$, $\phi \to f_0(980)\gamma$ branching ratios.

KLOE began to take data for physics in year 2000. Since the first data taking campaign the machine luminosity increased countinously (Fig. 1) together with the data quality, and in year 2002 DaΦne has reached a peak luminosity of $8 \times 10^{31} cm^{-2}s^{-1}$, delivering to KLOE 4.2 pb^{-1} per day. The total integrated luminosity is at present ∼500 pb^{-1}, corresponding to a sample of 1.3× 10^9 kaon pairs produced in a pure $J^{PC} = 1^{--}$ quantum state.

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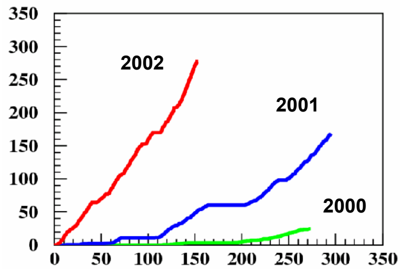

FIGURE 1. Integrated luminosity in KLOE in year 2000 ($\sim$25 pb^{-1}), 2001 ($\sim$170 pb^{-1}), and 2002 ($\sim$280 pb^{-1}).

In year 2003 there has been a major shutdown of DaΦne in order to:

- install a new interaction region (IP) for KLOE, designed to reduce the beam background inside the apparatus. The low-β quadrupoles have been mounted on a rotating structure which allows focusing optimization and operation at different KLOE soleinodal fields;
- rearrange the magnets in the straight sections: the new setup will increase the injection efficiency;
- modify the wigglers: the reshaping of the poles will improve the beam dynamical aperture and the lifetimes.

The DaΦne re-commissioning that started at the beginning of September should lead to operation with 110 bunches (the bunches were 50 in year 2002), at a peak luminosity of $2 \times 10^{32} cm^{-2} s^{-1}$, delivering to KLOE 10 pb^{-1} per day and 2 fb^{-1} per calendar year.

The detector. The design of the experiment has been optimized for the discrimination of the *CP*-violating decays $K_L \to \pi^+\pi^-$ and $\pi^0\pi^0$ from the much more abundant $K_L \to \pi\mu\nu$ and $K_L \to 3\pi^0$ decays. The detector must provide good momentum resolution for charged tracks, as well as full solid angle coverage and excellent energy and time resolution for photons. Moreover, given the rather long mean decay path of the K_L at DaΦne (3.4 m), a large detector is required in order to have a reasonable geometrical acceptance. The KLOE apparatus consists of a large drift chamber for the measurement of the charged particles, a sampling calorimeter made of lead and scintillating fibers, and a superconducting magnet providing the solenoidal field of 5.2 kGauss. The drift chamber [1], 2 m radius and 3.3 m long, is filled with a low-Z gas mixture of 90% Helium and 10% Isobutane, and enclosed by Carbon-Fiber/Epoxy walls. The light materials optimize the momentum resolution and reduce both, photon conversion and $K_L \to K_S$ regeneration. The transverse momentum resolution is $\sigma_{p_t}/p_t \sim 0.4\%$, and the kaon decay vertices are reconstructed with a precision of $\sim$3 mm. The electromagnetic calorimeter (ECAL) [2], 15 X_0 thick, is divided into a barrel and two C-shaped endcaps to optimize the hermecity. To complete the coverage of the solid angle, two small calorimeters

QCAL [3] are wrapped around the focusing quadrupoles. The energy resolution for photons is $\sigma_E/E = 5.7\%/\sqrt{E_{GeV}}$ and the time resolution is $\sigma_t = (54/\sqrt{E_{GeV}} \oplus 50)$ ps. The photon impact point is measured with a precision of $\sim$1 cm/ $\sqrt{E_{GeV}}$ along the fibers and $\sim$1 cm in the transverse coordinate.

HADRONIC CROSS SECTION MEASUREMENT.

Present interest to improve the precision of the $\sigma(e^+e^- \to \pi^+\pi^-)$ below 1 GeV comes from the discrepancies found between different evaluations of the hadronic vacuum polarization contribution to the muon magnetic moment [4]. The anomalous magnetic moment of the muon receives contributions, in decreasing order, from QED processes, from the lowest order hadronic vacuum polarization $a_\mu^{\text{had,LO}}$, from higher order hadronic loops, from light by light scattering, and from electroweak diagrams. The second largest contribution, $a_\mu^{\text{had,LO}}$, is also affected by the largest error. $a_\mu^{\text{had,LO}}$ is evaluated via the dispersion integral from the experimental data, and is affected by the uncertainties in the spectral function, especially those in the region of small Q^2, i.e. below 1 GeV^2 [5]. The data used for the spectral function in this energy range are the $e^+e^- \to \pi^+\pi^-$ annihilation cross section and the $\tau \to \pi\pi\nu$ decay, related to each other by the assumption of CVC and isospin conservation. Significant discrepancies remain between data from e^+e^- (dominated by CMD-2 results [6]) and τ (dominated by Aleph results [7]), especially in the energy region immediately above the ρ resonance (0.6:1 GeV^2).

Running at fixed e^+e^- center-of-mass energy, KLOE can determine the $\sigma(e^+e^- \to \pi^+\pi^-)$ by radiative return. The ISR processes reduce the effective energy for the $\pi\pi$ channel so that we can measure the $\sigma(e^+e^- \to \pi^+\pi^-)$ cross section from threshold to 1 GeV^2, provided that the knowledge of ISR, and ISR+FSR effects are well established. We are using the PHOKHARA generator [8] which is able to describe these processes with an accuracy of 5 per mil. A comparable precision (6 per mil) is achieved for the luminosity measurement, where the BABAYAGA [9] code has been interfaced with the KLOE MonteCarlo to provide the absolute luminosity scale by counting large-angle Bhabha's.

The analysis performed in KLOE to isolate the $\pi\pi\gamma$ events is reported in the A.Denig contribution to these proceedings. At present we have measured [10] the $\sigma(e^+e^- \to \pi^+\pi^-\gamma)$ on the basis of more than 1.5×10^6 large-angle $\pi\pi$ pairs, covering the kinematical region $(0.3 < s_\pi < 1)$ GeV^2. The KLOE preliminary result

$a_\mu^{\text{had,LO}} \times 10^{10}$ (0.37:0.93 GeV^2) = $378.4 \pm 0.8_{stat} \pm 4.5_{syst} \pm 3.0_{theo} \pm 3.8_{FSR}$ [2]

is compatible with the CMD-2 measurement, confirming the discrepancy between e^+e^- and τ data. The analysis is being finalized: we expect to reach 1% precision on both experimental, and theoretical systematics. Also the $\pi\pi\gamma$ events with detectable, large-angle photons are being studied at KLOE to extend the hadronic cross section measurement

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[2] The reported value is the outcome of an updated analysis presented at the Pisa Workshop SIGHAD03 - 8-10 October - and supersede the result $a_\mu^{\text{had,LO}} \times 10^{10}$ (0.37:0.95 GeV^2) = $374.1 \pm 1.1_{stat} \pm 5.2_{syst} \pm 3.0_{theo}(^{+7.5}_{-0} FSR)$ presented at this Conference.

down to the $(2m_\pi)^2$ threshold, at $(0.08 < s_\pi < 0.4)$ GeV^2.

KAON PHYSICS : RECENT ACHIEVEMENTS.

With the present statistics KLOE is improving the precision on the kaon masses, lifetimes, branching ratios, and decay distributions, of interest for the study of a wide range of phenomena, including the test of the unitarity of the CKM matrix, the asymmetries in semileptonic decays, the processes described by ChPT, and the direct CP violation.

At the ϕ factory it is possible to tag $K_{S,L}$ and $K^{+,-}$ beams : the presence of one K_S (K_L) signals the K_L (K_S) on the other side, and the same for K^+ (K^-). In practice, the K_S are tagged searching for the interaction of the K_L in the calorimeter, i.e. an energetic cluster with typical delay of 30 ns due to the low momentum (110 MeV/c) of the kaons produced at DAΦNE . The excellent timing of the KLOE calorimeter provides in this case the K_S momentum with an accuracy of 2 MeV/c, the same obtained for the K_L beams that are selected using the charged decays $K_S \to \pi^+\pi^-$, i.e. requiring one vertex in the interaction region compatible with the hypothesis of two charged pions with invariant mass equal to the kaon mass. Using these simple criteria, the tagging efficiencies (70% for the K_L tagging, and 30% for the K_S) are suitable to collect huge samples of well defined particles. The charged kaons are tagged by searching for the 2-body decays, $K \to \mu\nu$ and $K \to \pi\pi^0$ that in the kaon rest frame have monochromatic charged secondaries.

The KLOE published results on kaon physics are those of references [11], [12], [13], [14], [15].

For the K_S, KLOE obtained on the basis of the data collected in year 2000, for the main decay modes, the ratio $\Gamma(K_S \to \pi^+\pi^-(\gamma))/\Gamma(K_S \to \pi^0\pi^0) = 2.236 \pm 0.003 \pm 0.015$ [12], consistent but slightly larger than the world average of ${R_S}^\pi = 2.197 \pm 0.026$. The result is, at the present accuracy level, fully inclusive of the contribution coming from the radiative $K_S \to \pi\pi\gamma$ decays. The phase shift difference in $K \to \pi\pi$ transitions with I=0 and I=2 amplitudes from our measurement is $(48 \pm 3)^\circ$, in agreement with the strong $\pi\pi$ phase shift predicted by ChPT and with the value obtained from the $\pi\pi$ scattering data. In this anaysis the photon detection efficiency has been measured using $\Phi \to \pi^+\pi^-\pi^0$ events and the track reconstruction efficiency has been determined from the analysis in (p,θ) bins of the $K_S \to \pi^+\pi^-$ decays identified by looking for one pion only. Most of the systematics come from the statistical error on the control samples used to evaluate the selection efficiency from data and it is being improved with the analysis of larger data sets now available.

We are studying the largest sample, ∼20,000 events, of K_S semileptonic decays. They are selected [13] within the tagged K_S, looking for tracks of opposite charge with a vertex in the interaction region. In the hypothesis that both tracks are pions, their invariant mass must be smaller than 490 MeV/c to cut out the $K_S \to \pi^+\pi^-$ background. The background is furtherly reduced by the analysis of the time of flight of the two particles from the decay point to the calorimeter. The expected time of flight from the momentum and the length of the tracks is computed for each mass hypothesis, $m=m_e$ and $m=m_\pi$, and compared with the time measured by the calorimeter. This comparison

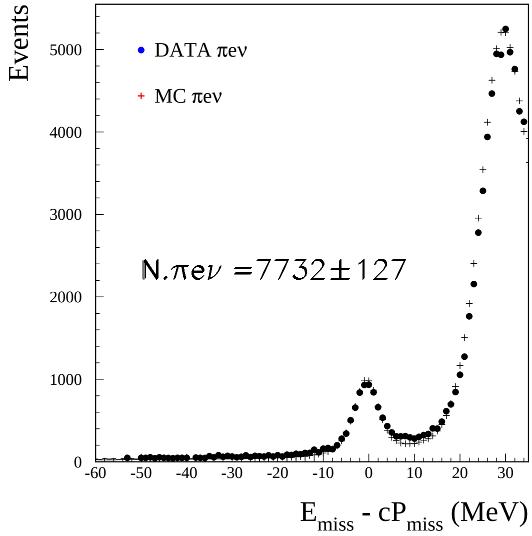

FIGURE 2. E$_{miss}$- c·P$_{miss}$ distribution. The $K_S \to \pi e \nu$ events show up in the region around zero, the rest of the distribution is due to $K_S \to \pi^+\pi^-$ decays. Solid markers are data, crosses are the result of the fit to the MC-expected shapes for the signal and the background.

is used also to isolate $\pi^+ e^-$ and $\pi^- e^+$ decays. The efficiencies of the analysis cuts have been controlled with a sample of $K_L \to \pi e \nu$ decays near the interaction region. The overall efficiency to detect $K_S \to \pi e \nu$ is 0.208 ± 0.004. The final event counting is done using the E$_{miss}$- c·P$_{miss}$ discriminant variable, with a fit of the distribution where contributions from the signal and the background ($K_S \to \pi^+\pi^-$) show up in separate regions (see Fig. 2). The preliminary result for the semileptonic branching ratio, coming from the analysis of 170 pb^{-1} and 7732±127 semileptonic decays, is BR($K_S \to \pi e \nu$) = $(6.81 \pm 0.12 \pm 0.10) \cdot 10^{-4}$. Assuming CPT conservation, the comparison of the K_S with the K_L semielectronic partial widths provides a probe of the $\Delta S = \Delta Q$ rule. Re x_+, the parameter measuring the $\Delta S = \Delta Q$ violation, from our value of BR($K_S \to \pi e \nu$) turns out to be Re $x_+ = (3.3 \pm 5.2 \pm 3.5) \cdot 10^{-3}$. This preliminary result has a precision comparable with the best available measurement [16]. We are analyzing the rest of the sample (280 pb^{-1}): the updated result, together with the expected improvement in the K_L semielectronic partial width from our data, will reduce the present error on Re x_+ by a factor of 1.5.

For the K_L, KLOE has recently published [14] a new measurement of the ratio $\Gamma(K_L \to \gamma\gamma) / \Gamma(K_L \to \pi^0\pi^0\pi^0)$, based on 362 pb^{-1} collected during 2001 and 2002. The $K_L \to \gamma\gamma$ decay rate is interesting for ChPT and is also connected with the $K_L \to \mu^+\mu^-$ decay, being the dominant contribution to the long-distance term of the process. The

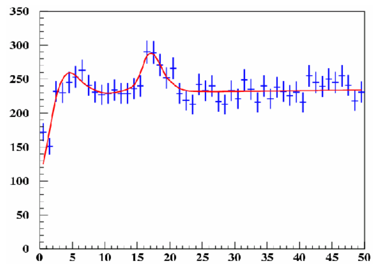

FIGURE 3. $K_L K_S \to \pi^+\pi^-\pi^+\pi^-$ events as a function of the difference in decay times ($\Delta T/\tau_S$). The interference pattern shows up at small ΔT ($\Delta T/\tau_S < 10$) and across the beam pipe wall location ($\Delta T/\tau_S \sim 15$), where the decays interfere with the coherent regeneration processes, $K_L \to K_S$. The curve is a fit to the interference function at fixed values of Γ_L and Γ_S.

$K_L \to \gamma\gamma$ events have a clear signature at the Φ-factory, being the only source of ∼250 MeV photon pairs that balance the momentum of tagging $K_S \to \pi^+\pi^-$ decay. The event selection can be highly inclusive so that the knowledge of the selection efficiency and the residual background can be very accurate. The final measurement, dominated by the statistical error on the $K_L \to \gamma\gamma$ events, is $\Gamma(K_L \to \gamma\gamma)/\Gamma(K_L \to \pi^0\pi^0\pi^0) = (2.79 \pm 0.02 \pm 0.02) \cdot 10^{-3}$, in good agreement with the recent result from NA48 [17].

The semileptonic decays of the kaons are used together with the hyperon semileptonic decays [18] and the $\tau \to K(n\pi)\nu$ [19] to derive the CKM matrix element $|V_{us}|$. Significative discrepancies remain between the different data sets and between the kaon semileptonic partial widths measured in years seventies (old data) and the recent results [20] obtained from experiment E865 at the BNL analyzing ∼70,000 K^+_{e3} decays. Moreover, the old data show a 2.2 σ effect when are compared with the best determination of $|V_{ud}|$ imposing the unitarity of the CKM matrix, i.e. $|V_{ud}|^2 + |V_{us}|^2 \sim 1$. The preliminary results of KLOE from neutral kaon decays [21] are in agreement with the old measurements: work is in progress to improve the experimental precision of all the relevant quantities, including the charged kaon semileptonic decays, the Dalitz plot slope parameters, and the $K_L/K^\pm$ lifetimes.

At KLOE, because the initial state of the neutral kaon pairs is an antisymmetric superposition of K_S and K_L, the final state decay products show characteristic interference patterns. By studying the time dependence of these patterns for different final state combinations it is possible to measure CP and CPT violation parameters. This program can be attacked with few fb^{-1} of integrated luminosity. In Fig. 3 the first attempt to search for these interference patterns is presented: the $K_L K_S \to \pi^+\pi^-\pi^+\pi^-$ final states are selected and the difference in decay times reported. The interference pattern shows up at small ΔT ($\Delta T/\tau_S < 10$), and across the beam pipe wall location ($\Delta T/\tau_S \sim 15$) the interference with the coherent regeneration processes ($K_L \to K_S$) become evident.

The Dalitz plot of the decays of the kaons into three pions is sensitive to the $\Delta S = 1$ CP violating transitions, and is at the same time a good probe of the ChPT calculations. Experimentally, the $K^\pm \to \pi^\pm\pi^0\pi^0$ branching ratio has been measured thirty years ago

[22] with a statistical accuracy of 3%. Using the entire data set of tagged charged kaons, KLOE has measured a new value of the BR($K^{\pm} \to \pi^{\pm}\pi^{0}\pi^{0}$) [15], and the Dalitz plot analysis is in progress. The event selection requires a charged kaon track reconstructed in the drift chamber with a decay vertex associated to only one charged track, and at least four neutral clusters with the correct time of flight from the charged vertex to the calorimeter. Loose kinematical cuts have been applied to the charged kaon and to its decay products. Residual background comprises mainly $K^{\pm} \to \pi^{\pm}\pi^{0}$ and $K^{\pm} \to e^{\pm}\pi^{0}\nu$ events, and has been measured from a fit of the missing mass spectrum in the data to the sum of the signal and the background spectra independently obtained by MonteCarlo simulations. The total background fraction is (0.75 ± 0.11)%. Special sub-samples of the signal have been used to measure the selection efficiency. In general, control samples selected by cutting on calorimeter variables have been used to compute the efficiencies involving the tracking in the drift chamber, and vice-versa. The efficiencies have been evaluated on samples not used in the branching ratio measurement, and the main error source comes from the limited statistics of those samples. Our final results is BR($K^{\pm} \to \pi^{\pm}\pi^{0}\pi^{0}$) = $(1.781 \pm 0.013 \pm 0.016) \cdot 10^{-2}$, 3.5 times more precise than the world average published in the 2002 PDG [23].

RESULTS FROM Φ RADIATIVE DECAYS.

Φ radiative decays to pseudoscalars are studied in the context of the chiral Lagragians. In particular, the BR($\Phi \to \eta'\gamma$) provides information about SU(3)-symmetry breaking and the amount of gluonium content of the η' meson. In KLOE we measured [24] the ratio of branching fractions BR($\Phi \to \eta'\gamma$) / BR($\Phi \to \eta\gamma$) selecting $\eta' \to \pi^{+}\pi^{-}\eta$ ($\eta \to \gamma\gamma$), and $\eta \to \pi^{+}\pi^{-}\pi^{0}$ ($\pi^{0} \to \gamma\gamma$) . The particles in the final state, i.e. $\pi^{+}\pi^{-}\gamma\gamma\gamma$, are the same so that most systematics uncertainties cancel in the ratio. The analysis [24] requires one charged vertex in the interaction region and three photons with the correct time of flight from the charged vertex to the calorimeter. A kinematic fit constraining the total energy, total momentum, and the photon time and positions is applied to the events to improve the photon energy determination and to reduce, by a loose cut on the χ^{2} value, the contamination from $\Phi \to K_{S}K_{L}$ and $\Phi \to \pi^{+}\pi^{-}\pi^{0}$. To further reduce these sources of background additional cuts, on the energy of the photons, and on the pion energy endpoint, have been separately applied for the two channels. After these cuts the $\Phi \to \eta'\gamma$ sample is still dominated by $\Phi \to \eta\gamma$ events that are separated using the energy correlation of the two most energetic photons. These photons, of energy E1 and E2, come from η decay in the case of $\Phi \to \eta'\gamma$, so that the energies are strongly anticorrelated, while in the other case one of the photons is the radiative photon with energy of 363 MeV. The final η' event counting is done from a fit of the $\pi^{+}\pi^{-}\gamma\gamma$ invariant mass, assuming for the signal the shape obtained from MonteCarlo and for the background the shape obtained from the events selected just outside the signal region in the E1-E2 plane. The ratio of the branching fractions is R=$(4.70 \pm 0.47 \pm 0.31) \cdot 10^{-3}$ and the value of the pseudoscalar mixing angle in the flavor basis is $\varphi_{P} = (41.8^{+1.9}_{-1.6})^{\circ}$. This value, taking into account of the constraints from other processes involving P$\to$ Vγ transitions, indicates a gluonium fraction in η' below 15%, as opposed to the suggestion coming from the large measured value of the BR(B $\to K\eta'$) [25].

At present the quark model can not clearly explain the phenomenology involving $f_0(980)$ and $a_0(980)$ scalar mesons. In particular, the decay rate of $\Phi \to \pi^0\pi^0\gamma$ is too large for the expected couplings of the f_0 to the KK and to the $\pi^0\pi^0$ mesons if the scalar (S) is an ordinary quark-antiquark state. These mesons may be 4-quarks structures or $K\bar{K}$ molecules: the $\Phi \to S\gamma$ branching ratio significantly change according to the different interpretations. KLOE performed the analysis of both the channels, $\pi^0\pi^0\gamma$ dominated by $\Phi \to f_0\gamma$ processes [26], and $\eta\pi^0\gamma$ coming mainly from $\Phi \to a_0\gamma$ decays [27]. We have measured the branching fractions and the differential $dN/dM_{\pi\pi}$, $dN/dM_{\eta\pi}$ spectra. The analyses include the study of the

- energy and momentum conservation to reduce various sources of background;
- $\pi\gamma$ and $\pi\pi$ invariant mass to cut the $\omega \to \pi^0\gamma$ contamination and to isolate $\pi^0\pi^0\gamma$ from $\eta\pi^0\gamma$ events;
- the photon pairing to identify $\pi^0\pi^0\gamma$ decays.

For the $\Phi \to \eta\pi^0\gamma$ analysis, the $\eta \to \gamma\gamma$ and the $\eta \to \pi^+\pi^-\pi^0$ decays have been considered. The angular distributions of the events show that the dominant contribution comes respectively from $\Phi \to f_0\gamma$ and $\Phi \to a_0\gamma$ decays. The final results, on the basis of data taken during 2000, are $BR(\Phi \to \pi^0\pi^0\gamma) = (1.08 \pm 0.03 \pm 0.05) \cdot 10^{-4}$ and $BR(\Phi \to \eta\pi^0\gamma) = (8.51 \pm 0.51 \pm 0.57) \cdot 10^{-5}$.

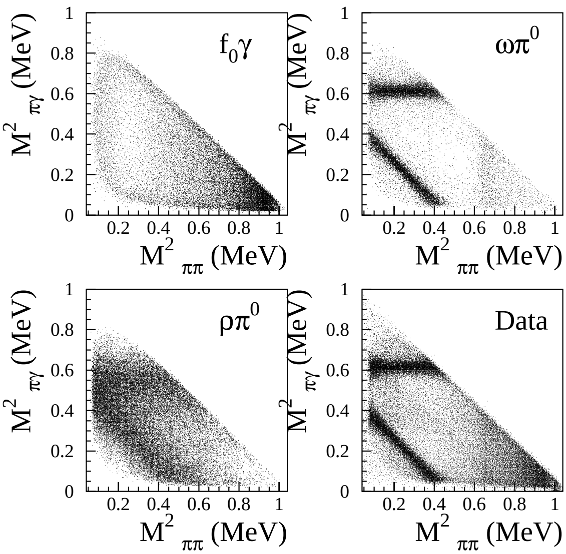

FIGURE 4. $M^2_{\eta\gamma}$ vs $M^2_{\pi^0\pi^0}$ distributions for : $\phi \to f_0\gamma$ MC simulation (top-left), $e^+e^- \to \omega\pi^0$ MC simulation (top-right), $\phi \to \rho\pi^0$ MC simulation (bottom-left) and real data (bottom-right). Data sample refer to the entire KLOE data set, i.e. $\sim$500 pb^{-1}.

The dN/dM$_{\pi\pi}$ from the selected $\pi^0\pi^0\gamma$ events and the dN/dM$_{\eta\pi}$ from the $\eta\pi^0\gamma$ sample have been used respectively to estimate the contributions coming from $\Phi \to f_0\gamma$ and $\Phi \to a_0\gamma$ processes. The terms from $S\gamma$ and $\rho\pi$ have been considered. The $S\gamma$ term has been treated by means of K$^+$K$^-$ loop model . The coupling $g^2{}_{SKK}$ and the coupling ratio $g^2{}_{SKK}/g^2{}_{S finalstate}$ have been left as free parameters. The contribution from $\rho\pi$ turns out to be negligible for both the analyzed channels. For the dN/dM$_{\pi\pi}$ spectral function of the $\pi^0\pi^0\gamma$ sample, a better agreement with data is obtained including an additional term coming from $\Phi \to \sigma\gamma \to \pi^0\pi^0\gamma$ plus the interference between σ and f$_0$ channels.The σ contribution has been parameterized assuming M$_\sigma$ = 478 MeV and Γ_σ = 324 MeV according to the measurement of reference [28]. The estimated branching fractions are BR($\Phi \to f_0\gamma$) = $(4.47 \pm 0.21) \cdot 10^{-4}$ and BR($\Phi \to a_0\gamma$) = $(7.4 \pm 0.7) \cdot 10^{-5}$, while the ratio of the coupling of the two scalars to the KK system is R$_{g^2}$ = $g^2{}_{f_0KK}$ / $g^2{}_{a_0KK}$ = 7.0 ± 0.7.

We are now re-evaluating with a model-independent analysis the contributions to the selected final states coming from different processes using the detailed description of the Dalitz plot provided by the new data available (see Fig. 4).

SUMMARY AND OUTLOOK

The KLOE measurement at 1% accuracy of the $\sigma(e^+e^- \to \text{hadrons})$ is forthcoming. The analysis of the collected sample of $\sim$500 pb^{-1} will improve, among other topics, the precision of the kaon branching fractions, and the K_L, $K^\pm$ lifetimes. In particular the study of the semileptonic decays will provide a new measurement of the CKM matrix element $|V_{us}|$. By the end of year 2003 DaΦne will restart delivering data to KLOE at improved luminosity and data taking conditions, providing 2 fb^{-1} per calendar year. New data will allow us to continue and extend the physics program including also measurements of the parameters describing the shape of the interference patterns in the neutral kaon system [29].

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