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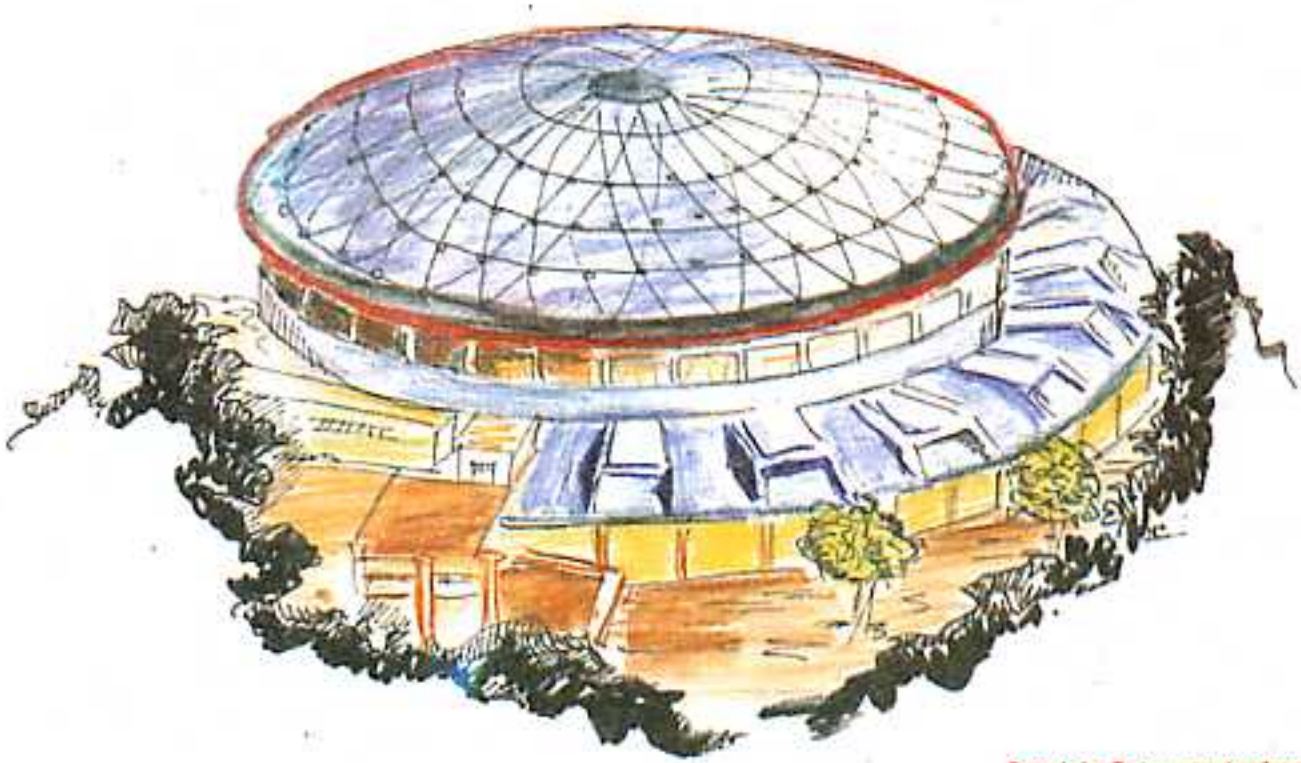
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G. Alexander:

BOSE-EINSTEIN EFFECT IN THE $K^0\bar{K}^0$ BOSON-ANTIBOSON SYSTEM

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Bose-Einstein Effect in the $K^0\overline{K}^0$ Boson-Antiboson System

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Abstract

It is shown that a Bose-Einstein effect, observed in a pair of identical bosons when emitted in the same phase space region, will also occur in the C=+1 subsample of spinless boson-antiboson pairs. This is illustrated by the recent OPAL study of Bose-Einstein Correlation using inclusive Z^0 hadronic decays into $K^0_s K^0_s$ pairs. The possible impact of this effect on the coupled channel analyses carried out to determine the branching ratio of $f_0(975) \to K\overline{K}$ is discussed.

1 Introduction

In reactions between particles which lead to multi-hadronic final states the interference between two identical bosons, the so called Bose-Einstein Correlation (BEC), is well known. These correlations lead to an enhancement of the number of identical bosons over that of non-identical bosons when the two particles are close to each other in phase space. Experimentally this effect, also known as the GGLP effect, was for the first time observed in particle physics by Goldhaber et al., [1] in like-sign charged pions produced in $p\overline{p}$ annihilations at $\sqrt{s} = 2.1$ GeV. In addition to the quantum mechanical aspect of the BEC, these correlations can also be used to estimate the dimension of the emitting source of the identical bosons [2]. Some recent reviews which summarize the underlying BEC theoretical aspects and the experimental results are given, for example, in references [3, 4, 5].

In this paper we will show that under certain conditions a Bose-Einstein like enhancement is also to be expected in a boson-antiboson system like the $K^0\overline{K}^0$ pair. In section 2 we will describe briefly the Bose-Einstein enhancement effect in identical bosons pairs. The current experimental information concerning the BEC effect in like-sign charged pions and Kaons is summarized in section 3. The results from a recent OPAL study of the correlation in the $K^0_sK^0_s$ system are also described in some details in the same section. In section 4 we will show that in a sample of spinless boson-antiboson system, which is a mixture of C = +1 and C = −1 states, the C = +1 part behaves like identical bosons in that it produces a BEC like low mass enhancement. The possible effect of this low mass enhancement on the determination of the $K\overline{K}$ decay branching ratios of the problematic scalar mesons $f_0(975)$ and $a_0(980)$ will also be described. Summary and conclusions will be presented in section 5.

2 Bose-Einstein Correlation in a Nutshell

To illustrate the nature of the Bose-Einstein Correlation we will here follow the simplified description given for example in Ref. [4]. To this end one can consider e.g., an e^+e^- (or $p\overline{p}$) reaction leading to multi-pion final state that includes at least one pair of like-sign charged pions. These identical pions may be envisaged to emerge from an interaction volume as shown in Fig. 1. In this figure the pair of identical pions, π_1 and π_2, emitted from the two points r_A and r_B, are detected by two counters placed at the r_1 and r_2 positions. Due to the identical nature of the two bosons, there exist two amplitudes which contribute to the same final state (see Fig. 1.). The probability $P_{1,2}$ for the final state shown in Fig. 1, assuming the production amplitude to be independent of r and uncorrelated, is given by:

$$P_{1,2} = \int d^4r_A d^4r_B |A_{1,2}|^2 \rho(r_A)\rho(r_B) = 1 + |\tilde{\rho}(q)|^2 \equiv C_2(q) \tag{1}$$

$$\text{with} \quad A_{1,2} = \frac{1}{\sqrt{2}}\left[e^{ip_1(r_1-r_A)}e^{ip_2(r_2-r_B)} + e^{ip_1(r_1-r_B)}e^{ip_2(r_2-r_A)}\right] \tag{2}$$

Here q is the four momentum difference between p_1 and p_2. At the limit of $q = 0$ one

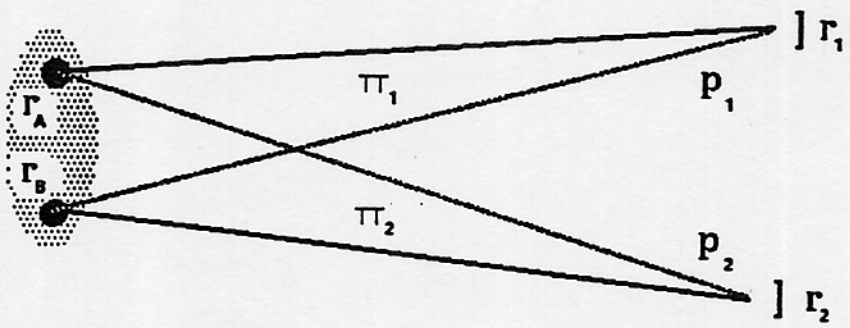


Figure 1: Schematic view of the Bose-Einstein effect.

has for identical bosons $C_2(q) = 2$ whereas at large q values $C_2(q) = 1$. In practice, the correlation function is measured by dividing a two particle correlation of identical particles $\sigma(p_1, p_2)$ with a reference distribution $\sigma_0(p_1, p_2)$ which should be, as far as possible, similar to that of $\sigma(p_1, p_2)$ in all its details but void of the Bose-Einstein effect. Using these two distributions one defines the correlation function $C_2(p_1, p_2)$ as

$$C_2(p_1, p_2) \equiv C_2(q) = \frac{\sigma(p_1, p_2)}{\sigma_0(p_1, p_2)} \tag{3}$$

These correlations have been observed in like-sign charged pion-pairs over a wide energy range and for many initial state reactions leading to multi-pion final states. A common parameterization of the correlation function, used in many experiments, is the one given by the expression:

$$C_2(Q) = N\left[1 + \lambda e^{-Q^2R^2}\right] \tag{4}$$

where Q is related to the invariant mass squared $M^2(m_B, m_B)$ of the two identical bosons of mass m_B by:

$$Q = \sqrt{-q^2} = \sqrt{M^2(m_B, m_B) - 4m_B^2} \tag{5}$$

The parameter λ measures the "Chaoticity" or strength of the effect and N is a normalization factor. The parameter R in GeV^{-1} (or $R_0 = \hbar c R$ in fm) is the related to the boson emitter dimension.

3 The Experimental Situation

In addition to the former BEC studies in like-sign charged pions, recently these $\pi^{\pm}\pi^{\pm}$ correlations have also been studied at high energy e^+e^- annihilations by three experiments at LEP, on and around the Z^0 mass. In these studies OPAL has measured the radius of the pion emitting source to be (0.928 ± 0.019 ± 0.150) fm [6] whereas ALEPH reported (0.65 ± 0.04 ± 0.16) fm [7] and DELPHI obtained (0.62 ± 0.04 ± 0.20) fm [8]. These values for the radius R_o, as well as the those found for the Chaoticity λ values, are very similar to the ones obtained at lower e^+e^- energies [5].

Experiment	Reaction	$\sqrt{s}$ (GeV)	Variable	λ	R_o (fm)
$K^{\pm}K^{\pm}$, [9]	$pp, \overline{p}p, \alpha\alpha$	53 - 126	q_t, q_o	0.58 ± 0.31	2.4 ± 0.9
$K^{\pm}K^{\pm}$, [10]	pp	27.4	q_t, q_o	0.57 ± 0.26	1.87 ± 0.33
$K^0_sK^0_s$, [12]	$\overline{p}p$	2.0	q_t, q_o	——	0.9 ± 0.2
$K^0_sK^0_s$, [13]	e^+e^-	91	Q	1.12 ± 0.33	0.72 ± 0.17

Table 1: Results for λ and R_o obtained from BEC studies of like-sign charged Kaons and K^0_s pairs using the Goldhaber variable Q and the variables q_t and q_o of Kopylov and Podgoretskii [14]. These are defined as follows: if $q = p_1 - p_2 = (q_o, q_i)$ then q_t denotes the component of q perpendicular to $p_1 + p_2$, where p_1, p_2 and q are the three momenta vectors. The errors given are statistical only.

Unlike the ample information that does exist on the BEC in pion pairs, very few studies have been reported on correlation effects in charged and neutral Kaon-pairs [9, 10, 11, 12]. From those studies the ones which gave an estimate for the emitter dimension R_0, are summarized in Table 1 together with the recent results of OPAL [13]. In that paper, the OPAL collaboration has reported on a study of $K^0_sK^0_s$ correlation in some 5×10^5 Z^0 multi-hadron decays [13]. From that sample, about 6000 events have been found to contain two or more K^0_s decaying into $\pi^+\pi^-$.

In order to search for a low mass enhancement in the Q distribution of the $K^0_sK^0_s$ data, it was necessary to choose a reference sample, $\sigma_0(p_1, p_2)$, which should simulate the experimental data in all its features apart from the BEC. In the studies of the BEC like-sign charged pions one natural choice for the reference sample is the correlations obtained from the $\pi^+\pi^-$ sample of the very same data. Such natural reference samples do not exist for the study of the BEC effect in a $K^0_sK^0_s$ data sample. In particular the use of K^+K^- data as a reference sample suffers from two drawbacks. The first is the strong presence near the threshold of the $\phi(1020) \rightarrow K^+K^-$ decay. The second is connected to the difficulties, in particular at high energies, to separate the charge Kaons from the charged pions and protons (anti-protons). For these reasons, a detailed Monte-Carlo generated sample was chosen as a reference sample after verifying that it describes the experimental data in all its details. The resulting correlation function $C_2(Q)$ obtained by OPAL is shown in Fig. 3a. Two important features are present. The first, there are indications for the decay of resonances into $K^0_sK^0_s$ pairs in the mass range 1.2 to 1.6 GeV. The other prominent feature of the $C_2(Q)$ distribution is the presence of a low mass enhancement similar in shape and strength to that obtained for the BEC of like-sign charged pion pairs in the very same experiment [6].

4 Physics Interpretation

The interpretation of the low mass enhancement seen in the $K^{\pm}K^{\pm}$ studies, which are listed in Table 1, is clearly identical to that deduced in the $\pi^{\pm}\pi^{\pm}$ analyses. In both cases one deals with identical boson pairs having an overall charge of ± 2 which cannot be the decay products of known mesons and therefore are automatically attributed to Bose-Einstein Correlations. This interpretation for the enhancement seen in the $K^0_sK^0_s$ correlation studies is not so evident since their origin is also coming from $K^0\overline{K}^0$ pairs, i.e. **non-identical bosons** where *a priori* no Bose-Einstein enhancement should be present.

4.1 Bose-Einstein Like Phenomenon

In trying to understand the nature of the low mass enhancement seen in the Q distribution of the $K^0_sK^0_s$ system, we will first ignore possible contributions from resonances decay. In that case, the $K^0_sK^0_s$ enhancement seen in the OPAL experiment has two sources. The first are K^0K^0 and $\overline{K}^0\overline{K}^0$ pairs which are systems of identical bosons where a BEC enhancement should be present. However these pairs of identical bosons should only account, at low Q values, for about 25% of the $K^0_sK^0_s$ sample investigated by OPAL [13] and it is unlikely that this by itself will result in the observed large threshold enhancement. In any case, the $K^0_sK^0_s$ low mass enhancement studied by Cooper et al. [12] utilized a pure $K^0\overline{K}^0$ sample obtained from the annihilation process $\bar{p}p \rightarrow K^0\overline{K}^0\pi^+\pi^-$.

As will be shown in the following, a Bose-Einstein like threshold enhancement is nevertheless expected in the $Q(K^0_s, K^0_s)$ distribution although its origin is a pure $K^0\overline{K}^0$ system [15]. To show this we will neglect the effects due to CP violation.

The $K^0\overline{K}^0$ system, which is an eigenstate of the charge conjugation operator C, can be decomposed as a superposition of the two eigenvalues C = +1 and C = −1. If no outside constraints are present, the probability amplitude of the $\left|K^0;\overline{K}^0\right\rangle$ state can be written as:

$$\left|K^0;\overline{K}^0\right\rangle = \frac{1}{\sqrt{2}}\left|K^0;\overline{K}^0\right\rangle_{C=+1} + \frac{1}{\sqrt{2}}\left|K^0;\overline{K}^0\right\rangle_{C=-1} \tag{6}$$

We further can write the probability amplitude for a given charge conjugation eigenvalue C as follows

$$\frac{1}{\sqrt{2}}\left|K^0;\overline{K}^0\right\rangle_{C=\pm 1} = \frac{1}{2}\left|K^0(p);\overline{K}^0(-p)\right\rangle \pm \frac{1}{2}\left|\overline{K}^0(p);K^0(-p)\right\rangle \tag{7}$$

where p is now the three momentum vector defined in the $K^0\overline{K}^0$ center of mass system. In the limit of $Q = 0$, where the BEC should be maximal, $p = 0$ and Eq. 7 reads

$$\frac{1}{\sqrt{2}}\left|K^0;\overline{K}^0\right\rangle_{C=\pm 1} = \frac{1}{2}\left|K^0(0);\overline{K}^0(0)\right\rangle \pm \frac{1}{2}\left|\overline{K}^0(0);K^0(0)\right\rangle \tag{8}$$

This means that, at $Q = 0$, the probability amplitude for the C = −1 state (odd ℓ values) is zero whereas that of the state C = +1 (even ℓ values) is maximal. It is here important to note that so far these equations do hold not only for the $K^0\overline{K}^0$ but for any spinless boson-antiboson pair such as $\pi^+\pi^-$ and K^+K^- systems [1] What distinguishes the $K^0\overline{K}^0$ from the other spinless boson-antiboson pairs is the simplicity in which one is able to project out the C = +1 or the C = −1 parts of the probability amplitude.

As is well known, the K^0 and the $\overline{K}^0$ mesons are described in terms of the two CP eigenstates, K_s^0 with CP = +1 and K_ℓ^0 with CP = −1. This being the case it then follows that, when the $K^0\overline{K}^0$ pair is detected through their K_s^0 and K_ℓ^0 decays, a definite eigenvalue C of the $K^0\overline{K}^0$ system can be selected. Thus, as Q approaches zero, an increase should be observed in the probability to detect $K_s^0K_s^0$ pairs and/or $K_\ell^0K_\ell^0$ pairs (C = +1), whereas a decrease should be seen in the probability to find $K_s^0K_\ell^0$ pairs (C = −1). Since both Copper et al. [12] and OPAL [13] restricted their investigations to the $K_s^0K_s^0$ pairs, which picks out the C = +1 state, a BEC enhancement in the low Q region is expected. This $C_2(Q)$ dependence on Q, for the $\lambda = 1$ value, is illustrated schematically in Fig. 2. As seen, when Q approaches the 0 value, $C_2(Q)$ splits into two branches, one rises up to the value two and the other goes down to zero in such a way that their sum is everywhere equal to the constant value of 1. This means that if all the decay modes of the $K^0\overline{K}^0$ pairs are detected and used simultaneously in the same correlation analysis, then according to Eqs. 7 and 8, no BEC effect will be observed at $Q = 0$. This however should not come as a surprise if one remembers that the $K^0\overline{K}^0$ system is at the very end not composed of identical bosons.

In conclusion, when studying the $K_s^0K_s^0$ pairs, as in the OPAL work, a BEC-like enhancement should be observed, similar to that of like-sign charged pions and charged Kaons, irrespective of their origin, be it identical K^0K^0 ($\overline{K}^0\overline{K}^0$) boson-pair or $K^0\overline{K}^0$ boson-antiboson system.

Under the assumption that the low Q enhancement shown in Fig. 3 is entirely due to the BEC effect, OPAL [13] has fitted the expression

$$C_2(Q) = N(1 + f(Q)\lambda e^{-Q^2R^2})(1 + \delta Q) \tag{9}$$

to their data. In this expression, which is related to Eq. 4, the term δQ is added in order to account for long range correlations and the function $f(Q)$ is introduced to take care of the experimental background and its Q dependence. In practice $f(Q)$ was found in the OPAL experiment to be independent of Q and equal to 0.79.

The fitting procedure was repeated for four, (λ, R_o, δ, N), three (λ, R_o, δ) and two (λ, R_o) free parameters. The results of the three fits are presented in Table 2 and the 2-parameter fit values are also compared in Fig. 3a with the data. Only moderate correlation exists between both parameters as is illustrated in Fig. 3b where R_0 versus λ is plotted. The cross in the figure represents the best OPAL value and the two contours define the allowed domains with 50 and 90 % confidence level. The final R_0 and λ values given by OPAL [13] are:

$$\lambda = 1.12 \pm 0.33 \pm 0.29 \quad \text{and} \quad R_o = (0.72 \pm 0.17 \pm 0.19) \text{ fm}$$

[1] The $\pi^0\pi^0$ pair is a pure C = +1 state.

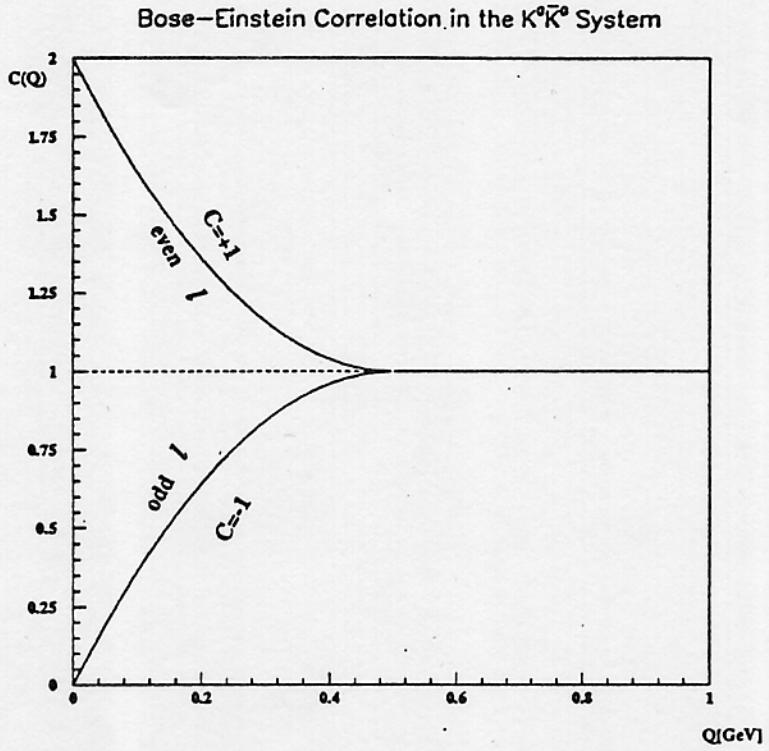


Figure 2: A schematic behavior of the correlation function $C(Q)$ for the $K^0\overline{K}^0$ system. At low Q values the C=+1 probability amplitude reaches the value 2 at the limit of $Q = 0$ whereas the C=−1 probability amplitude reaches the value 0. The sum of the C=+1 and C=-1 remains flat.

where the first error is the statistical one and the second is the systematic error.

In evaluating the BEC interpretation of the $K^0_sK^0_s$ low mass enhancement one should note the following:

a) The R_o value is similar to those obtained in previous BEC analyses of like-sign charged pions.

b) Although the value of the Chaoticity parameter λ is somewhat higher than those obtained in the analyses of like-sign charged pions, it still agrees with them within the current large errors (note that the λ upper limit is 1).

c) Since the low mass enhancement occurs for the C= +1 $K\overline{K}$ state(s), it follows that only the even angular momentum values are allowed. So far OPAL has not carried out a partial wave analysis of the $K^0_sK^0_s$ system at low Q values, but due to the proximity of the enhancement to threshold it is not unreasonable to assume that it is dominated by the S-wave.

4.2 Resonance Decay Interpretation

The isoscalar meson $f_0(975)$ and the nearby lying isovector $a_0(980)$, both of which are below but near to the $K\overline{K}$ threshold, pose to this very day a puzzle as they do not fit in a simple way to the SU(3) nonets scheme built out of $q\overline{q}$ states. Their mass

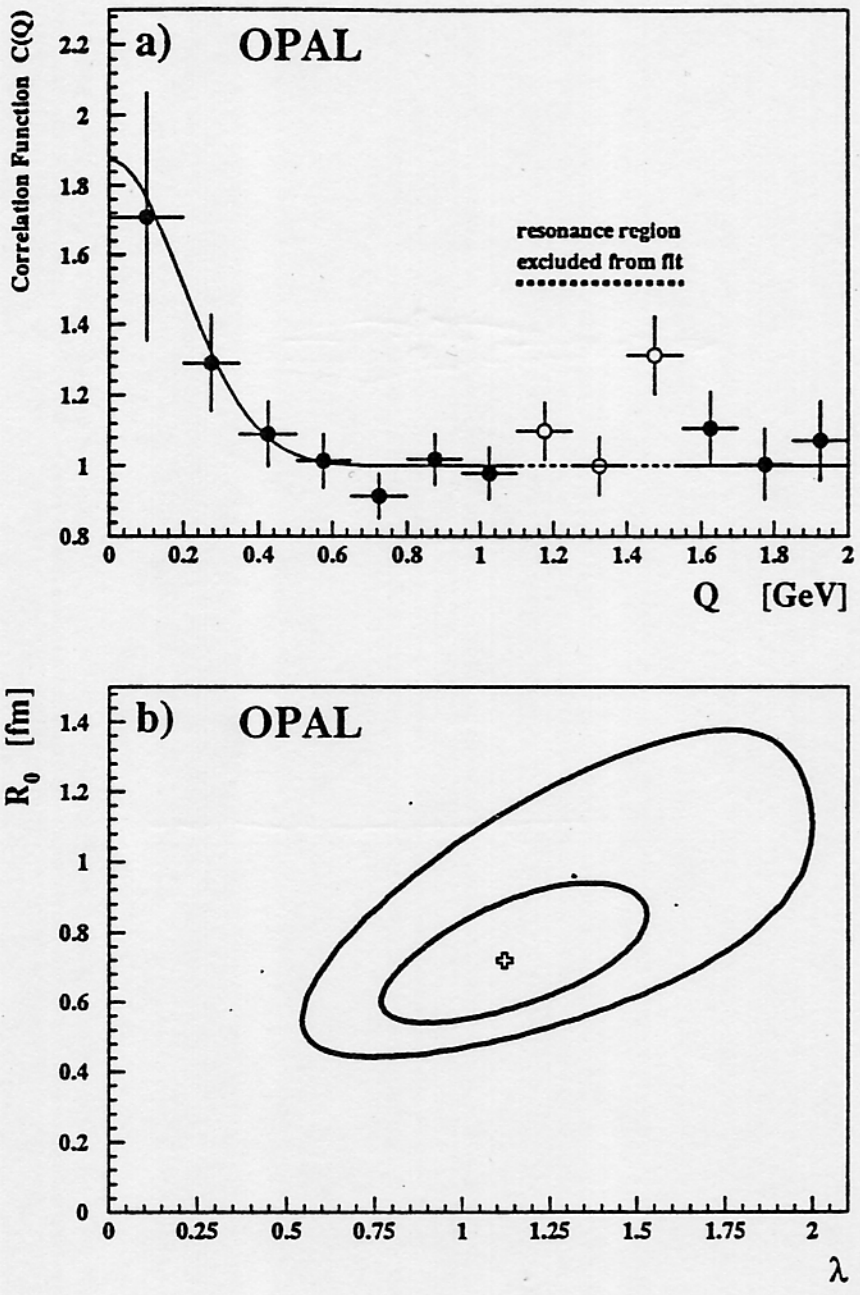


Figure 3: a) The OPAL measured correlation function $C(Q)$ of the $K^0_s K^0_s$ pairs in the range $0.0 \leq Q \leq 2.0$ GeV. The error bars represent the combined statistical uncertainty of the data and Monte-Carlo samples. The solid line represents the best fit to the data using Eq. 9 with a 2-parameter χ^2 fit. The region of the $f'_2(1525)$ and the $f_o(1710)$ has been omitted from the fit. b) λ versus R_o obtained in a 2-parameter χ^2 fit of $C(Q)$ to the OPAL data. The cross represents the best values and the contours around it represent the allowed regions for a 50% and 90% confidence level using the statistical errors only.

Free Parameters	χ^2/N_D	λ	R_o (fm)	δ (GeV^{-1})	N
λ, R_o, δ, N	1.9/6	1.13 $\pm$0.47	0.61 $\pm$0.16	0.10$\pm$ 0.11	0.89$\pm$0.11
λ, R_o, δ	2.9/7	1.01 $\pm$0.49	0.71 $\pm$0.18	0.01$\pm$0.04	——
λ, R_o	3.4/8	1.12 $\pm$0.33	0.72 $\pm$0.17	——	——

Table 2: Results of the χ^2 fits of $C_2(Q)$, as defined in Eq. 9, to the $K^0_sK^0_s$ OPAL data in the range of Q=0 to Q=2.0 GeV. The region of the $f'_2(1525)$ and $f_o(1710)$ resonances, $1.1 \leq Q \leq 1.55$ GeV, has been omitted from the fit. The errors are statistical only.

values are too low, their width too narrow and their apparent strong coupling to the $K\overline{K}$ channel is difficult to understand if they are the light quark members of the scalar nonet [16, 17]. In fact, it is currently believed that the P-wave $q\overline{q}$ mesons that should be assigned to the $J^{PC} = 0^{++}$ scalar nonet are the $a_0(1320), K_0(1430), f_0(1400)$ and the $f_0(1590)$ resonances [16].

This being the case, several attempts have been made to define the nature of the $f_0(975)$ resonance in terms of structures other than that of a $q\overline{q}$ state. Among those considered are also a $q\overline{q}q\overline{q}$ structure and a K-$\overline{K}$ molecule [16, 18]. This molecule-like proposal is to a large extent motivated by the proximity of the $f_0(975)$ to the $K\overline{K}$ threshold and its relative large branching ratio of

$$\mathrm{BR}(f_0(975) \rightarrow K\overline{K}) = (21.9 \pm 2.4)\ \%,$$

deduced from the coupled channel analyses [17].

The $f_0(975)$ in its decay to $\pi^+\pi^-$ is well established and has recently also been seen in the multi-hadron decays of the Z^0 [19]. Since the $K\overline{K}$ is above the $f_0(975)$ threshold, its decay into Kaon pairs cannot cover the full Breit-Wigner width but should be seen as a threshold enhancement in reactions having a Kaon pair in their final state. Experimentally the use of reactions such as $\pi^-p \rightarrow nK^+K^-$ are disfavored since the K^+K^- system is strongly dominated by the presence of the vector meson $\phi(1020)$ which is very near the $K\overline{K}$ threshold.

For this reason the $K^0_sK^0_s$ system of the reaction $\pi^-p\rightarrow$ n $K^0\overline{K}^0\rightarrow$ n $K^0_sK^0_s$, has been utilized in various coupled channel analyses to determine the scalar $f_0(975)$ decay branching ratio to $K\overline{K}$ [17, 20]. In these analyses the possibility that a BEC like effect could contribute to the low $K^0_sK^0_s$ mass region has not explicitly been considered. It is obvious that the BEC effect constitutes a background in those cases where the coupled channel analysis utilized as an input, the low mass threshold enhancement which is build up from even angular momentum partial waves. The advantage of extracting in a partial wave analysis the S-wave part of the $K^0_sK^0_s$ low mass enhancement to be used in the coupled channel studies has been pointed out by Lipkin [15]. This will in any case eliminate the non S-wave contributions to the low mass enhancement. However, in such an analysis the entire S-wave part will be extracted irrespective of its origin, whether from the $f_0(975)$ and $a_0(980)$ decays or from other sources or from both.

5 Summary and Conclusions

It has been shown that a Bose-Einstein like low mass enhancement is expected in a sample of a spinless boson-antiboson system when the state with an eigenvalue C= +1 is chosen. This enhancement is similar to that seen in a system of identical bosons like $\pi^{\pm}\pi^{\pm}$. At the same time the state with the eigenvalue C = −1 behaves like identical fermions. The system $K^0\overline{K}^0$ is an ideal one for the experimental study of the BEC effect as both the K_s^0 and K_ℓ^0 are eigenstates of CP.

Due to the long lifetime of the K_ℓ^0 meson the studies of the BEC effect were so far restricted to the C = +1 sample of $K_s^0K_s^0$ pairs [11, 12, 13]. In the OPAL study a low mass enhancement has been seen [13] and further analyzed under the assumption that it is entirely due to the BEC. In that analysis the values for the emitter dimension and the Chaoticity parameter obtained were found to be very similar to those found in the same experiment for the like-sign charged pions. At present it is impossible to determine experimentally what fraction of the low mass enhancement seen by OPAL originates from decay of the $f_0(975)$ and $a_0(980)$ resonances. In any case it is unlikely that the $K_s^0K_s^0$ mass enhancement seen by OPAL is entirely due to the decay of the $f_0(975)$ meson as there is no evidence in the same experiment for the $f_0(975)$ decay into the K^+K^- channel [21]. To clear this point up it may be of use to compare some features, like the x_f distribution, of the $f_0(975)$ in its decay to $\pi^+\pi^-$ to the $K_s^0K_s^0$ low mass enhancement. Furthermore a partial wave analysis of the OPAL observed $K_s^0K_s^0$ system may also be useful to clarify the nature of the low mass enhancement.

A Bose-Einstein like effect can also be experimentally studied in other neutral boson-antiboson pairs like that of the $B^0\overline{B}^0$ system [15]. On the other hand in the case of a charged boson-antiboson pair, like the $\pi^+\pi^-$ system, there is not in general a simple way to project out a state with a one C eigenvalue. There may be however some special cases where it will be possible to take advantage of outside constraints. For example, one may consider the decay $J/\psi(3097) \rightarrow K^+K^-\pi^+\pi^-$ with a branching ratio of $(9.0 \pm 0.3) \times 10^{-3}$ [17]. In this decay the $\pi^+\pi^-$ system is a mixture of C = +1 and C = −1 states. Part of this decay (about 10%) proceeds via the intermediate process of $J/\psi(3097) \rightarrow \phi\pi^+\pi^-$ so that the $\pi^+\pi^-$ is in a C = +1 state. To investigate the $\pi^+\pi^-$ BEC like effect in this $\phi\pi^+\pi^-$ final state, one can then use the J/ψ decay final state $K^+K^-\pi^+\pi^-$ as a reference sample by using only those events with values of M(K^+K^-) outside but near to the ϕ mass value of 1020 MeV.

The presence of BEC like effect in the $K_s^0K_s^0$ system may introduce some uncertainty to the value of the decay branching ratio $f_0(975) \rightarrow K\overline{K}$ obtained from coupled channel analyses. In those analyses where one used the reaction $\pi^-p \rightarrow nK_s^0K_s^0$ clearly the low $K_s^0K_s^0$ mass enhancement may receive also a contribution from the BEC effect which occurs in even ℓ values.

As mentioned above, at high energy reactions the experiments are restricted in their BEC studies to the $K_s^0K_s^0$ system. On the other hand it will also be interesting to study the system $K_\ell^0K_s^0$ where there should be a depletion of events at low Q values (see Fig. 2). Such a study may be realized with the $\overline{p}p$ low energy LEAR collider at CERN and in the near future with the "ϕ-factory" $DA\Phi NE$, now under construction in the Italian National Laboratory in Frascati. This "factory", which is designed to reach $\sqrt{s}$ values

up to about 2 GeV, will allow to study for example the reaction $e^+e^- \to \pi^+\pi^- K^0\overline{K}^0$ which has an approximate cross section of 1 nb. Due to the relative low energy of the K^0' mesons, it will be possible to identify the $K^0_\ell K^0_s$ pairs with a high efficiency using the large KLOE detector earmarked for $DA\Phi NE$. Furthermore, in these BEC studies at $DA\Phi NE$ one can use an ideal reference sample namely, the sum of all the $K^0\overline{K}^0$ decay modes, $K^0_sK^0_s$, $K^0_\ell K^0_\ell$, $K^0_sK^0_\ell$ and $K^0_\ell K^0_s$. The drawback of these studies at low energy is the presence of low mass resonances which will have to be accounted for.

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