CHARGED AND NEUTRAL KAON PRODUCTION IN ELECTRON-POSITRON ANNIHILATION

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A model for description of electromagnetic form factors of the charged and neutral kaons in the energy region $\sqrt{s} \sim$ 1-2 GeV is presented. Our approach is based on extended vector-meson-dominance model. It accounts for dependence of photon-meson vertices on the invariant energy and includes self-energy contribution to vector-meson propagators. Interaction vertices follow from Lagrangian of Chiral Perturbation Theory (ChPT) with explicit vector-meson degrees of freedom. The form factors, calculated without fitting parameters, are in a good agreement with experiment for space-like and time-like photon momenta. In addition we have calculated contribution of the $K\overline{K}$ channel to the muon anomalous magnetic moment.

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1. INTRODUCTION

$K-$mesons (kaons) are the particles with quantum numbers $I(J^P)=\frac{1}{2}(0^-)$ and nonzero "strangeness". They have lead to discovery of interesting phenomena related to weak interactions, such as strangeness oscillation, K^0 regeneration, and CP violation.

Quark content of these particles is as follows: $K^+ = u\bar{s}$, $K^0 = d\bar{s}$ with $strangeness = +1$ and $K^- = \overline{K^+} = \bar{u}s$, $\overline{K^0} = \bar{d}s$ with $strangeness = -1$. The charged kaon lifetime is $\tau = 1.2\times10^{-8}\,s$. Neutral kaons are conventially decribed by short-lived (S) and long-lived (L) eigenstates of CP operator:

$$K_S = \frac{1}{\sqrt{2}}(K^0 + \overline{K^0}) : \tau = 0.9\times10^{-10}s,$$

$$K_L = \frac{1}{\sqrt{2}}(K^0 - \overline{K^0}) : \tau = 5.2\times10^{-8}s.$$

We study electromagnetic properties of $K-$mesons related to their interaction with one photon at different photon invariant mass (scanning energy) $\sqrt{s}$. Experimental information in the time-like region ($q^2 \equiv s \geq 4m_K^2$) of photon momentum q comes from cross section measurement of electron-positron annihilation $e^+e^- \to K\overline{K}$:

$$\sigma(e^+e^- \to K\overline{K}) = \frac{\pi\alpha^2}{3q^2}(1-\frac{4m_K^2}{q^2})^{3/2}|F_K(q^2)|^2 \qquad (1)$$

High precision measurements are performed by CMD-2 [1] and SND Collaborations [2] in Novosibirsk (Russia), and in Orsay (France) by use of DM1 [3] and DM2 [4] detectors.

In the space-like region $q^2 \equiv s < 0$ the form factors can be measured in different ways. Kaon scattering on atomic electrons, performed by NA7 collaboration [5], gives information at relatively small momentum transfer (photon momentum squared $-s < 0.16$ GeV^2). One can reach large momentum transfer up to $-s \approx 3$ GeV^2 by performing electron-proton scattering with kaon-hyperon production ($ep \to e\Lambda K^+$ and $ep \to e\Sigma^0 K^+$). These experiments are currently carried out at Jefferson Lab in USA [6].

2. MOTIVATION

Studying kaon form factors (FF's) is a good testbed for effective hadronic models. Let us mention a few ones.

Chiral Perturbation Theory (ChPT) is the effective low-energy hadronic theory, which has symmetries of Quantum Chromodynamics (for review of ChPT see Ref. [7]). Although one could argue on the region of ChPT applicability, it is a appropriate approach to describe the kaon electromagnetic properties.

Vector-meson dominance (VMD) of the electromagnetic (EM) interaction is an old and well-developed concept. Nevertheless it can be generalized or extended in different ways. Studying the kaon FF's gives opportunities to explore these extensions.

Electromagnetic interaction exhibits the so-called quantum chiral anomaly, which is usually treated by means of Wess, Zumino and Witten (WZW) anomalous Lagrangian [8,9]. The inclusion of WZW-like interactions in ChPT Lagrangian is not trivial and should be tested in the observed properties of the kaons.

The aspects mentioned above are of our main interest throughout this research. We would also like to mention that there is a number of models for kaon FF in the space-like region, for example, quark-level linear sigma model [10], non-perturbative QCD calculations [11] and some others.

The model developed here is closely connected with the study of vector mesons ($J^P = 1^-$): $\rho(770)$, $\omega(782)$, $\phi(1020)$, and their radial excitations $\rho' = \rho(1450)$, $\omega' = \omega(1420)$ and $\phi' = \phi(1680)$, and possibly some others.

Hadronic contribution to the muon anomalous magnetic moment (AMM) $a_\mu = (g_\mu - 2)/2$, which is measured by "Muon g-2" Collaboration [12] with high precision, includes in particular contribution due to kaon loops. The latter can be expressed in terms of kaon electromagnetic FF. The kaon contribution is one of the sources of uncertainty in theoretical prediction for AMM [13].

3. INTERACTIONS IN EVEN-INTRINSIC-PARITY SECTOR

The ChPT $SU(3)_L \times SU(3)_R$ Lagrangian [14,15] is

$$L_{chiral-sym.} = \frac{F_\pi^2}{4}\mathrm{Tr}(D_\mu U D^\mu U^\dagger) + \frac{iG_V}{\sqrt{2}}\mathrm{Tr}(V_{\mu\nu}u^\mu u^\nu) + \frac{eF_V}{2\sqrt{2}}F^{\mu\nu}\mathrm{Tr}(V_{\mu\nu}(uQu^\dagger + u^\dagger Q u)) + .. \quad (2)$$

$$L_{chiral-sym.breaking} = \frac{F_\pi^2}{4}\mathrm{Tr}(\chi U^\dagger + \chi^\dagger U), \quad (3)$$

where Φ describes the octet of pseudoscalar mesons ($J^P = 0^-$)

$$\Phi = \begin{pmatrix} \pi^0/\sqrt{2} + \eta_8/\sqrt{6} & \pi^+ & K^+ \\ \pi^- & -\pi^0/\sqrt{2} + \eta_8/\sqrt{6} & K^0 \\ K^- & \bar{K}^0 & -2\eta_8/\sqrt{6} \end{pmatrix},$$

$D_\mu U \equiv \partial_\mu U + ieB_\mu[U, Q]$ is a covariant derivative with quark charge matrix $Q \equiv diag(\frac{2}{3}, -\frac{1}{3}, -\frac{1}{3})$, B^μ is the electromagnetic field, $V_{\mu\nu}$ is octet of vector mesons, the pion weak-decay constant is $F_\pi = 92.4\,\mathrm{MeV}$, and $U \equiv \exp(i\sqrt{2}\Phi/F_\pi)$, $u = U^{1/2}$, $u^\mu = iu^\dagger(D^\mu U)u^\dagger$. The chiral-symmetry breaking part is due to nonzero quark masses and quark condensate

$$\chi = -\frac{2}{3F_\pi^2}diag(m_u, m_d, m_s)\langle 0|\bar{q}q|0\rangle$$

$$\overset{SU(2)_f}{=} diag(m_\pi^2, m_\pi^2, 2m_K^2 - m_\pi^2).$$

Expansion of (2) in powers of meson momenta (derivatives) describes the following interactions

$$L_{\gamma\Phi\Phi} = ieB_\mu \mathrm{Tr}(Q[\partial_\mu\Phi, \Phi]),$$

$$L_{\gamma\gamma\Phi\Phi} = -\frac{e^2}{2}B^\mu B_\mu \mathrm{Tr}([\Phi, Q]^2),$$

$$L_{\gamma V} = e\frac{F_V}{\sqrt{2}}F^{\mu\nu}\mathrm{Tr}(V_{\mu\nu}Q),$$

$$L_{V\Phi\Phi} = i\frac{\sqrt{2}G_V}{F_\pi^2}\mathrm{Tr}(V_{\mu\nu}\partial^\mu\Phi\partial^\nu\Phi),$$

$$L_{V\Phi\Phi\gamma} = e\frac{F_V}{4\sqrt{2}F_\pi^2}F^{\mu\nu}\mathrm{Tr}([V_{\mu\nu}, \Phi][Q, \Phi]). \quad (4)$$

These interactions conserve the "normality" quantum number

$$N = \mathrm{Parity} \times (-1)^{\mathrm{spin}}. \quad (5)$$

4. INTERACTIONS IN ODD-INTRINSIC-PARITY SECTOR

These interactions are proportional to Levi-Chivita tensor $\varepsilon^{\mu\nu\alpha\beta}$ and do not conserve "normality" (5).

WZW Lagrangian [8,9] describes interactions of photons with pseudoscalar mesons, in particular,

$$L_{\gamma\Phi\Phi\Phi} = -\frac{i\sqrt{2}e}{4\pi^2 F_\pi^3}\varepsilon^{\mu\nu\alpha\beta}B_\mu \mathrm{Tr}(Q\partial_\nu\Phi\partial_\alpha\Phi\partial_\beta\Phi); \quad (6)$$

$$L_{\gamma\gamma\Phi} = \frac{-3\sqrt{2}e^2}{8\pi^2 F_\pi}\varepsilon^{\mu\nu\alpha\beta}\partial_\mu B_\nu \partial_\alpha B_\beta \mathrm{Tr}(Q^2\Phi). \quad (7)$$

For interactions involving vector mesons one has

$$L_{VV\Phi} = \frac{g_{vvp}}{\sqrt{2}F_\pi}\varepsilon^{\mu\nu\alpha\beta}\mathrm{Tr}(\partial_\mu V_\nu \partial_\alpha V_\beta \Phi); \quad (8)$$

$$L_{V\gamma\Phi} = \frac{4d}{F_\pi}\varepsilon^{\mu\nu\alpha\beta}\partial_\mu B_\nu \mathrm{Tr}(QV_\alpha\partial_\beta\Phi); \quad (9)$$

$$L_{V\Phi\Phi\Phi} = \frac{ih}{F_\pi^3}\varepsilon^{\mu\nu\alpha\beta}\mathrm{Tr}(V_\mu\partial_\nu\Phi\partial_\alpha\Phi\partial_\beta\Phi). \quad (10)$$

A generalization of WZW anomalous term for vector and axial vector mesons [16,17] is

$$L_{V\Phi\Phi\Phi} = \frac{-ig}{4\pi^2 F_\pi^3}\varepsilon^{\mu\nu\alpha\beta}\mathrm{Tr}(V_\mu\partial_\nu\Phi\partial_\alpha\Phi\partial_\beta\Phi); \quad (11)$$

$$L_{VV\Phi} = \frac{-3g^2}{8\sqrt{2}\pi^2 F_\pi}\varepsilon^{\mu\nu\alpha\beta}\mathrm{Tr}(\partial_\mu V_\nu \partial_\alpha V_\beta \Phi). \quad (12)$$

Electromagnetic field is included by the substitution

$$V_\mu \to V_\mu + \frac{\sqrt{2}e}{g}QB_\mu. \quad (13)$$

As a result one obtains an effective $\gamma V\Phi$ interaction

$$L_{V\gamma\Phi} = -\frac{3eg}{4\pi^2 F_\pi}\varepsilon^{\mu\nu\alpha\beta}\partial_\mu B_\nu \mathrm{Tr}(QV_\alpha\partial_\beta\Phi). \quad (14)$$

***Table 1**. Values of the EM coupling constants*

couplings	d	h	g_{vvp}
"ideal" values	$-\frac{3eg}{16\pi^2} = 0.034$	$\frac{g}{4\pi^2} = 0.15$	$\frac{3g^2}{8\pi^2} = -1.354$
experiment	0.033	0.003	−1.321

Thus one obtains the estimate for the coupling, and besides coupling can be found from experiment. See Table 1 for corresponding values.

5. KAON ELECTROMAGNETIC FORM FACTORS

The quark electromagnetic current is

$$j^\mu_{em}(x) = \frac{2}{3}\bar{u}(x)\gamma^\mu u(x) - \frac{1}{3}\bar{d}(x)\gamma^\mu d(x) - \frac{1}{3}\bar{s}(x)\gamma^\mu s(x). \quad (15)$$

The EM form factors $F_K(q^2)$ are defined as

$$\langle K(p_1)\bar{K}(p_2)|\, j^\mu_{em}(x=0)\,|0\rangle \equiv (p_1 - p_2)^\mu F_K(q^2), \quad (16)$$

where the photon invariant energy squared is $q^2 = (p_1 + p_2)^2 \equiv s$, and p_1, p_2 are kaon and anti-kaon momenta.

Form factor is an analytic function of q^2 and describes both the time-like and space-like regions of momentum transfer.

We calculate FF's from (4), (6), (8), (9) and (10):

$$F_{K^+}(s) = 1 - \sum_{V=\rho,\omega,\phi} \frac{g_{VK^+K^-}}{f_V(s)} A_V(s);$$

$$F_{K^0}(s) = - \sum_{V=\rho,\omega,\phi} \frac{g_{VK^0\overline{K^0}}}{f_V(s)} A_V(s);$$

$$A_V(s) \equiv \frac{s}{s - m_V^2 - \Pi_V(s)}, \quad (17)$$

where $\Pi_V(s)$ is self-energy operator of vector meson $V = \rho, \omega, \phi$. The correct normalization conditions

$$F_{K^+}(0) = 1, \qquad F_{K^0}(0) = 0 \quad (18)$$

are fulfilled due to gauge invariance of EM interaction.

5.1. SELF-ENERGY OPERATORS

Dressed ("exact", or full) propagator of vector particles includes self-energy operators $\Pi_V(s)$ which account for many intermediate states, such as $\pi^+\pi^-$, $\omega\pi^0$, $K\bar{K}$, $\omega\pi^0 \to \pi^0 K^+ K^-$ for ρ meson, etc.

The dominant contributions (see Fig. 1) are

$$\Pi_\rho = \Pi_{\rho(\pi^0\omega)\rho} + \Pi_{\rho(\pi\pi)\rho}; \quad (19)$$

$$\Pi_\omega = \Pi_{\omega(\pi^0\rho)\omega} + \Pi_{\omega(KK)\omega} + 2\Pi_{\omega(3\pi,\pi\rho)\omega}; \quad (20)$$

$$\Pi_\phi = \Pi_{\phi(KK)\phi}. \quad (21)$$

Imaginary part of self-energy gives rise to energy-dependent widths of vector mesons, $\Gamma_V(s) = -m_V^{-1} \operatorname{Im} \Pi_V(s)$. To restrict fast growth with s of the partial widths we have to introduce cut-off FF's [18].

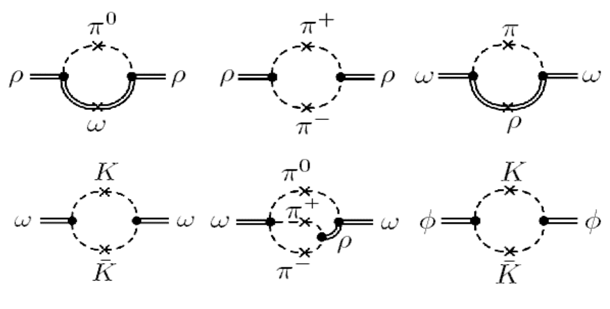

Fig. 1. Loops included in self-energy of vector–mesons

5.2. ELECTROMAGNETIC VERTEX MODIFICATION

To be consistent with the approximation for the self-energy contributions in the previous subsection, we include only the imaginary part of the loop contributions to the photon vector-meson vertex functions (see Fig. 3).

In numerical calculation the following formulae are used:

$$\operatorname{Im}\Pi_{\gamma(\pi^0\omega)\rho}(s) = 2d/g_{vvp} \operatorname{Im}\Pi_{\rho(\pi^0\omega)\rho}(s),$$

$$\operatorname{Im}\Pi_{\gamma(\pi\pi)\rho}(s) = e/g \operatorname{Im}\Pi_{\rho(\pi\pi)\rho}(s),$$

$$\operatorname{Im}\Pi_{\gamma(\pi^0\rho)\omega}(s) = 2d/3g_{vvp} \operatorname{Im}\Pi_{\omega(\pi^0\rho)\omega}(s),$$

$$\operatorname{Im}\Pi_{\gamma(KK)\omega}(s) = e/g \operatorname{Im}\Pi_{\omega(KK)\omega}(s),$$

$$\operatorname{Im}\Pi_{\gamma(KK)\phi}(s) = -e/(\sqrt{2}g) \operatorname{Im}\Pi_{\phi(KK)\phi}(s),$$

$$\operatorname{Im}\Pi_{\gamma(3\pi,\pi\rho)\omega}(s) = -e/(12\pi^2 h) \operatorname{Im}\Pi_{\omega(3\pi,\pi\rho)\omega}(s). \quad (22)$$

These expressions are multiplied by the cut-off FF [18].

The equations for the modified EM couplings read in terms of the loop corrections

$$1/f_V(s) = 1/f_V^{(0)} - i/(es)\sum_c \operatorname{Im}\Pi_{\gamma(c)V}(s), \quad (23)$$

for $V = \rho^0, \omega, \phi$, where index $c = (\pi^0\omega, \pi\pi,\ \pi^0\rho, KK,\ 3\pi, 3\pi - \rho\pi)$ stands for the diagrams shown in Fig. 2. Note that $\operatorname{Im} f_V^{(0)} = 0$. The modified couplings $f_V(s)$ at $s = m_V^2$ have to describe the leptonic decay widths of the vector mesons:

$$|f_V(s = m_V^2)|^2 = \frac{4}{3}\pi\alpha^2 \frac{m_V}{\Gamma(V \to e^+e^-)}. \quad (24)$$

This allows us to find the bare couplings:

$$\frac{1}{(f_V^{(0)})^2} = \frac{1}{|f_V(s = m_V^2)|^2} - \frac{1}{e^2 m_V^4}\left(\sum_c \operatorname{Im}\Pi_{\gamma(c)V}(s = m_V^2)\right)^2. \quad (25)$$

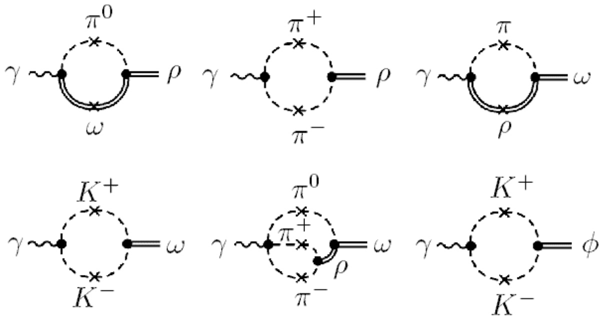

Fig. 2. Loops for EM vertex modification

Using the particle properties [19] we obtain

$$f_\rho^{(0)} = 5.026, \quad f_\omega^{(0)} = 17.060, \quad f_\phi^{(0)} = 13.382, \quad (26)$$

and for arbitrary s the real and imaginary parts of $f_V(s)$ are calculated from (23).

The FF of the kaon is schematically represented in Fig. 3.

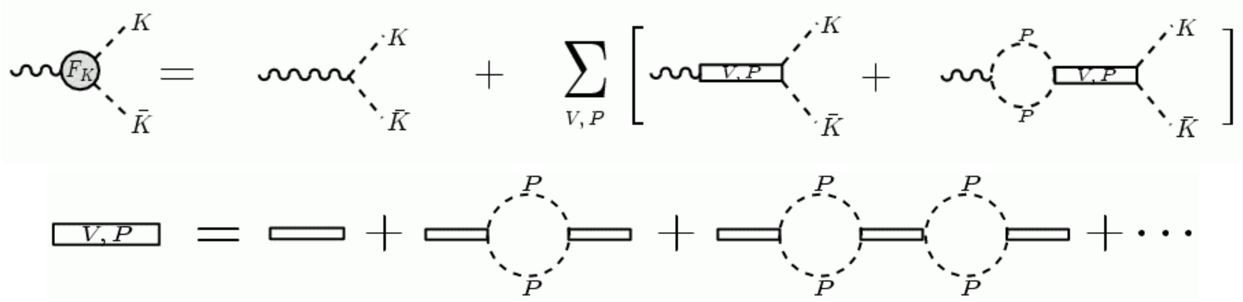

Fig. 3. *Electromagnetic form factor of charged kaon*

5.3. CONTRIBUTION FROM HIGHER RESONANCES

Contribution from the higher resonances ρ',ω',ϕ' is included by adding

$$\Delta F_{K^+}(s) = -\sum_{V'=\rho',\omega',\phi'} A_{V'}(s)\, g_{V'K^+K^-} / f_{V'}(s);$$
$$\Delta F_{K^0}(s) = -\sum_{V'=\rho',\omega',\phi'} A_{V'}(s)\, g_{V'K^0\bar{K}^0} / f_{V'}(s), \quad (27)$$

to form factors (17). The masses and widths can be taken from [19].

If we assume the $SU(3)$ relation for the ratios of the strong and EM couplings for the "primed" resonances (see Tables 2 and 3) and use the known branching ratios [19], we obtain $g_{\rho'K^+K^-}/f_{\rho'} = -0.063$, $g_{\omega'K^+K^-}/f_{\omega'} = -0.021$ and $g_{\phi'K^+K^-}/f_{\phi'} = -0.036$.

Table 2*. Values of the EM coupling constants. photon – vector meson coupling* $f_V = m_\rho / F_V$

$(V=\rho^0,\omega,\phi)$	ρ^0	ω	ϕ
$SU(3): f_V$	f	$3f$	$-3f/\sqrt{2}$
f_V	4.97 ± 0.04	17.06 ± 0.29	-13.38 ± 0.21

Table 3. $SU(3)$ *values of the vector-meson coupling to two pseudoscalar mesons, where* $g = G_V\, m_\rho / F_\pi^2 = 5.965$ *(from* $\rho \to \pi\pi$ *decay)*

	$\pi^+\pi^-$	K^+K^-	$K^0\bar{K}^0$
ρ^0	g	$\frac{1}{2}g$	$-\frac{1}{2}g$
ω	–	$\frac{1}{2}g$	$\frac{1}{2}g$
ϕ	–	$-\frac{1}{\sqrt{2}}g$	$-\frac{1}{\sqrt{2}}g$

6. CONTRIBUTION TO ANOMALOUS MAGNETIC MOMENT OF MUON

The contribution of $K\bar{K}$ channels to AMM of the muon is determined via the dispersion integral [20]:

$$a_\mu^{had,K\bar{K}} = \frac{\alpha^2}{3\pi^2}\int_{4m_K^2}^{\infty} W(s)R(s)\frac{ds}{s}; \quad (28)$$

$$W(s) = \int_0^1 \frac{x^2(1-x)}{x^2+(1-x)s/m_\mu^2}\, dx, \quad (29)$$

where m_μ is the muon mass, and $R(s)$ is the ratio

$$R(s) = \frac{\sigma(e^+e^- \to K\bar{K})}{\sigma(e^+e^- \to \mu^+\mu^-)} = \frac{(1-\frac{4m_K^2}{s})^{3/2}}{4(1+2\frac{m_\mu^2}{s})(1-\frac{4m_\mu^2}{s})^{1/2}} |F_K(s)|^2 . \quad (30)$$

Therefore this contribution is directly expressed through $F_{K^+}(s)$ and $F_{K^0}(s)$. The values calculated in our model are presented In Table 4.

Table 4*. Contribution of* $K\bar{K}$ *– channels to anomalous magnetic moment of the muon in units 10* $^{-10}$

	K^+K^-	$K^0\bar{K}^0$	total $K\bar{K}$
$a_\mu^{had,KK}$	19.06±0.57	15.64±0.44	34.01±1.01

The total hadronic contribution is [13]

$$a_\mu^{had,LO} = (696.3 \pm 6.2_{exp} \pm 3.6_{rad}) \times 10^{-10}. \quad (31)$$

It is seen that the $K\bar{K}$ channels contribute about 5% of the total hadronic contribution.

7. RESULTS OF FORM FACTOR CALCULATION

The FF's calculated from (17) and (27) in the time-like region of virtual photon momentum are shown in Figs. 4 and 5.

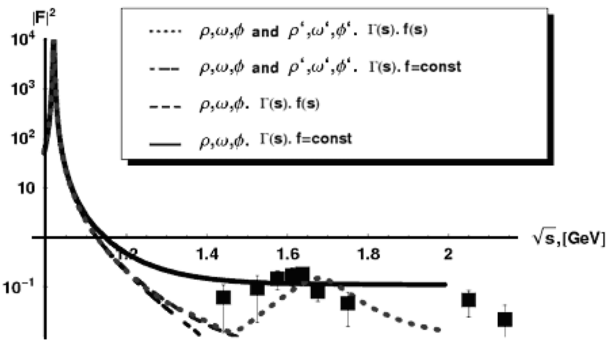

Fig. 4. *Neutral kaon EM form factor in the time-like region. Data (boxes) from [3]*

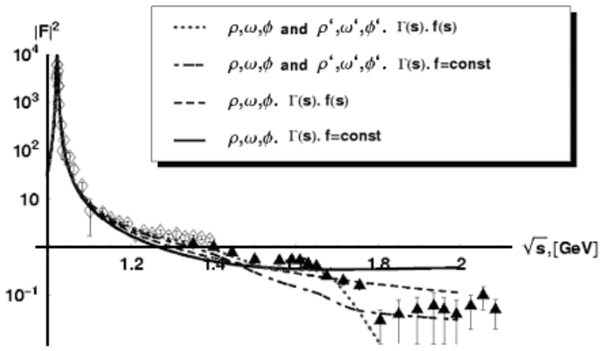

Fig. 5. Charged kaon EM form factor in the time-like region. Data: diamonds [21], triangles[4]

In order to study influence of different ingredients of the model presented in Section 2, where motivations were discussed, these plots show several curves, which can be compared to experimental data.

The solid curves (see legends in the plots) represent a simple VMD-like model in which only ρ, ω and ϕ resonances are included. The meson widths are taken s-dependent while the couplings of vector mesons to photon are independent of momentum. As known, such a model can describe experiment only in vicinity of the $\phi(1020)$ resonance.

The long-dashed curves include in addition the momentum-dependent EM couplings (see Section 5.2).

Taking into consideration ρ', ω' and φ' resonances with momentum-dependent widths (Section 5.1), and constant couplings f_V, we obtain the dot-dashed curves in figures for FF's.

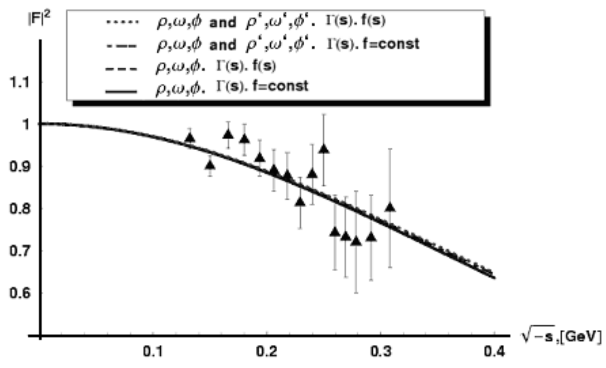

Fig. 6. Charged kaon EM form factor in the space-like region. Data are from [5]

The short-dashed curves represent main result of the study. These curves include momentum-dependent widths for all intermediate states, as in (19)-(21), "dressed" EM vertices (for the lower vector-meson resonances, eq. (23)) and cut-off FF's [18] in the self-energies and EM vertices. We have not attempted to develop the EM vertex "dressing" for the higher resonances because of the present experimental uncertainties in their decay rates, though our approach does account for ρ', ω' and φ' contributions (as shown in (27)).

We note that the authors of [22] also obtained a good description of the data by fixing the values of the parameters f_V from the fit. In our procedure of "dressing" the couplings, a reasonable agreement is achieved without need for fitting the parameters.

Finally the plot in Fig. 6 shows the charged kaon FF in the space-like region of photon momenta. This figure demonstrates agreement with available data [5], and a weak sensitivity of the FF to the model ingredients.

8. CONCLUSIONS

A model for electromagnetic form factors of the K – mesons in the time-like ($s \geq 4m_K^2$) and space-like ($s < 0$) regions of the photon momentum is developed.

Agreement with experiments on $e^+e^- \to K\overline{K}$ annihilation at $\sqrt{s} = 1 - 1.75$ GeV is obtained without fitting parameters.

Deviations from the data which appear at $\sqrt{s} > 2$ GeV are probably related to higher resonances $\rho(1700)$ and $\omega(1650)$.

Form factor agrees with the data in the space-like region at small momentum transfer $-q^2 < 0.16\,\mathrm{GeV}^2$. Results from Jefferson Lab at large momentum transfer, which are coming soon [6], may help to discriminate between variants of the model.

Contribution of $K\overline{K}$ – channel to the anomalous magnetic moment of the muon is calculated to be

$$a_\mu^{had,K^+K^-} + a_\mu^{had,K^0\overline{K}^0} = (34.01 \pm 1.01) \times 10^{-10} \qquad (32)$$

and corresponds to about 5% of the total hadronic contribution.

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ЭЛЕКТРОН-ПОЗИТРОННАЯ АННИГИЛЯЦИЯ В КАОННУЮ ПАРУ В РАСШИРЕННОЙ МОДЕЛИ ДОМИНАНТНОСТИ ВЕКТОРНЫХ МЕЗОНОВ

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Предложена модель для описания электромагнитных форм-факторов заряженного и нейтрального K-мезонов в области $\sqrt{s} \sim$ 1-2 ГэВ. Наш подход основывается на расширеной модели доминантности векторных мезонов. Он учитывает зависимость фотон-мезонных вершин от инвариантной энергии и включает собственно-энергетический вклад в пропагатор векторных мезонов. Вершины взаимодействий выведены из лагранжиана киральной теории возмущений (КТВ), включающего векторные мезоны. Вычисленные на основе лагранжиана КТВ форм-факторы находятся в хорошем соответствии с экспериментальными данными для пространственно-подобных и времениподобных импульсов фотона. Также нами был рассчитан вклад K^+K^-– и $K^0\bar{K}^0$–каналов в аномальный магнитный момент мюона.

ЕЛЕКТРОН-ПОЗИТРОННА АНІГІЛЯЦІЯ У КАОННУ ПАРУ В РОЗШИРЕНІЙ МОДЕЛІ ДОМІНАНТНОСТІ ВЕКТОРНИХ МЕЗОНІВ

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Запропоновано модель для опису електромагнітних форм-факторів зарядженого та нейтрального K-мезонів в області $\sqrt{s} \sim$ 1-2 ГеВ. Наш підхід базується на розширеній моделі домінантності векторних мезонів. Він враховує енергетичну залежність фотон-мезонних вершин та включає власно-енергетичний внесок до пропагаторів векторних мезонів. Вершини взаємодій отримані з лагранжиана кіральної теорії збурень (КТЗ) з векторними мезонами. Розраховані з лагранжиану КТЗ форм-фактори знаходяться у добрій відповідності до експериментальних даних для просторовоподібних та часоподібних імпульсів фотона. Також нами був розрахований внесок K^+K^-– і $K^0\bar{K}^0$–каналів до аномального магнітного моменту мюона.