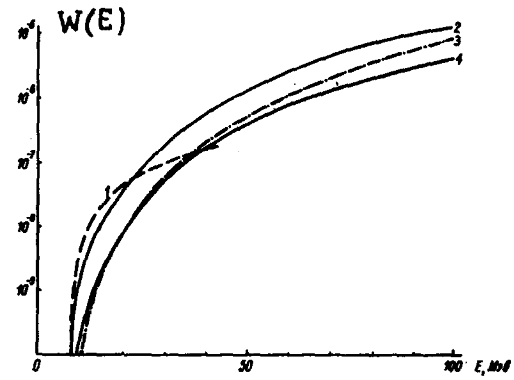
$$-\gamma\left(-\frac{3}{4}, \frac{3,5\,\beta^{4/3}}{E^2}\right)] \qquad (5)$$

$\gamma(q, x)$ is the incomplete γ function, and

$$\beta = \frac{Z_1 Z_2}{12,65} A_1^{1/2}\left(1 + \frac{A_1}{A_2}\right)\Delta E.$$

Probability of excitation of Mossbauer levels of the ions F^{19} and Fe^{57} decelerated in different media: 1 - F^{19} + Fe^{57}, 2 - Fe^{57} + Fe, 3 - Fe^{57} + Pb, 4 - Fe^{57} + Be.



The figure shows the excitation probability, calculated with the aid of formulas (4) and (5), of the 14.4-keV $(3/2)^-$ level of Fe^{57} and the 110-kev $(1/2)^-$ level of F^{19} when the Fe^{57} and F^{19} ions are decelerated in different media. For Fe^{57} we took into account both the direct $(1/2)^- \to (3/2)^-$ E2 transition (B(E2, $(1/2)^- \to (3/2)^-$ = 0.001 [3]) and excitation via the 136-keV $(5/2)^-$ level (B(E2, $(1/2)^- \to (5/2)^-$ = 0.05 [1]) followed by a γ(E2) transition to the $(3/2)^-$ level, $\eta_{(5/2)^-,(3/2)^-} = 0.91$ [3]. The main contribution to the excitation cross section of the 110-keV level of F^{19} is made by the direct E1 transition, for which B(E1, $(1/2)^+ \to (1/2)^-$ = 6×10^{-6} [4].

The results of the calculations show that the choice of the target introduces no appreciable changes in the character of the $W_f(E)$ dependence.

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CHARGE ASYMMETRY IN K^0_{e3} DECAYS AND PARAMETERS OF THE K^0-$\bar{K}^0$ SYSTEM

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1. The charge asymmetry was recently measured in K^0_{e3} (1) and $K^0_{\mu 3}$ (2) decays with greatly differing values of the asymmetry parameters $\alpha_e = (\Gamma_{e^+} - \Gamma_{e^-})/(\Gamma_{e^+} + \Gamma_{e^-})$:

$$\alpha_e = (2.24 \pm 0.36) \times 10^{-3}, \tag{1}$$

$$\alpha_\mu = (4.05 \pm 1.35) \times 10^{-3}. \tag{2}$$

We shall show here that the result (1) does not agree with the experimental values of the other parameters of the K^0-$\bar{K}^0$ system and that the result (2) does not contradict them.*

2. Let us write out the Wu-Yang relations for the parameters of the K^0-$\bar{K}^0$ system [3]:

$$\eta_{+-} = \epsilon + r\, e^{i(\pi/2+\Delta)}, \tag{3}$$

$$\eta_{oo} = \epsilon - 2r\, e^{i(\pi/2+\Delta)}, \tag{4}$$

where, with some deviations from the customary notation,

$$r = \frac{1}{\sqrt{2}} \mathrm{Im} \frac{<2|T|K^o>}{<0|T|K^o>}, \tag{5}$$

$\Delta = \delta_2 - \delta_0$. The unitarity relation and the assumption of the smallness of the CP-violating amplitudes in the K^0_{e3} and $K^0_{3\pi}$ decays yields [3]

$$\mathrm{Im}\, \epsilon/\mathrm{Re}\, \epsilon = 2\Delta m/\Gamma_S, \quad \Delta m = m_L - m_S. \tag{6}$$

In addition, from the rule $\Delta Q = \Delta S$ it follows that [1]

$$2\mathrm{Re}\, \epsilon = \alpha. \tag{7}$$

We shall henceforth use, besides (1) and (2), also the following experimental information:

$$\Delta m = (0{,}48 \pm 0{,}02)\, \Gamma_S\ [4],\ |\eta_{+-}| = (1{,}96 \pm 0{,}09)\, 10^{-3},\ |\eta_{00} = (4{,}4 + \pm 0{,}3)\, 10^{-3}\ [2] \tag{8}$$

and the summary angle intervals for the phases $\hat{\eta}_{+-}$ and Δ, as obtained from a number of experiments performed during the last one and half or two years, are

$$-15° \leq \hat{\eta}_{+-} \leq 101° \quad [5], \quad -\pi/2 \leq \Delta \leq 0 \quad [6]. \tag{9}$$

The relations (3) - (7) together with the experimental data (1) (or (2)) and (8) suffice for the determination of all the remaining parameters of the K^0-$\bar{K}^0$ complex, particularly $\hat{\eta}_{+-}$ and Δ. It is obviously reasonable to take as the criterion for the suitability of the solution the agreement of these quantities with the conditions (9). The lack of such an agreement upon checking with the results of (8) and (9) would be evidence against the use of the asymmetry parameter α in the solution of the system (3) and (4).

3. Let us find the limiting values of r and $|\epsilon|$. For r they can be gotten from the relation

$$\sin(\hat{\eta}_{+-} - \Delta) = \frac{9r^2 + |\eta_{+-}|^2 - |\eta_{00}|^2}{6r|\eta_{+-}|} \tag{10}$$

and the conditions (9) for the phases $\hat{\eta}_{+-}$ and Δ:

$$(1.15 \pm 0.1) \times 10^{-3} \leq r \leq (2.1 \pm 0.15) \times 10^{-3} \tag{11}$$

for $r > 0$ and

$$(-1.5 \pm 0.1) \times 10^{-3} \leq r \leq (-0.8 \pm 0.15) \times 10^{-3} \tag{12}$$

for $r < 0$. The condition (9) for Δ is compatible only with $r < 0$, as can be readily seen from the relation

$$r \sin(\hat{\epsilon} - \Delta) = \frac{4|\eta_{+-}|^2 - |\eta_{00}|^2 - 3|\epsilon|^2}{12|\epsilon|} < 0 \tag{13}$$

with allowance for the fact that the asymmetry is positive, $\alpha > 0$. The corresponding interval for $|\epsilon|$ can now be determined from the ratio of the moduli

$$6r^2 + 3|\epsilon|^2 = 2|\eta_{+-}|^2 + |\eta_{00}|^2. \tag{14}$$

This interval is

$$(2.5 \pm 0.25) \times 10^{-3} \leq |\epsilon| \leq (2.8 \pm 0.15) \times 10^{-3}. \tag{15}$$

On the other hand, the values of $|\epsilon|$ which follow from (1) and (2) when (6) is used are:

$$|\epsilon|_e = (1.55 \pm 0.25) \times 10^{-3}, \quad |\epsilon|_\mu = (2.8 \pm 0.95) \times 10^{-3}. \tag{15'}$$

It is easy to see that $|\epsilon|_e$ lies outside the interval of the permissible values of (15), and the average value of $|\epsilon|_\mu$ lies at its upper limit. Using (11), we can show that $|\epsilon|_e$ from (15') corresponds to $r > 0$ and consequently, according to (13), $\pi + \hat{\epsilon} > \Delta > \hat{\epsilon}$. Thus, regardless of the fixed value of the phase $\hat{\eta}_{+-}$ in the interval (9), the result (1) does not agree with the experimental deductions concerning the $\pi\pi$ scattering phase difference. We note that when the sign of Δm is reversed all the phases, including Δ, reverse sign and the agreement is restored. This possibility was discussed in [1]. However, agreement can be obtained also by increasing** the absolute value of Δm to $0.7\,\Gamma_S$ and higher. When $\Delta m \cong 0.8\,\Gamma_S$, the mean value of one of the solutions for Δ approaches the interval (9) from below. The best agreement with the results of recent measurements of the phases δ_0 and δ_2 (Walker et al. [6]) and $\hat{\eta}_{+-}$ (Bott-Bodenhausen et al. [5]; see also the paper of Rubbia and Steinberger [5]) occurs when $\Delta m \cong 1.1\,\Gamma_S$. However, if we take into consideration the fact that the experimental values of Δm should fluctuate quite weakly near $\Gamma_S/2$, then the alternative indicated here can likewise not be considered seriously in this case.

The result (2) yields for the parameters of the K^0-$\bar{K}^0$ system a solution that agrees with the conditions (9). The large error in (2) makes it impossible, unfortunately, to calculate the values of $\hat{\eta}_{+-}$ and Δ with any greater accuracy than indicated in the conditions (9). We point out here that the mean values of the phase shifts are connected by the relation***

$$\hat{\epsilon} = \frac{\bar{\Delta}}{2} + \Delta = \hat{\eta}_{+-} = \hat{\eta}_{00}. \tag{16}$$

4. It is of interest, finally, to predict the value of the asymmetry parameter by fixing one of the phases $\hat{\eta}_{+-}$ or Δ in accordance with the latest measurement results. We shall fix**** $\Delta = -55° \pm 15°$ [5]. The corresponding solution is:

$$\begin{aligned} a &= (4{,}0 \pm 0{,}25)\cdot 10^{-3},\ |\epsilon| = (2{,}75 \pm 0{,}15)\cdot 10^{-3}, \\ r &= (-0{,}85 \pm 0{,}2)\cdot 10^{-3},\ \hat{\eta}_{+-} = 48 \pm 8°,\ \hat{\eta}_{00} = 41 \pm 7°. \end{aligned} \tag{17}$$

It is easy to see that $\hat{\eta}_{+-}$ from (17) satisfies the condition (9), and the asymmetry parameter α agrees well with the result of Dorfan et al. [2]. Further conclusions concerning the suitability of the solution (17) can be drawn only after the values of α, $\hat{\eta}_{+-}$, and Δ are determined more accurately, and particularly after the phase $\hat{\eta}_{00}$ is measured more accurately. This solution corresponds to a strong violation of CP invariance in the $K^0 \to \bar{K}^0$ transitions off the mass shell.

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* This fact was pointed out in [1]. We shall show that it holds also in the more general case, namely regardless of the value of the phase shift $\hat{\eta}_{+-}$ of the quantity η_{+-}.

** This is accompanied by an increase of the modulus of $|\epsilon|$, and solutions with $r < 0$ and $-\pi + \hat{\epsilon} < \Delta < \hat{\epsilon}$ come also into play starting with $\Delta m \gtrsim 0.55\ \Gamma_S$.

*** It is of interest to note that similar relations between the phases are predicted by the Truong pole model, which was recently discussed by Glashow [7].

**** The opposite alternative was considered by Cronin [8]. His predictions differ from ours.