[1] A. Donnachie and G. Shaw, Phys. Rev. D 5, 1117 (1972). This paper is referred to as I in the text, and the notation follows this reference throughout.

[2] For a discussion of earlier work on these topics and references, we refer to I.

[3] T. Fujii *et al.*, Phys. Rev. Lett. 28, 1672 (1972). We would like to thank Professor T. Fujii for providing us with the numerical details of the experimental results.

[4] G. Von Holtey *et al.*, Phys. Lett. 40B, 589 (1972).

[5] Pavia-Frascati-Roma-Napoli (PFRN) collaboration, Frascati Report No. LNF-71-44 (unpublished).

[6] Aachen-Berlin-Bonn-Hamburg-Heidelberg-München (ABBHHM) Collaboration. See A. Donnachie, in *Proceedings of the 1971 International Symposium on Electron and Photon Interactions at High Energies*, edited by N. B. Mistry (Laboratory of Nuclear Studies, Cornell University, Ithaca, N. Y., 1972).

[7] There is need for some reservation still in that the present experiments use bremsstrahlung rather than tagged photon beams. This is of course a more serious disadvantage when working with deuterium rather than hydrogen.

[8] T. Fujii *et al.*, Phys. Rev. Lett. 26, 1672 (1971).

[9] A. I. Sanda and G. Shaw, Phys. Rev. Lett. 24, 1310 (1970); Phys. Rev. D 3, 243 (1970).

[10] For a detailed discussion of the dip test see G. Shaw, in Proceedings of the Informal Meeting on Electromagnetic Interactions, Frascati, 1972.

[11] The same value of t is obtained if the E_{0+} waves are fixed at their theoretical values, as is done in most of the fits (to less precise data) in I. However, the quality of the fits to the π^-/π^+ ratio is not so satisfactory.

[12] D. Schinzel (private communication). This supersedes the earlier published result of the same group [J. Favier *et al.*, Phys. Lett. 1, 60 (1970)].

[13] P. A. Berardo *et al.*, Phys. Rev. Lett. 26, 201 (1971).

[14] Cf. Ref. 3 for an illustration of this. The capture data are again from Berardo *et al.* (Ref. 13).

[15] S. Barshay, Phys. Rev. Lett. 17, 49 (1966).

[16] B. L. Schrock *et al.*, Phys. Rev. Lett. 26, 1659 (1971).

[17] One should bear in mind that the data for π^+ photoproduction and for the π^-/π^+ ratio, on which these predictions for the π^- reaction are based, have typical errors of 7% (π^+) and 3% (π^-/π^+), respectively.

[18] The other previously outstanding anomaly—that in the η-decay asymmetry parameter—has been removed by the recent data of J. G. Layter *et al.* [Phys. Rev. Lett. 29, 316 (1972)].

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Possible SU(3) Classification of E Meson*

Richard H. Capps

Physics Department, Purdue University, West Lafayette, Indiana 47906

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We point out that the 1420-MeV E meson cannot be a pure SU(3) singlet. We discuss the possibility, suggested earlier, that the E is a tenth member of the pseudoscalar-meson multiplet of the pion. The $(K\bar{K}^* + \bar{K}K^*)$ decay partial width, calculated from an extension of Odorico's bootstrap condition for pseudoscalar mesons, is consistent with experiment.

The 1420-MeV E meson is observed to be of j^P (spin-parity) either 0^- or 1^+ and of zero isospin and positive G parity.[1] The observation of the $(K\bar{K}^* + \bar{K}K^*)$ decay mode shows that the E cannot be a pure SU(3) singlet. This follows because the singlet classification would require the existence of a $\pi\rho$ mode, a mode forbidden by G-parity conservation.

In this note, we assume that future experiments will show the E to be a P (pseudoscalar) meson. We discuss a recent suggestion that the E is a tenth member of the lightest P multiplet, a multiplet corresponding to the SU(3) representation $\underline{8} \oplus \underline{1} \oplus \underline{1}$.[2] At the end of the note, the possibility that $j^P = 1^+$ is considered briefly.

We now assume that the E is a P meson and that its nonsinglet part is associated with an octet. In the mass region 1300–1600 MeV/c^2, the E is the only nonstrange meson listed in the meson table of Ref. 1 that could possibly be associated with a P octet whose $I_z = Y = 0$ members are of even C parity. Thus, the E must be significantly heavier or lighter than the other nonstrange members of the octet or nonet. The second possibility is unlikely, since isosinglet members of other known meson octets or nonets are of mass less than the average multiplet mass only when they decay strongly into two-pion or three-pion states. Therefore, the most likely assignment for a pseudoscalar E is as a tenth member of the $\pi K \eta X$ multiplet.

This assignment has been suggested previously by the author.[2] It was shown in Ref. 2 that there are two solutions to Odorico's linear-zero-bootstrap conditions for PP scattering.[3] Of these, only the solution discussed by Odorico in Ref. 3 is compatible with the measured $\pi\eta/K\bar{K}$ branching ratio of the A_2 meson. It was further shown in Ref. 2 that Odorico's solution is compatible with bootstrap conditions for certain reaction amplitudes involving internal P mesons only if the P representation is $\underline{8}\oplus\underline{1}\oplus\underline{1}$. Two of the isoscalar mesons are predicted to be particular octet-singlet mixtures, while the third must be a pure singlet. It was suggested in Ref. 2 that the E is the pure singlet. However, as pointed out above, this is incompatible with the E-decay data. In this model the $X(958)$ must be the pure singlet, and the η and E the singlet-octet mixtures.[4] We take the η to be the mixture with the larger octet component.

If this assignment is made, the ratio of the $K^*(890)$-$K\pi$ and $K^*(890)$-KE couplings may be computed from the interaction constants of Ref. 2. The phase-space factor for the $K^*\to K\pi$ decay is often taken as p^3/M^2, where p is the decay momentum in the K^* rest system, and M is the K^* mass. If the VPP vertex is of the type $e\cdot(p_1-p_2)$, where e is the V polarization four-vector, and p_1 and p_2 are the four-momenta of the two P mesons, the corresponding phase-space factor for the $E\to K^*\bar{K}$ decay is $p^3/E_{K^*}{}^2$, where E_{K^*} is the decay energy of the K^*, approximately the K^* mass. If these phase-space factors are used, a K^* width of 50 MeV leads to a predicted $(\bar{K}K^*+\bar{K}K^*)$ partial width of the E of ~9 MeV. This compares favorably with the tentative value of ~12 MeV given in Ref. 1.

Finally, we want to point out that if the E is in an axial-vector meson, there remains a problem with the SU(3) classification. The $A_1(1100)$ has the appropriate G parity to belong to the E octet. The $A_1\to\pi\rho$ decay appears experimentally to occur predominantly in the S wave. If one uses a simple phase-space factor of p for the S-wave decays, the ~300-MeV width of the $A_1\to\pi\rho$ decay leads to a predicted $E\to(K\bar{K}^*+\bar{K}K^*)$ partial width of about 200 MeV, if the E is a pure octet particle. This is compatible with the measured value of ~12 MeV only if the octet component of the E is extremely small.

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[1]Particle Data Group, Rev. Mod. Phys. Suppl. 45, S1 (1973).

[2]Richard H. Capps, Phys. Rev. D 7, 3394 (1973).

[3]R. Odorico, Phys. Lett. 38B, 37 (1972).

[4]Some experimental evidence has been cited that favors 2^- over 0^- for the spin-parity of the $X(958)$. See V. I. Ogievetsky, W. Tybor, and A. N. Zaslavsky, Phys. Lett. 35B, 69 (1971); G. R. Kalbfleisch *et al.*, Phys. Rev. Lett. 31, 333 (1973). If this turns out to be the case, the E may be the ninth member of the nonet, and the predictions of Ref. 2 do not apply.

PHYSICAL REVIEW D VOLUME 8, NUMBER 11 1 DECEMBER 1973

Field-Theoretic Calculation of the Direct-Emission Amplitude in $K^\pm\to\pi^\pm\pi^0\gamma$

C. A. Dominguez and A. Zepeda

Departamento de Física, Centro de Investigación y de Estudios Avanzados del Instituto Politecnico Nacional, Apartado Postal 14-740, Mexico 14, D.F.

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We show that to order eg^2G the direct-emission amplitude in the decay $K^\pm\to\pi^\pm\pi^0\gamma$ is logarithmically divergent.

The possible existence of a direct emission in the decay $K^\pm\to\pi^\pm\pi^0\gamma$ (Refs. 1–4) has recently attracted much attention after clear evidence for such a contribution was reported.[1,2] A short time ago Barshay and Hvegholm[5] computed the direct-emission amplitude to order eg^2G,[6] in perturbation theory, in a model in which the two pions rescatter through a ρ meson in the direct channel. In their calculation the divergences of the pion loops cancel out and thus a finite result is obtained. However, the direct-channel contribution is not the only one arising at order eg^2G. In other words, given the interaction-Hamiltonian density considered in Ref. 5, the crossed-channel diagrams of that same order should in principle be considered also.

The purpose of the present paper is to point out that if all diagrams to order eg^2G are included in the calculation the direct-emission amplitude turns out to be logarithmically divergent.

The considered interaction-Hamitonian density