Addendum to "Arguments concerning an SU(3)-scalar term in the electromagnetic current operator and the value for $\Gamma(\rho\to\pi\gamma)$"

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The SU(3)-scalar term in the electromagnetic current is used to predict the value of $\Gamma(K^{*+}\to K^+\gamma)$ from the new value of $\Gamma(\rho\to\pi\gamma)$.

The only basis for the suggestion[1] of the purely magnetic SU(3)-scalar term V_μ^s in the electromagnetic current operator

$$V^{\rm el}=V_\mu^{\pi^0}+\frac{1}{\sqrt{3}}V_\mu^\eta+V_\mu^s \qquad (1)$$

was the value $\Gamma(\rho\to\pi\gamma)=35\pm 10$ keV of one experiment,[2] which was widely believed to be wrong because the resulting value for $\Gamma(\rho\to\pi\gamma)/\Gamma(\omega\to\pi\gamma)$ contradicted the usual SU(3) prediction (quark model without anomalous magnetic moment for the quarks). In the meanwhile this value has been remeasured[3] with the result $\Gamma(\rho\to\pi\gamma)=45\pm 10$ keV.[7] As the predictions for $\Gamma(\rho\to\pi\gamma)/\Gamma(\omega\to\pi\gamma)$ are—independent of the quark model—based upon very general assumptions,[4] the confirmation of this value will most probably mean that the Gell-Mann–Nishijima formula for the electromagnetic current is insufficient. Equation (1) is the simplest amendment of the Gell-Mann–Nishijima formula that explains the experimental value of $\Gamma(\rho\to\pi\gamma)$; it is not in contradiction to the experimental value $\Gamma(\eta'\to\rho\gamma)/\Gamma(\eta'\to\omega\gamma)=9.9\pm 0.2$,[5] but does not yet lead to a good fit of the hyperon magnetic moments.[6] The prediction that (independent of any symmetry-breaking assumption) follows from (1) and the value

$$\Gamma(\rho\to\pi\gamma)/\Gamma(\omega\to\pi\gamma)=\left|\frac{S}{d}\right|^2=\frac{45\pm 10}{870\pm 60}$$

is

$$\Gamma(K^{+*}\to K^+\gamma)/\Gamma(K^{0*}\to K^0\gamma)=|S/(d+S)|^2\,.$$

Using the experimental value $\Gamma(K^{0*}\to K^0\gamma)=75\pm 35$ keV one obtains

$$\Gamma(K^{+*}\to K^+\gamma)=\begin{cases}6.5\pm 3.6\text{ keV for sign}d=-\text{sign}S\,,\\ 2.6\pm 1.3\text{ keV for sign}d=+\text{sign}S\,.\end{cases}$$

In this prediction only deviations from ideal mixing and/or the Okubo-Zweig-Iizuka rule as well as the mass differences between ρ and ω, K^+ and K^0, and K^{+*} and K^{0*} have been ignored. An experimental value for $\Gamma(K^{+*}\to K^+\gamma)$ substantially larger than 10 keV would therefore show that the SU(3)-scalar term in (1) is also not sufficient. Preliminary results[7] indicate that the experimental decay rate for $K^{+*}\to K^+\gamma$ is smaller than previously expected.

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[1]A. Bohm and R. B. Teese, Phys. Rev. D 18, 330 (1978); Phys. Rev. Lett. 38, 629 (1977).
[2]B. Gobbi, J. L. Rosen, H. A. Schött, S. L. Shapiro, L. Strawczynski, and C. M. Meltzer, Phys. Rev. Lett. 33, 1450 (1974).
[3]D. Berg *et al.*, University of Rochester Report No. UR-677, presented at XIX International Conference on High Energy Physics, Tokyo, 1978 (unpublished).
[4](a)A. Bohm, Phys. Rev. D 17, 3127 (1978); (b) A. Bohm, M. Hossain and R. B. Teese, *ibid.* D 18, 248 (1978); (c) A. Bohm, R. B. Teese, University of Texas Report No. ORO 317 (unpublished); abridged version in Phys. Rev. D 18, 4178 (1978).
[5]Reference 4(c), Sec. III gives a detailed discussion of this point.
[6]The hyperon-magnetic-moment predictions are, however, dependent upon the assumption for "symmetry breaking" [A. Bohm, Phys. Rev. D 18, 2547, (1978)].
[7]F. Lobkowicz (private communication).

