Letter to the Editor

REMARK ABOUT THE EXPERIMENTAL STATUS OF BRANCHING RATIOS OF SOME SELECTED DALITZ DECAYS

ЗАМЕТКА К СОСТОЯНИЮ ЭКСПЕРИМЕНТА ПО ОПРЕДЕЛЕНИЮ ОТНОШЕНИЯ ВЕТВЛЕНИЯ НЕКОТОРЫХ ВЫБРАНЫХ РАСПАДОВ ДАЛИЦА

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The question of directly produced low mass lepton pairs is from the experimental point of view still open. The most important contribution to the background comes from the Dalitz decays of pseudo scalar ($P \to V1^+1^-$) or vector ($V \to P1^+1^-$) resonances. The branching ratios for these decays are known with a not sufficient accuracy. The purpose of this note is to demonstrate that one can combine experimental information to obtain the branching ratios of the considered decays with a significantly better accuracy.

Decays of type $P \to V1^+1^-$ ($V \to P1^+1+-$) are related to decays $P \to V\gamma$ ($V \to P\gamma$) by the equation (see e.g. [1])

$$\frac{BR(A \to B1^+1^-)}{BR(A \to B\gamma)} = \frac{2\alpha}{3\pi} \int \frac{d\mu}{\mu} \left[\frac{Q}{Q_o}\right]^3 |F_{AB\gamma}|^2 \left[1 - \frac{4m_1^2}{\mu^2}\right]^{1/2} \left[1 + \frac{2m_1^2}{\mu^2}\right],$$

where α is electromagnetic fine structure constant, Q momentum of 1^+1^- pair in the rest frame of particle A, Q_o momentum of real γ in the rest frame of particle A, μ effective mass of 1^+1^- pair, m_1 mass of lepton (electron or muon), $F_{AB\gamma}$ transition form factor (in the case $B \equiv \gamma$ the above formula should be multiplied by a factor 2).

Because the branching ratio $BR(A \to B\gamma)$ is usually known with a much better experimental accuracy than $BR(A \to B1^+1^-)$ one can use the above relation to improve the accuracy of $BR(A \to B1^+1^-)$. One needs also the dependence of transition form factors as a function of μ^2. There are measurements of the $F_{\eta\gamma\gamma}, F_{\omega\pi\gamma}, F_{\eta\gamma\gamma}$ transition form factors [1]. The following parametrization has been used for $F_{\eta\gamma\gamma}$ and $F_{\omega\pi\gamma}$

$$|F_{AB\gamma}|^2 = \left[1 - \frac{\mu^2}{\Lambda^2_{AB\gamma}}\right]^{-2}.$$

Fit to experimental data gives $\Lambda_{\eta\gamma\gamma} = (0.72 \pm 0.09)$ GeV and $\Lambda_{\omega\pi\gamma} = (0.65 \pm 0.03)$ GeV. The transition form factor for $F_{\eta,\gamma\gamma}$ was found in good agreement with the vector dominance model [1, 2].

In the following table are compared the corresponding branching ratios – direct measurements and those via the above formula. Experimental errors of input branching ratios and of transition form factors have been taken into account in an estimated standard deviation.

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Table 1
Comparison of direct measurements of branching ratios of selected Dalitz decays with e^+e^- in final state and the same branching ratios obtained by the procedure explained in text.

$A \to Be^+e^-$	$BR_{A\to B\gamma}$	$BR_{A\to Bee}$ (exp)	$BR_{A\to Bee}$ (Theor)
$\pi^0 \to \gamma ee$	$0.98798 \mp .00032$	0.01198	0.01178 ∓ 4.10^{-6}
$\eta \to \gamma ee$ *	$0.389 \mp .005$	$(5 \pm 1.2)10^{-3}$	$(6.545 \mp .084)10^{-3}$
$\rho^0 \to \pi^0 ee$	$(7.9 \mp 2)10^{-4}$		$(6.8 \mp 1.7)10^{-6}$
$\rho^0 \to \eta ee$	$(3.8 \mp .7)10^{-4}$		$(2.7 \mp .5)10^{-6}$
$\rho^\pm \to \pi^\pm ee$	$(4.5 \mp .5)10^{-4}$		$(3.85 \mp .4)10^{-6}$
$\omega \to \pi^0 ee$ *	0.085 ∓ 0.005	$(5.9 \pm 1.9)10^{-4}$	$(8.26 \mp .5)10^{-4}$
$\eta' \to \rho ee$	0.3 ∓ 0.015		$(2.08 \mp 0.1)10^{-3}$
$\eta' \to \omega ee$	0.03 ∓ 0.003		$(2.04 \mp .2)10-4$
$\eta' \to \gamma ee$ *	0.0216 ∓ 0.0016		$(3.89 \mp .29)10^{-4}$
$\phi \to \eta ee$	0.0128 ∓ 0.0006	$(1.3\pm^{.8}_{.6})10^{-4}$	$(1.06 \mp .05)10^{-4}$
$\phi \to \pi^0 ee$	$0.00131 \mp .00013$		$(1.18 \mp .12)10^{-5}$

Table 2
The same as in Table 1 for the $\mu^+\mu^-$ final state.

$A \to B\mu^+\mu^-$	$BR_{A\to B\gamma}$	$BR_{A\to B\mu\mu}$ (exp)	$BR_{A\to B\mu\mu}$ (Theor)
$\eta \to \gamma\mu\mu$ *	0.389	$(3.1 \pm .4)10^{-4}$	$(3.22 \mp .04)10^{-4}$
$\omega \to \Pi^0\mu\mu$ *	0.085	$(.96 \pm .23)10^{-4}$	$(1.24 \mp 0.07)10^{-4}$
$\eta' \to \gamma\mu\mu$ *	0.0216	$(1.1 \pm 0.3)10^{-4}$	$(6.8 \mp .5)10^{-5}$
$\phi \to \eta\mu\mu$	0.0128		$(4.3 \mp 0.2)10^{-6}$
$\phi \to \Pi^0\mu\mu$	0.00131		$(1.17 \mp .12)10^{-6}$

I should strees that only in raw's marked by * the functional dependence of transition form factors has been taken into account. Other cases (where the transition form factor is set to constant) should be considered only as resonable estimates for the purpose of, e.g., the calculation of the backround to low mass direct lepton pairs.

One can see that by the above way one obtains branching ratios for $\eta \to \gamma 1^+1^-$, $\omega \to \pi^0 1^+1^-$, $\eta \to \gamma 1^+1^-$ with a much better accuracy than that known from direct measurements.

REFERENCES

[1] Landsberg, L. G.: Phys. Rep. *128* (1985), 301.

[2] Craigie, N. S.: Phys. Rep. *47* (1978), 1.

[3] Review of particle properties Phys. Lett. *239* (1990), 1.

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