Comments and Addenda

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Branching Ratio for the Decay of ϕ Mesons into Lepton Pairs*

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Values of the branching ratio for the decay of ϕ mesons into lepton pairs obtained from colliding-beam experiments are compared with values obtained from photoproduction experiments.

In a recent paper[1] we reported a measurement of the yield of ϕ mesons photoproduced from carbon and decaying into muon pairs. We found that the product of the extrapolated $t=0$ ϕ photoproduction cross section and the muon pair branching ratio $B_{\phi\mu\mu}$ of the ϕ is $C_\phi = (0.66 \pm 0.10) \times 10^{-4}$ mb/GeV^2. We also reported that, assuming muon-electron universality, this result was in substantial disagreement with preliminary reports[2] of measurements of the ϕ photoproduction cross section and the electron-pair branching ratio, $B_{\phi ee}$. Subsequently, new values for both the ϕ cross section[3] and $B_{\phi ee}$[4,5] have been reported. The product of these values is in much better agreement with our measurement.

We have used the recent determination[3] of the ϕ photoproduction cross section for carbon and our previously measured yield[1] of muon pairs to obtain a value for the muon-pair branching ratio[6] of $B_{\phi\mu\mu} = (2.69 \pm 0.46) \times 10^{-4}$. This value of $B_{\phi\mu\mu}$ is in fair agreement with the values of $B_{\phi ee}$ obtained in colliding-beam experiments[4,5]: $B_{\phi ee} = (2.81 \pm 0.25) \times 10^{-4}$ and $B_{\phi ee} = (3.45 \pm 0.27) \times 10^{-4}$. An independent determination[7] of $B_{\phi\mu\mu}$ has been reported for a muon photoproduction experiment similar to ours. If this experiment were reanalyzed using the ϕ cross section of Ref. 3, we believe the resulting value of $B_{\phi\mu\mu}$ would agree well with ours. In conclusion, present determinations of $B_{\phi\mu\mu}$ from photoproduction experiments are consistent with determinations of $B_{\phi ee}$ from colliding-beam experiments, as required by electron-muon universality.

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[1] S. Hayes *et al.*, Phys. Rev. Letters 25, 393 (1970).

[2] See Ref. 1 for references to these reports.

[3] G. McClellan *et al.*, Phys. Rev. Letters 26, 1593 (1971); G. McClellan *et al.*, Cornell University Laboratory of Nuclear Studies Report No. CLNS-140, 1971 (unpublished). These authors obtain a ϕ photoproduction cross section for carbon of $d\sigma/dt = 189e^{52t_p} + 19.5(1 - e^{26t}) \times e^{4.68t_p}$ μb/GeV^2, where t is the square of the four-momentum transfer to the nucleus and $t_p = t - (M_\phi^2/2k)^2$.

[4] V. E. Balakin *et al.*, Phys. Letters 34B, 328 (1971).

[5] J. C. Bizot *et al.*, Phys. Letters 32B, 416 (1970).

[6] As in Ref. 1, we use only the data for which $|t| < 0.04$ GeV^2. For this range of t our determination of $B_{\phi\mu\mu}$ is not very sensitive to the assumed t dependence of the ϕ cross section. For example, if we take the $\theta = 0$ cross section from Ref. 3 but the t dependence of the cross section from Ref. 1, our value of $B_{\phi\mu\mu}$ changes by less than 5%.

[7] D. R. Earles *et al.*, Phys. Rev. Letters 25, 1312 (1970). These authors report $B_\phi = (2.17 \pm 0.60) \times 10^{-4}$, but they assume that the cross section is ~30% larger than that found in Ref. 3.