

75. The $\rho(770)$

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The determination of the parameters of the $\rho(770)$ is beset with many difficulties because of its large width. In physical region fits, the line shape does not correspond to a relativistic Breit-Wigner function with a P -wave width, but requires some additional shape parameter. This dependence on parameterization was demonstrated long ago [1]. Bose-Einstein correlations are another source of shifts in the $\rho(770)$ line shape, particularly in multiparticle final state systems [2].

The same model-dependence afflicts any other source of resonance parameters, such as the energy-dependence of the phase shift δ_1^1 , or the pole position. It is, therefore, not surprising that a study of $\rho(770)$ dominance in the decays of the η and η' reveals the need for specific dynamical effects, in addition to the $\rho(770)$ pole [3,4].

The cleanest determination of the $\rho(770)$ mass and width comes from e^+e^- annihilation and τ -lepton decays. Analysis of ALEPH [5] showed that the charged $\rho(770)$ parameters measured from τ -lepton decays are consistent with those of the neutral one determined from e^+e^- data [6]. This conclusion is qualitatively supported by the later studies of CLEO [7] and Belle [8]. However, model-independent comparison of the two-pion mass spectrum in τ decays, and the $e^+e^- \rightarrow \pi^+\pi^-$ cross section, gave indications of discrepancies between the overall normalization: τ data are about 3% higher than e^+e^- data [7,9]. A detailed analysis using such two-pion mass spectra from τ decays measured by OPAL [10], CLEO [7], and ALEPH [11,12], as well as recent pion form factor measurements in e^+e^- annihilation by CMD-2 [13,14], showed that the discrepancy can be as high as 10% above the ρ meson [15,16]. This discrepancy remains after recent measurements of the two-pion cross section in e^+e^- annihilation at KLOE [17,18] and SND [19,20]. This effect is not accounted for by isospin breaking [21–24], but the accuracy of its calculation may be overestimated [25,26].

This problem seems to be solved after a recent analysis in [27] which showed that after correcting the τ data for the missing $\rho - \gamma$ mixing contribution, besides the other known isospin symmetry violating corrections, the $\pi\pi$ $I=1$ part of the hadronic vacuum polarization contribution to the muon $g - 2$ is fully compatible between τ based and e^+e^- based evaluations including more recent BaBar [28] and KLOE [29] data. Further proof of the consistency of the data on τ decays to two pions and e^+e^- annihilation is given by the global fit of the whole set of the ρ , ω , and ϕ decays, taking into account mixing effects in the hidden local symmetry model [30].

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