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 by PISUT 68. Bose-Einstein correlations are another source of shifts in the $\rho(770)$ line shape, particularly in multiparticle final state systems (LAFFERTY 93).

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 (ABELE 97B, BENAYOUN 03B).

The cleanest determination of the $\rho(770)$ mass and width comes from the e^+e^- annihilation and τ-lepton decays. BARATE 97M 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 of BARKOV 85. This conclusion is qualitatively supported by the high statistics study of ANDERSON 00A. However, model-independent comparison of the two-pion mass spectrum in τ decays, and the $e^+e^- \to \pi^+\pi^-$ cross section, gave indications of discrepancies between the overall normalization: τ data are about 3% higher than e^+e^- data (ANDERSON 00A, EIDELMAN 99). A detailed analysis using such two-pion mass spectra from τ decays measured by OPAL (ACKERSTAFF 99F), CLEO (ANDERSON 00A), and ALEPH (DAVIER 03A, SCHAEL 05C) as well as recent pion form factor measurements in e^+e^- annihilation by CMD-2 (AKHMETSHIN 02, AKHMETSHIN 04), showed that the discrepancy can be as high as 10% above the ρ meson (DAVIER 03, DAVIER 03B). This discrepancy remains after recent measurements of the two-pion cross section in e^+e^- annihilation at KLOE (ALOISIO 05) and SND (ACHASOV 05A, ACHASOV 06). This effect is not accounted for by isospin-breaking (ALEMANY 98, CZYZ 01,

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CIRIGLIANO 01, CIRIGLIANO 02), but the accuracy of its calculation may be overestimated (MALTMAN 06). GHOZZI 04 suggested that this effect can be explained if the charged ρ mass were higher than that of the neutral one by a few MeV. Existing theoretical models of the possible mass difference predict either a much smaller value (BIJNENS 96), or a heavier neutral ρ meson (ACHASOV 99F). Experimental accuracy is not yet sufficient for unambiguous conclusions. The size of the effect is also sensitive to the possible width difference (SANCHEZ 07, FLOREZ-BAEZ 07). Recently BENAYOUN 08 performed a detailed analysis of the whole set of the ρ, ω, and ϕ decays, consistently taking into account mixing effects in the hidden local symmetry model, and claimed that in this approach, τ decays to two pions can be naturally accounted for.