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 retains 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, 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.