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Three-Pion Decays of the tau Lepton, the a_1(1260) Properties, and the a_1-rho-pi Lagrangian

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We show that the a_1-rho-pi Lagrangian is a decisive element for obtaining a good phenomenological description of the three-pion decays of the tau lepton. We choose it in a two-component form with a flexible mixing parameter sin(theta). In addition to the dominant a_1-> rho+pi intermediate states, the a_1-> sigma+pi ones are included. When fitting the three-pion mass spectra, three data sets are explored: (1) ALEPH 2005 pi-pi-pi+ data, (2) ALEPH 2005 pi-pi0pi0 data, and (3) previous two sets combined together and supplemented with the ARGUS 1993, OPAL 1997, and CLEO 2000 data. The corresponding confidence levels are (1) 28.3%, (2) 100%, and (3)7.7%. After the inclusion of the a_1(1640) resonance, the agreement of the model with data greatly improves and the confidence level reaches 100% for each of the three data sets. From the fit to all five experiments [data set (3)] the following parameters of the a_1(1260) are obtained m_{a_1}=(1233+/-18) MeV, Gamma_{a_1}=(431+/-20) MeV. The optimal value of the Lagrangian mixing parameter sin(theta)=0.459+/-0.004 agrees with the value obtained recently from the e+e- annihilation into four pions.

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