THE $f_0(1710)$

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The $f_0(1710)$ is seen in the radiative decay $J/\psi(1S) \to \gamma f_0(1710)$; therefore $C = +1$. It decays into $\eta \eta$ and $K_S^0K_S^0$, which implies $f^GJ^{PC} = 0^+(even)^{++}$. The spin of the $f_0(1710)$ has been controversial, but evidence for spin $0$ has accumulated recently in all production modes.

An analysis of radiative $J/\psi$ decays at BES into $\pi^+\pi^-\pi^+\pi^-$ (BAI 00) clearly favors spin $0$. Combined amplitude analyses of the $K^+K^-$, $K_S^0K_S^0$ and $\pi^+\pi^-$ systems produced in $J/\psi(1S)$ radiative decay by MARK III (CHEN 91 and more recently DUNWOODIE 97) find a large spin-0 component, and at the same time reproduce known parameters of the $f_2(1270)$ and $f_2^*(1525)$. In addition, a recent reanalysis (BUGG 95) of the $4\pi$ channel from MARK III, allowing both $\rho\rho$ and two $\pi\pi$ S-waves, also finds a $0^{++}$ assignment for the $f_0(1710)$. Earlier analyses of this final state (BISELLO 89B, BALTRUSAITIS 86B) found only pseudoscalar activity in the $f_0(1710)$ region, but considered only the process $J/\psi \to \gamma \rho\rho$. Similarly, earlier analyses of the $K^+K^-$ system based on less statistics (BALTRUSAITIS 87, BAI 96) found a spin of $2$ for the $f_0(1710)$.

A similar situation is present in central production, with earlier analyses favoring spin $2$ over spin $0$ (ARMSTRONG 89D). More recent analyses with greater statistics by BARBERIS 99 ($K^+K^-,K_S^0K_S^0$), BARBERIS 99B ($\pi^+\pi^-$), and FRENCH 99 ($K^+K^-$) however clearly indicate spin $0$, and exclude spin $2$. Generally, analyses preferring spin $2$ concentrate on angular distributions in the $f_0(1710)$ region, and do not include possible interferences or distortion due to the nearby $f_2^*(1525)$.

The $f_0(1710)$ is also observed in $K\overline{K}$ (FALVARD 88) in $J/\psi(1S) \to \omega K\overline{K}$ and $J/\psi(1S) \to \phi K\overline{K}$, but with no spin-parity analysis, as well as in $\eta \eta$ in radiative $J/\psi$ decays (EDWARDS 82). It is also clearly seen in 300-GeV/c $pp$ central production in both $K^+K^-$ and $K_S^0K_S^0$ (ARMSTRONG 89D). Mass and width are determined via a fit to non-interfering Breit-Wigners over a polynomial background, which leads to large systematic errors for the width. ARMSTRONG 93C also
sees a broad peak in $\eta\eta$ at 1747 MeV, which may be the $f_0(1710)$.

This resonance is not observed in the hypercharge-exchange reactions $K^-p \rightarrow K^0_S K^0_S \Lambda$ (ASTON 88D) and $K^-p \rightarrow K^0_S K^0_S Y^*$ (BOLONKIN 86); these non-observations are explained by a spin of 0 (LINDENBAUM 92). A possible observation in $\gamma\gamma$ collisions leading to $K^0_S K^0_S$ (BRACCINI 99, but no spin determination), and a non-observation in $\gamma\gamma \rightarrow \pi^+\pi^-$ (BARATE 00E) is consistent with a large $\bar{s}s$ component.