J/Ψ DECAYS, CHIRAL DYNAMICS AND OZI VIOLATION

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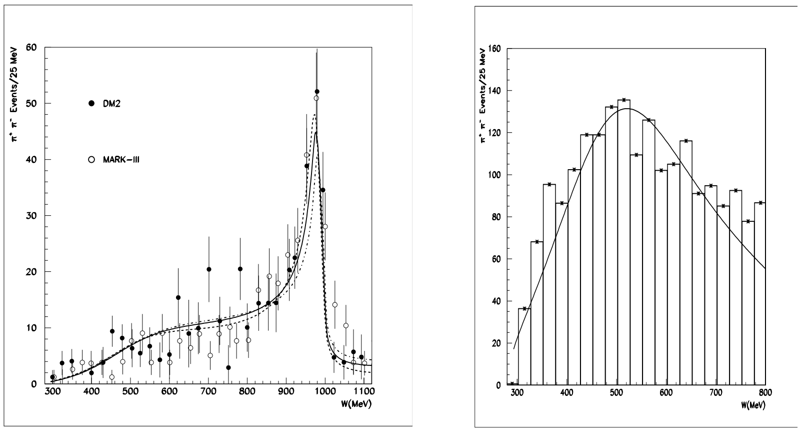
The $J/\Psi \to \phi(\omega)\pi^+\pi^-$, K^+K^- up to energies $\sqrt{s} \lesssim 1.2$ GeV are well reproduced. These decays turn out to be very sensitive to OZI violating physics lending further credit to the statement that the OZI rule is subjected to large corrections in the 0^{++} sector.

The 0^{++} meson sector is a unique one mainly because in it really strong interactions between hadrons take place. This is contrary to what can be expected from large N_c QCD (the only known general explanation of the OZI rule) which predicts that QCD in this limit is a weak coupling theory when formulated in terms of hadronic degree of freedoms. These large corrections to large N_c (OZI rule) give rise to very large rescattering effects between hadrons that dynamically generate meson-meson resonances.[1]

Experimentally, the strong scattering data in the 0^{++} is not precise enough to disentangle the underlying dynamics and has to be supplied with data from meson–meson production mechanisms. In the latter case the strong interactions manifest themselves through Final State Interactions (FSI). This is why we discuss here, following ref.[2], the S-wave contribution to the J/Ψ decays to a vector and two pseudoscalars. By taking into account the experimental fact that the ϕ is a spectator which does not interact appreciably with the pions, one derives[2] the following Lagrangian for the considered J/Ψ decays: $\mathcal{L} = g\Psi_\mu \phi^\mu S$ with $S = \bar{s}s + \bar{n}n$ and $\bar{n}n = (\bar{u}u + \bar{d}d)/\sqrt{2}$.[a] This can be easily generalized to SU(3) without including any new free parameter.[2]

Thus, the problem is reduced[2] to calculate the strange $\langle 0|\bar{s}s|MM'\rangle$ and non–strange $\langle 0|\bar{n}n|MM'\rangle$ scalar form factors. Notice that λ_ϕ is a OZI suppressed constant since in this limit case the $\phi = \bar{s}s$ requiring that $\lambda_\phi = 0$. The calculation of the scalar form factors is done in ref.[2] using a non–perturbative chiral approach to derive the strong scattering amplitudes.[3] In this way unitarity is fulfilled and furthermore the σ and $f_0(980)$ mesons are generated dynamically and appear as meson–meson resonances. A general expression giving the scalar form factors in terms of the next–to–leading CHPT ones

[a] In ref.[2] is also shown that in the energy interval considered here and because of the large J/Ψ mass, more complicated derivative structures can be reduced to the present one.



a) **b)**

Figure 1. a) and b): $\pi^+\pi^-$ event distributions for the $J/\Psi \to \phi(\omega)\pi^+\pi^-$, respectively.

and the previous T-matrix is also derived in ref. [2] Incidentally the $\mathcal{O}(p^4)$ $K\bar{K}$ CHPT scalar form factors are for the first time calculated there. Because of the matching to CHPT our expressions for the decay amplitudes depend on the low energy counterterms L_5, L_8, L_4 and L_6. The values of L_5 and L_8 are taken from their recent determination in ref.[4]. However, L_4 and L_6 are not well known and we fit them, together with λ_ϕ, to several event distributions of $J/\Psi \to \phi\pi\pi$. The $J/\Psi \to \omega\pi\pi$ decay can be considered as a prediction of the model, see fig.1.

The value of λ_ϕ results definitively different from zero as well as the one of L_4, being the latter rather large. These facts clearly indicate large OZI violations. However, L_6 is in agreement with OZI suppression. Let us remark[2] that the value of L_4 and L_6 is in agreement with $\mathcal{O}(p^6)$ $SU(2)$ CHPT determinations.[4]

References

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