Flavour Physics Notes and Proofs

Warwick Week Graduate Lectures

Matthew Kenzie

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Generalised Meson Decay Formalism

Time propagation of states:

$$|X^0(t)\rangle = g_+(t)|X^0\rangle + \frac{q}{p}g_-(t)|\overline{X}^0\rangle \tag{1}$$

$$|\overline{X}^0(t)\rangle = g_+(t)|\overline{X}^0\rangle + \frac{p}{q}g_-(t)|X^0\rangle \tag{2}$$

where

$$g_+(t) = \frac{1}{2}\left(e^{-iM_Ht}e^{-\Gamma_Ht/2} + e^{-iM_Lt}e^{-\Gamma_Lt/2}\right) \tag{3}$$

$$= \frac{1}{2}e^{-iMt}e^{-\Gamma t/2}\left(e^{-i\Delta mt/2}e^{-\Delta\Gamma t/4} + e^{i\Delta mt/2}e^{\Delta\Gamma t/4}\right) \tag{4}$$

$$= e^{-iMt}e^{-\Gamma t/2}\left[\quad \cos\left(\frac{\Delta mt}{2}\right)\cosh\left(\frac{\Delta\Gamma t}{4}\right) - i\sin\left(\frac{\Delta mt}{2}\right)\sinh\left(\frac{\Delta\Gamma t}{4}\right)\right] \tag{5}$$

$$g_-(t) = \frac{1}{2}\left(e^{-iM_Ht}e^{-\Gamma_Ht/2} - e^{-iM_Lt}e^{-\Gamma_Lt/2}\right) \tag{6}$$

$$= \frac{1}{2}e^{-iMt}e^{-\Gamma t/2}\left(e^{-i\Delta mt/2}e^{-\Delta\Gamma t/4} - e^{i\Delta mt/2}e^{\Delta\Gamma t/4}\right) \tag{7}$$

$$= e^{-iMt}e^{-\Gamma t/2}\left[-\cos\left(\frac{\Delta mt}{2}\right)\sinh\left(\frac{\Delta\Gamma t}{4}\right) + i\sin\left(\frac{\Delta mt}{2}\right)\cosh\left(\frac{\Delta\Gamma t}{4}\right)\right] \tag{8}$$

$$\tag{9}$$