

8.851 Homework 4

Iain Stewart, March 15, 2006

Problem 1) HQET for Antiquarks

Do problem 1 in section 2 of the book.

Problem 2) Heavy-to-Light Form Factors in HQET

Consider heavy-to-light semileptonic decays, B to a vector meson.

a) Do the first part of problem 3 in chapter 2 of the book. (ie. Do not bother with the final part which asks you to discuss the decays to ρ mesons and V_{ub} .) Hint: Argue that

$$\langle V(p', \epsilon) | \bar{q} \Gamma Q_v | P^{(Q)}(v) \rangle = \text{tr} (M_V \Gamma H_v^{(Q)}), \quad (1)$$

where M_V depends on p' , ϵ^* , and v , and the pseudoscalar field in $H_v^{(Q)}$ on the RHS is replaced by 1. Then show that the most general M_V gives no reduction in the number of vector and axial-vector form factors (which is why this problem considers flavor symmetry relations but not spin symmetry relations).

b) Use your results from a) to derive at least one of the results in problem 4 in section 2. This problem shows that there are spin symmetry relations for the tensor current. [For bonus derive all three results.]

You may wish to use a program like FeynCalc in Mathematica to do the traces, or another trace program if you have a favorite.