Physics 56400 Assignment #5 – Due October 18th

1. In high energy hadron collisions, the ground state b-baryons are produced with the following relative fractions:
$$f_{B^+} = f_{B^0} = 34\%$$
$$f_{B_S^0} = 11\%$$
$$f_{\Lambda_b} = 21\%$$

and have the following lifetimes:
$$\tau_{B^+} = 1.638 \text{ ps}$$
$$\tau_{B^0} = 1.519 \text{ ps}$$
$$\tau_{B_S^0} = 1.512 \text{ ps}$$
$$\tau_{\Lambda_b} = 1.451 \text{ ps.}$$

The B^+ and Λ_b do not mix, while the B_S^0 mixes at such a high frequency that in practice it has an equal probability of being observed decaying in either of the b or $\bar{b}$ flavor states. The probability of observing a B-meson decay in time interval $(t, t + dt)$ in the same/opposite flavor in which it was produced is
$$P(B^0/\bar{B}^0, t|B^0)dt = \frac{e^{-\Gamma t}}{2\Gamma}(1 \pm \cos \Delta mt)dt$$

Assuming $b\bar{b}$ pairs hadronize independently into the different species of heavy hadrons with fractions given above, calculate the expected ratio of same-sign to opposite-sign di-lepton events.