Mølmer-Sørensen Gates

Assigned: April 8th, 2020
Due: April 15, 2020

Problem 1: Implement a Mølmer-Sørensen gate simulation in QuTiP. In all cases plot the probability of being in the $|00\rangle$, $|01\rangle$, $|10\rangle$, and $|11\rangle$ state vs time.

(a) Use the parameters $\Omega_0 = 2\pi \times 100\,\text{kHz}$ and $\eta = 0.15$ to implement an ideal MS gate.

(b) Use your model to show the effect of a 5% mismatch in blue and red sideband Rabi frequencies.

(c) Use your model to show the effect of a 5% asymmetric detuning error (i.e. $\delta_r' = -\nu - 0.95\epsilon$, $\delta_b' = \nu + 1.05\epsilon$).

(d) Use your model to show the effect of a 5% symmetric detuning error (i.e. $\delta_r' = -\nu - 1.05\epsilon$, $\delta_b' = \nu + 1.05\epsilon$).

(e) Based on your results, discuss if you are more worried about drifts in the trap frequency, laser amplitudes, or laser frequency.