

Mølmer-Sørensen gate simulation

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1 Goal

Derive the expression for simulating and optimizing a Mølmer-Sørensen gate pulse sequence.

2 Setup and scope

We'll discuss a simple two tone pulse sequence where the two tones are perfectly symmetric around the carrier. We'll ignore any error in the carrier frequency in this note. Crosstalk, coupling to carrier and other sideband orders are also ignored.

For a typical gate sequence, what we care about are

1. Ion motion:

The MS interaction will drive each of the motional mode in a spin-dependent way. For a proper MS gate, we'd like the final motional state to be identical to where we started. Any deviation from this results in a closure error.

2. Spin operation:

The enclosed area in phase-space from the driven motion results in a spin-dependent phase which is the main goal of the MS gate. Deviation in the control parameter could result in spin/angle error in the spin space.