Fall 2023 Writeup

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1 Introduction

This writeup will summarize the work done concerning state creation using the Simon Mukunda gadget referencing this paper. However, we ultimately decided to not use the three wave plate setup described in the paper in favor of a four wave plate setup in order to isolate creation and measurement for our lab setup. The code for all of this can be found at the Lynn Quantum Optics GitHub in the Fall-2023-Spring-2024 repository, specifically, the file simon_mukunda.py.

2 Method and Results

The main function within the code is SMgadget, which will return the angles of the three waveplates given a desired state and measurement basis. The state is the entangled state that we want to make, and the measurement basis is the basis we want to measure the state in. Both of these are in the forms of unitary matrices that are in the "HV basis" where the columns represent coefficients of a linear combination of H and V. Our total transformation matrix for the gadget should be the product of the state matrix and the adjunct of the measurement matrix. If N is the state matrix and M is the measurement matrix, then our transformation matrix should be $A = M^\dagger N$. This is because the measurement matrix transforms from the HV basis into our measurement basis, so doing the reverse would transform the measurement basis into HV, which is what we want. Using equations 32 and 33, we can now solve for the angles of each wave plate. For some special cases where $\phi = 0$ or $\phi = \pi/2$, specific equations are used to solve for the angles. However, in the end, we concluded that it would be more beneficial to keep creation and measurement separate because it would allow for easier troubleshooting in the lab and a clearer report of the results.