Optical Experiment Manuscript

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1 Introduction

In this manuscript, we will go through the detail of the optical experiment setup of the quantum circuit for Variational Quantum Eigensolver (VQE).

2 Components

Reference

Quarter-wave plate (QWP):

$$e^{\frac{-i\pi}{4}} \begin{bmatrix} \cos^2(\theta) + i\sin^2(\theta) & (1-i)\sin(\theta)\cos(\theta) \\ (1-i)\sin(\theta)\cos(\theta) & \sin^2(\theta) + i\cos^2(\theta) \end{bmatrix}$$

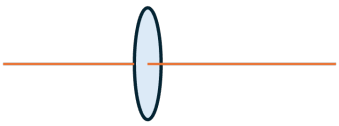

Figure 1: Quarter-wave plate

Quarter-wave plate with fast axis vertical (QWPv):

$$e^{\frac{i\pi}{4}} \begin{bmatrix} 1 & 0 \\ 0 & -i \end{bmatrix}$$

Quarter-wave plate with fast axis horizontal (QWPh):

$$e^{\frac{-i\pi}{4}} \begin{bmatrix} 1 & 0 \\ 0 & i \end{bmatrix}$$

Half-wave plate (HWP):

$$\begin{bmatrix} \cos(2\phi) & \sin(2\phi) \\ \sin(2\phi) & -\cos(2\phi) \end{bmatrix}$$

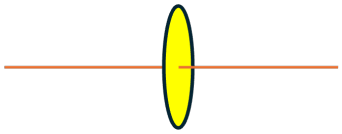

Figure 2: Half-wave plate

Dove Prism (DP) using Rotation matrix acting on the spatial mode:

$$\begin{bmatrix} \cos(\omega) & -\sin(\omega) \\ \sin(\omega) & \cos(\omega) \end{bmatrix}$$

Figure 3: Dove Prism

Beamsplitter (BS):

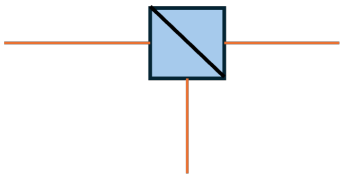

Figure 4: Beamsplitter

Polarizing beamsplitter (PBS):

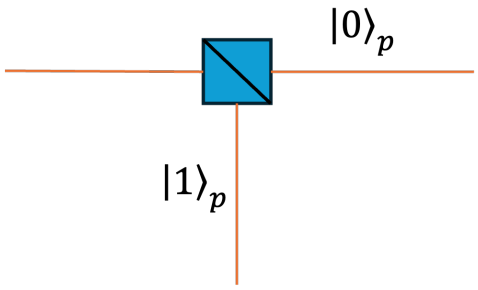

Figure 5: Polarizing Beamsplitter

3 Gates Realization