GBS Generating $|011\rangle + |100\rangle$

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The input is given by

$$|r_i, \alpha_i\rangle = D(\alpha_i)S(r_i)|0\rangle,$$

where we set $r_i, \alpha_i, \theta_i, \phi_i \in \mathbb{R}, \forall i$. In fact, my search parameter space was more strict

$r_i \in [-1.73, 1.73]$ (note this is $[-15\text{ dB}, 15\text{ dB}]$)

$\alpha_i \in [-1, 1]$

$\theta_i, \phi_i \in [-\pi, \pi]$

using just global optimisation (basin hopping).

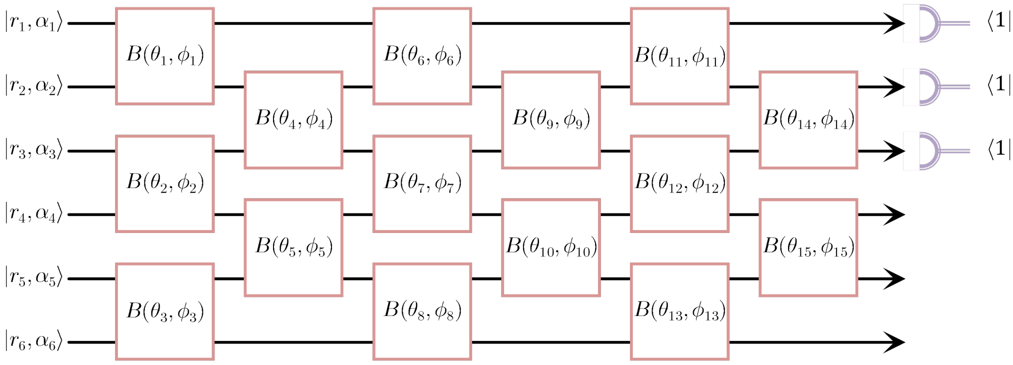
The gates are defined as

$$S(r) = \exp[\tfrac{1}{2}(r^* a^2 - r a^{\dagger 2})]$$

$$D(\alpha) = \exp[\alpha a^\dagger - \alpha^* a]$$

$$B(\theta_i, \phi_i) = \exp[\theta(e^{i\phi} a_1 a_2^\dagger - e^{-i\phi} a_1^\dagger a_2)]$$

and we detect $\langle 111|$ in the first three output modes as follows



An $m = 6$ interferometer needs $\frac{m(m-1)}{2} = 15$ beam-splitters to make any unitary transformation.

See para_x.csv files for ordered list of variables. This leads to a three mode output state $|\psi\rangle$ with fidelity and probability

$$F = |\langle 011|\psi\rangle + \langle 100|\psi\rangle|^2 = 0.9998$$

$$P = 2.1065 \times 10^{-6}$$

Note that the output state has a global phase shift $|\psi\rangle \approx e^{-0.4i}(|011\rangle + |001\rangle)$.