Figure 1

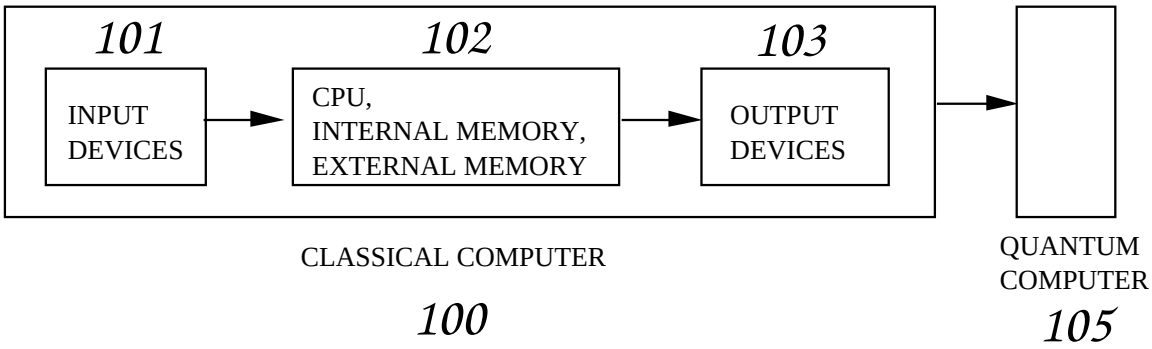
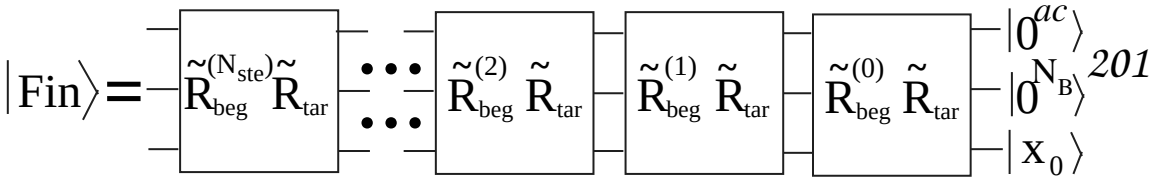
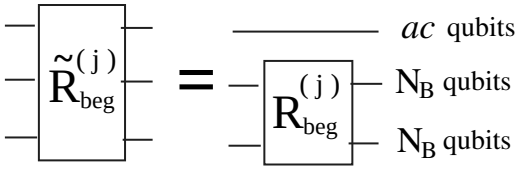

101
102
103
INPUT DEVICES
CPU, INTERNAL MEMORY, EXTERNAL MEMORY
OUTPUT DEVICES
CLASSICAL COMPUTER
100
QUANTUM COMPUTER
105

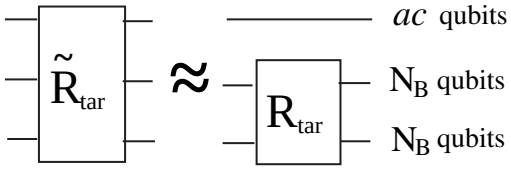
Figure 2



201



202



203

$$R_{beg}^{(j)} = \exp(i\alpha_j |s'\rangle\langle s'|) \qquad 204$$

$$R_{tar} = \exp(i\Delta\lambda |t\rangle\langle t|) \qquad 205$$

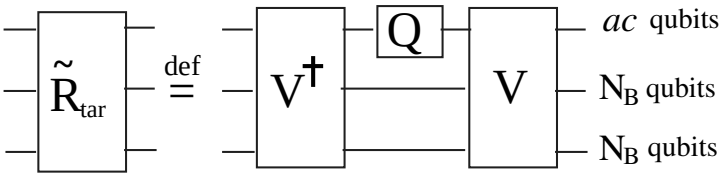
$$|s'\rangle = |0^{N_B}\rangle \otimes |x_0\rangle \qquad 206$$

$$|t\rangle = |0^{N_B}\rangle \otimes |\sqrt{\pi}\rangle \qquad 207$$

$$|\sqrt{\pi}\rangle = \sum_x \sqrt{\pi(x)}\,|x\rangle \qquad 208$$

$$e^{i\alpha}|Fin\rangle \approx |0^{ac}\rangle \otimes |0^{N_B}\rangle \otimes |\sqrt{\pi}\rangle \qquad 209$$

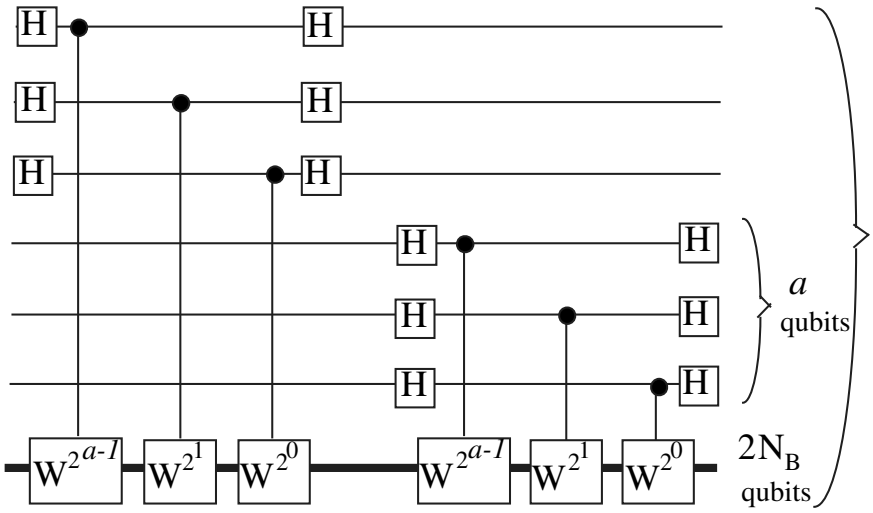
Figure 3



301

$$Q = \exp(i \Delta\lambda |0^{ac}\rangle\langle 0^{ac}|) \qquad 302$$

V=



303

Figure 4

$$W = U\,(-1)^{\check{\pi}}\,U^{\dagger}\,(-1)^{\hat{\pi}} \qquad 401$$

$$\check{\pi} = \overline{|0^{N_B}\rangle\langle 0^{N_B}|}^{\;N_B \text{ qubits}} \qquad 402$$

$$\hat{\pi} = \underline{|0^{N_B}\rangle\langle 0^{N_B}|}_{\;N_B \text{ qubits}} \qquad 403$$

For $j, k = 0, 1, 2, \ldots, 2^{N_B} - 1$

$$\begin{matrix}\langle\, 0\,|\\ \langle m_k|\end{matrix} U \begin{matrix}|m_j\rangle\\ |\,0\,\rangle\end{matrix} = m_j \delta^j_k \qquad 404$$

$$M_{hyb}|m_j\rangle = m_j|m_j\rangle \qquad 405$$

Figure 5

$$\langle y | M_{hyb} | x \rangle = M_{hyb}(y|x) = \Lambda_2(x|y)\Lambda_1(y|x) \quad 501$$

$$\Lambda_q(y|x) = \sqrt{M_q(y|x)} \quad \text{for } q = 1, 2 \quad 502$$

If $x = (x_1, x_2, x_3)$, $y = (y_1, y_2, y_3)$

$$M_1(y|x) =$$

$$P(y_1 | x_2, x_3)\, P(y_2 | x_3, y_1)\, P(y_3 | y_1, y_2)$$
$$\underline{x}_1 | \underline{x}_2 \underline{x}_3 \qquad \underline{x}_2 | \underline{x}_3 \underline{x}_1 \qquad \underline{x}_3 | \underline{x}_1 \underline{x}_2 \quad 503$$

$$M_2(y|x) =$$

$$P(y_1 | y_2, y_3)\, P(y_2 | y_3, x_1)\, P(y_3 | x_1, x_2)$$
$$\underline{x}_1 | \underline{x}_2 \underline{x}_3 \qquad \underline{x}_2 | \underline{x}_3 \underline{x}_1 \qquad \underline{x}_3 | \underline{x}_1 \underline{x}_2 \quad 504$$