

Diagrammatic representation of a quantum circuit transformation. The left side shows a sequence of three operations: a Hadamard-like gate, a phase gate, and another Hadamard-like gate. The first and third gates are enclosed in a red dashed box, and the middle gate is enclosed in a blue dashed box. The right side shows the equivalent single gate.

Below the diagrams, the corresponding matrix representations are given:

$$\begin{bmatrix} \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} \\ \frac{1}{\sqrt{2}} & \frac{-1}{\sqrt{2}} \end{bmatrix}
 \begin{bmatrix} e^{i\varphi_0} & 0 \\ 0 & e^{i\varphi_1} \end{bmatrix}
 \begin{bmatrix} \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} \\ \frac{1}{\sqrt{2}} & \frac{-1}{\sqrt{2}} \end{bmatrix}
 =
 \begin{bmatrix} \cos \frac{\varphi}{2} & -i \sin \frac{\varphi}{2} \\ -i \sin \frac{\varphi}{2} & \cos \frac{\varphi}{2} \end{bmatrix}$$