

Lemma 1 *A unitary matrix $U \in \mathcal{U}(2)$ can be expressed in the form*

$$U = e^{ia} \begin{pmatrix} e^{-ib} & 0 \\ 0 & e^{ib} \end{pmatrix} \begin{pmatrix} \cos c & -\sin c \\ \sin c & \cos c \end{pmatrix} \begin{pmatrix} e^{-id} & 0 \\ 0 & e^{id} \end{pmatrix},$$

for some real numbers a, b, c , and d .