Single qubit gates

Single qubit gates	qiskit example (circuit symbol)	Notes/ Equivalencies	*X*-gate eigenstates		*Y*-gate eigenstates		*Z*-gate eigenstates	
	last argument always indicates the qubit to which the gate is applied		$\vert+\rangle = \frac{1}{\sqrt{2}}\begin{bmatrix}1\\1\end{bmatrix}$	$\vert-\rangle = \frac{1}{\sqrt{2}}\begin{bmatrix}1\\-1\end{bmatrix}$	$\vert\circlearrowright\rangle = \frac{1}{\sqrt{2}}\begin{bmatrix}1\\i\end{bmatrix}$	$\vert\circlearrowleft\rangle = \frac{1}{\sqrt{2}}\begin{bmatrix}i\\1\end{bmatrix}$	$\vert 0\rangle = \begin{bmatrix}1\\0\end{bmatrix}$	$\vert 1\rangle = \begin{bmatrix}0\\1\end{bmatrix}$
X-gate (Pauli) NOT-gate $X = \begin{bmatrix}0 & 1\\1 & 0\end{bmatrix}$	`qc.x(0)` q ─ X ─	Performs rotation of π radians around X-axis	$X\vert+\rangle = \vert+\rangle$	$X\vert-\rangle = -\vert-\rangle$	$X\vert\circlearrowright\rangle = \vert\circlearrowleft\rangle$	$X\vert\circlearrowleft\rangle = \vert\circlearrowright\rangle$	$X\vert 0\rangle = \vert 1\rangle$	$X\vert 1\rangle = \vert 0\rangle$
Y-gate (Pauli) $Y = \begin{bmatrix}0 & -i\\i & 0\end{bmatrix}$	`qc.y(0)` q ─ Y ─	Performs rotation of π radians around Y-axis	$Y\vert+\rangle = -i\vert-\rangle$	$Y\vert-\rangle = i\vert+\rangle$	$Y\vert\circlearrowright\rangle = \vert\circlearrowright\rangle$	$Y\vert\circlearrowleft\rangle = -\vert\circlearrowleft\rangle$	$Y\vert 0\rangle = i\vert 1\rangle$	$Y\vert 1\rangle = -i\vert 0\rangle$
Z-gate (Pauli) $Z = \begin{bmatrix}1 & 0\\0 & -1\end{bmatrix}$	`qc.z(0)` q ─ Z ─	Performs rotation of π radians around Z-axis $Z = P(\pi)$	$Z\vert+\rangle = \vert-\rangle$	$Z\vert-\rangle = \vert+\rangle$	$Z\vert\circlearrowright\rangle = -i\vert\circlearrowleft\rangle$	$Z\vert\circlearrowleft\rangle = i\vert\circlearrowright\rangle$	$Z\vert 0\rangle = \vert 0\rangle$	$Z\vert 1\rangle = -\vert 1\rangle$
H-gate Hadamard gate $H = \frac{1}{\sqrt{2}}\begin{bmatrix}1 & 1\\1 & -1\end{bmatrix}$	`qc.h(0)` q ─ H ─	$H = U\left(\frac{\pi}{2}, 0, \pi\right)$	$H\vert+\rangle = \vert 0\rangle$	$H\vert-\rangle = \vert 1\rangle$	$H\vert\circlearrowright\rangle = \sqrt{-i}\vert\circlearrowleft\rangle$	$H\vert\circlearrowleft\rangle = \sqrt{i}\vert\circlearrowright\rangle$	$H\vert 0\rangle = \vert+\rangle$	$H\vert 1\rangle = \vert-\rangle$
P-gate Phase gate $P(\phi) = \begin{bmatrix}1 & 0\\0 & e^{i\phi}\end{bmatrix}$	`qc.p(pi/4,0)` q ─ P π/4 ─	Performs rotation of ϕ around Z-axis $P(\phi) = U(0,0,\phi)$	$P\left(\frac{\pi}{4}\right)\vert+\rangle = \frac{1}{\sqrt{2}}\begin{bmatrix}1\\\sqrt{i}\end{bmatrix}$	$P\left(\frac{\pi}{4}\right)\vert-\rangle = \frac{1}{\sqrt{2}}\begin{bmatrix}1\\-\sqrt{i}\end{bmatrix}$	$P\left(\frac{\pi}{4}\right)\vert\circlearrowright\rangle = \frac{1}{\sqrt{2}}\begin{bmatrix}1\\i\sqrt{i}\end{bmatrix}$	$P\left(\frac{\pi}{4}\right)\vert\circlearrowleft\rangle = \frac{1}{\sqrt{2}}\begin{bmatrix}-1\\-i\sqrt{i}\end{bmatrix}$	$P\left(\frac{\pi}{4}\right)\vert 0\rangle = \vert 0\rangle$	$P\left(\frac{\pi}{4}\right)\vert 1\rangle = \sqrt{i}\vert 1\rangle$
S-gate $\sqrt{Z}$-gate $S = \begin{bmatrix}1 & 0\\0 & i\end{bmatrix}$,	`qc.s(0)` q ─ S ─	$SS = Z$ $S = P(\pi/2)$	$S\vert+\rangle = \vert\circlearrowright\rangle$	$S\vert-\rangle = -i\vert\circlearrowleft\rangle$	$S\vert\circlearrowright\rangle = \vert-\rangle$	$S\vert\circlearrowleft\rangle = i\vert+\rangle$	$S\vert 0\rangle = \vert 0\rangle$	$S\vert 1\rangle = i\vert 1\rangle$
T−gate $\sqrt[4]{Z}$-gate $T = \begin{bmatrix}1 & 0\\0 & \sqrt{i}\end{bmatrix}$	`qc.t(0)` q ─ T ─	$TTTT = Z$ $T = P(\pi/4)$	$T\vert+\rangle = \frac{1}{\sqrt{2}}\begin{bmatrix}1\\\sqrt{i}\end{bmatrix}$	$T\vert-\rangle = \frac{1}{\sqrt{2}}\begin{bmatrix}1\\-\sqrt{i}\end{bmatrix}$	$T\vert\circlearrowright\rangle = \frac{1}{\sqrt{2}}\begin{bmatrix}1\\i\sqrt{i}\end{bmatrix}$	$T\vert\circlearrowleft\rangle = \frac{1}{\sqrt{2}}\begin{bmatrix}-1\\-i\sqrt{i}\end{bmatrix}$	$T\vert 0\rangle = \vert 0\rangle$	$T\vert 1\rangle = \sqrt{i}\vert 1\rangle$
I-gate Identity gate Id-gate $I = \begin{bmatrix}1 & 0\\0 & 1\end{bmatrix}$	qc.i(0) q ─ I ─	$I = XX$ $I = P(0)$	$I\vert+\rangle = \vert+\rangle$	$I\vert-\rangle = \vert-\rangle$	$I\vert\circlearrowright\rangle = \vert\circlearrowright\rangle$	$I\vert\circlearrowleft\rangle = \vert\circlearrowleft\rangle$	$I\vert 0\rangle = \vert 0\rangle$	$I\vert 1\rangle = \vert 1\rangle$
$T^\dagger$-gate T-dagger $\sqrt[4]{Z^\dagger}$-gate $T^\dagger = \begin{bmatrix}1 & 0\\0 & \sqrt{-i}\end{bmatrix}$	`qc.tdg(0)` q ─ T† ─	$T^\dagger T^\dagger T^\dagger T^\dagger = Z$ $T^\dagger = P(-\pi/4)$	$T\vert+\rangle = \frac{1}{\sqrt{2}}\begin{bmatrix}1\\\sqrt{-i}\end{bmatrix}$	$T\vert-\rangle = \frac{1}{\sqrt{2}}\begin{bmatrix}1\\-\sqrt{-i}\end{bmatrix}$	$T\vert\circlearrowright\rangle = \frac{1}{\sqrt{2}}\begin{bmatrix}1\\i\sqrt{-i}\end{bmatrix}$	$T\vert\circlearrowleft\rangle = \frac{1}{\sqrt{2}}\begin{bmatrix}-1\\-i\sqrt{-i}\end{bmatrix}$	$T^\dagger\vert 0\rangle = \vert 0\rangle$	$T^\dagger\vert 1\rangle = -\sqrt{i}\vert 1\rangle$
$S^\dagger$-gate S-dagger $\sqrt{Z^\dagger}$-gate $S^\dagger = \begin{bmatrix}1 & 0\\0 & -i\end{bmatrix}$	`qc.sdg(0)` q ─ S† ─	$S^\dagger S^\dagger = Z$ $S^\dagger = P(-\pi/2)$	$S^\dagger\vert+\rangle = -i\vert\circlearrowleft\rangle$	$S^\dagger\vert-\rangle = \vert\circlearrowright\rangle$	$S^\dagger\vert\circlearrowright\rangle = \vert+\rangle$	$S^\dagger\vert\circlearrowleft\rangle = i\vert-\rangle$	$S^\dagger\vert 0\rangle = \vert 0\rangle$	$S^\dagger\vert 1\rangle = -i\vert 1\rangle$
U-gate $U(\theta,\phi,\lambda) = \begin{bmatrix}\cos\left(\frac{\theta}{2}\right) & -e^{i\lambda}\sin\left(\frac{\theta}{2}\right)\\e^{i\phi}\sin\left(\frac{\theta}{2}\right) & e^{i(\phi+\lambda)}\cos\left(\frac{\theta}{2}\right)\end{bmatrix}$	`qc.u(pi/2,0,pi,0)` q ─ U π/2, 0, π ─	most general of all single-qubit quantum gates	$U\left(\frac{\pi}{2},0,\pi\right)\vert+\rangle = \vert 0\rangle$	$U\left(\frac{\pi}{2},0,\pi\right)\vert-\rangle = \vert 1\rangle$	$U\left(\frac{\pi}{2},0,\pi\right)\vert\circlearrowright\rangle = \sqrt{-i}\vert\circlearrowleft\rangle$	$U\left(\frac{\pi}{2},0,\pi\right)\vert\circlearrowleft\rangle = \sqrt{i}\vert\circlearrowright\rangle$	$U\left(\frac{\pi}{2},0,\pi\right)\vert 0\rangle = \vert+\rangle$	$U\left(\frac{\pi}{2},0,\pi\right)\vert 0\rangle = \vert-\rangle$