02_cz_gf

November 3, 2023

[4]:
```
from quantum_logical.operators import selective_destroy
from quantum_logical.interaction import ConversionGainInteraction
from weylchamber import c1c2c3
import numpy as np
import qutip
from qutip.operators import destroy
```

[5]:
```
op = (
    selective_destroy(levels=3, from_level=1, to_level=0)
    + selective_destroy(3, 1, 0).dag()
    + selective_destroy(3, 2, 1)
    + selective_destroy(3, 2, 1).dag()
)
w = qutip.identity(3) + (1 / np.sqrt(2) * op)
w
```

[5]:
Quantum object: dims = [[3], [3]], shape = (3, 3), type = oper, isherm = True

$$\begin{pmatrix} 1.0 & 0.707 & 0.0 \\ 0.707 & 1.0 & 0.707 \\ 0.0 & 0.707 & 1.0 \end{pmatrix}$$

[6]:
```
H = qutip.tensor(w, w)
t = np.pi
u = (-1j * H * t).expm()
u
```

[6]:
Quantum object: dims = [[3, 3], [3, 3]], shape = (9, 9), type = oper, isherm = True

$$\begin{pmatrix} 0.500 & 0.0 & 0.500 & 0.0 & 0.0 & 0.0 & 0.500 & 0.0 & -0.500 \\ 0.0 & 1.000 & 0.0 & 0.0 & 0.0 & 0.0 & 0.0 & 0.0 & 0.0 \\ 0.500 & 0.0 & 0.500 & 0.0 & 0.0 & 0.0 & -0.500 & 0.0 & 0.500 \\ 0.0 & 0.0 & 0.0 & 1.0 & 0.0 & 0.0 & 0.0 & 0.0 & 0.0 \\ 0.0 & 0.0 & 0.0 & 0.0 & 1.0 & 0.0 & 0.0 & 0.0 & 0.0 \\ 0.0 & 0.0 & 0.0 & 0.0 & 0.0 & 1.000 & 0.0 & 0.0 & 0.0 \\ 0.500 & 0.0 & -0.500 & 0.0 & 0.0 & 0.0 & 0.500 & 0.0 & 0.500 \\ 0.0 & 0.0 & 0.0 & 0.0 & 0.0 & 0.0 & 0.0 & 1.0 & 0.0 \\ -0.500 & 0.0 & 0.500 & 0.0 & 0.0 & 0.0 & 0.500 & 0.0 & 0.500 \end{pmatrix}$$

[7]:
```
# verify makes an CZ_gf gate
# convert to 2Q between g and f by removing indexes connected to e
# (quick and dirty way to trace out e)
indices = [0, 2, 6, 8]
reduced_matrix = u[np.ix_(indices, indices)]
print(c1c2c3(reduced_matrix))
u
```

```
(0.5, 0.0, 0.0)
```

[7]:

Quantum object: dims = [[3, 3], [3, 3]], shape = (9, 9), type = oper, isherm = True

$$\begin{pmatrix} 0.500 & 0.0 & 0.500 & 0.0 & 0.0 & 0.0 & 0.500 & 0.0 & -0.500 \\ 0.0 & 1.000 & 0.0 & 0.0 & 0.0 & 0.0 & 0.0 & 0.0 & 0.0 \\ 0.500 & 0.0 & 0.500 & 0.0 & 0.0 & 0.0 & -0.500 & 0.0 & 0.500 \\ 0.0 & 0.0 & 0.0 & 1.0 & 0.0 & 0.0 & 0.0 & 0.0 & 0.0 \\ 0.0 & 0.0 & 0.0 & 0.0 & 1.0 & 0.0 & 0.0 & 0.0 & 0.0 \\ 0.0 & 0.0 & 0.0 & 0.0 & 0.0 & 1.000 & 0.0 & 0.0 & 0.0 \\ 0.500 & 0.0 & -0.500 & 0.0 & 0.0 & 0.0 & 0.500 & 0.0 & 0.500 \\ 0.0 & 0.0 & 0.0 & 0.0 & 0.0 & 0.0 & 0.0 & 1.0 & 0.0 \\ -0.500 & 0.0 & 0.500 & 0.0 & 0.0 & 0.0 & 0.500 & 0.0 & 0.500 \end{pmatrix}$$