In [1]:
```
import pulser
import pulser_simulation
import numpy as np
import qutip
```

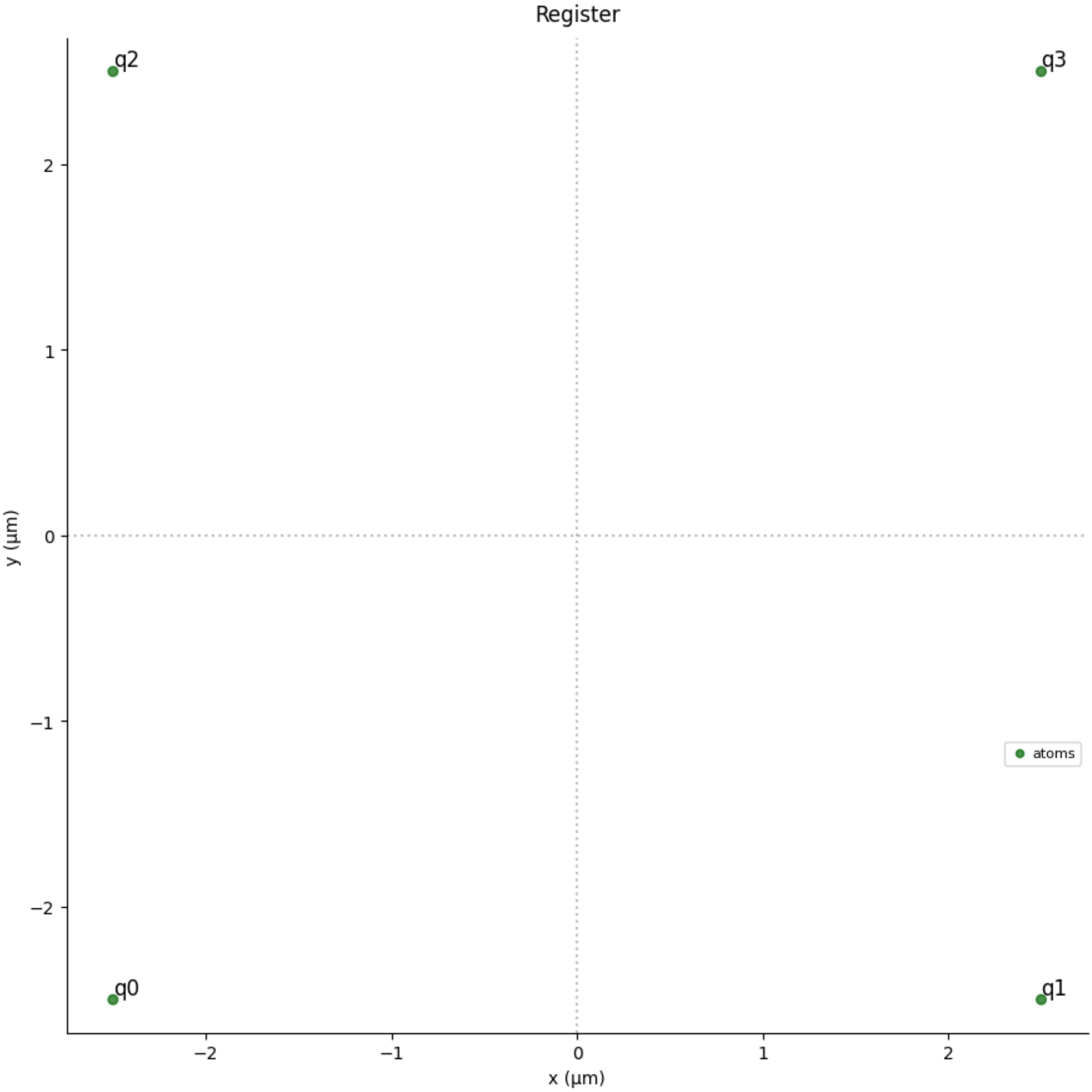
In [2]:
```
pulser.AnalogDevice.to_abstract_repr()
```

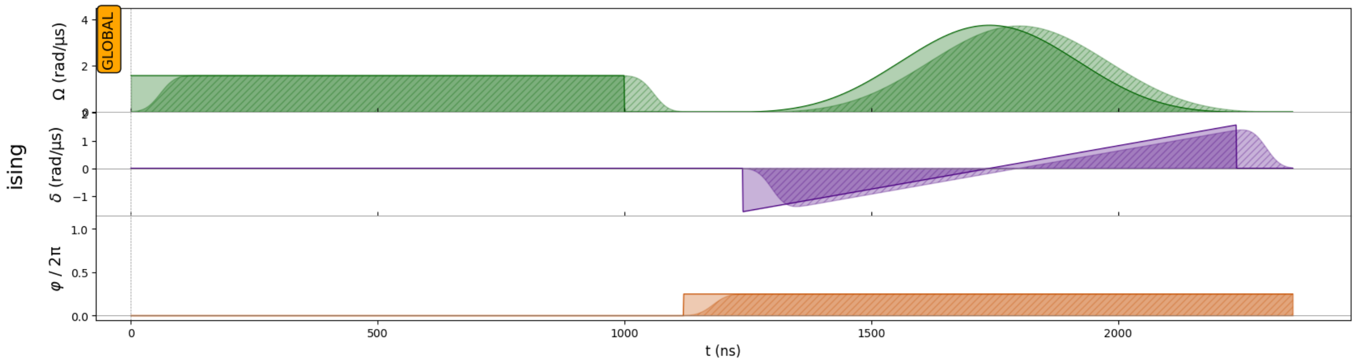
Out[2]:

```
'{"name": "AnalogDevice", "dimensions": 2, "rydberg_level": 60, "min_atom_distance": 5, "max_
atom_num": 25, "max_radial_distance": 35, "interaction_coeff_xy": null, "supports_slm_mask":
false, "max_layout_filling": 0.5, "max_sequence_duration": 4000, "max_runs": 2000, "reusable_
channels": false, "pre_calibrated_layouts": [{"coordinates": [[-20.0, 0.0], [-17.5, -4.33012
7], [-17.5, 4.330127], [-15.0, -8.660254], [-15.0, 0.0], [-15.0, 8.660254], [-12.5, -12.99038
1], [-12.5, -4.330127], [-12.5, 4.330127], [-12.5, 12.990381], [-10.0, -17.320508], [-10.0,
-8.660254], [-10.0, 0.0], [-10.0, 8.660254], [-10.0, 17.320508], [-7.5, -12.990381], [-7.5,
-4.330127], [-7.5, 4.330127], [-7.5, 12.990381], [-5.0, -17.320508], [-5.0, -8.660254],
[-5.0, 0.0], [-5.0, 8.660254], [-5.0, 17.320508], [-2.5, -12.990381], [-2.5, -4.330127],
[-2.5, 4.330127], [-2.5, 12.990381], [0.0, -17.320508], [0.0, -8.660254], [0.0, 0.0], [0.0,
8.660254], [0.0, 17.320508], [2.5, -12.990381], [2.5, -4.330127], [2.5, 4.330127], [2.5, 12.9
90381], [5.0, -17.320508], [5.0, -8.660254], [5.0, 0.0], [5.0, 8.660254], [5.0, 17.320508],
[7.5, -12.990381], [7.5, -4.330127], [7.5, 4.330127], [7.5, 12.990381], [10.0, -17.320508],
[10.0, -8.660254], [10.0, 0.0], [10.0, 8.660254], [10.0, 17.320508], [12.5, -12.990381], [1
2.5, -4.330127], [12.5, 4.330127], [12.5, 12.990381], [15.0, -8.660254], [15.0, 0.0], [15.0,
8.660254], [17.5, -4.330127], [17.5, 4.330127], [20.0, 0.0]], "slug": "TriangularLatticeLayou
t(61, 5.0\\u00b5m)"}], "accepts_new_layouts": false, "version": "1", "pulser_version": "1.2de
v1", "channels": [{"id": "rydberg_global", "basis": "ground-rydberg", "addressing": "Global",
"max_abs_detuning": 125.66370614359172, "max_amp": 12.566370614359172, "min_retarget_interval
": null, "fixed_retarget_t": null, "max_targets": null, "clock_period": 4, "min_duration": 16
, "max_duration": 100000000, "mod_bandwidth": 8, "eom_config": {"limiting_beam": "RED", "max_
limiting_amp": 188.49555921538757, "intermediate_detuning": 2827.4333882308138, "controlled_b
eams": ["BLUE"], "mod_bandwidth": 40, "custom_buffer_time": 240}}], "is_virtual": false}'
```

In [3]:
```
seq = pulser.Sequence(pulser.Register.square(2, 5, "q"), pulser.AnalogDevice)
seq.declare_channel("ising", "rydberg_global")
seq.add(pulser.Pulse.ConstantPulse(1000, np.pi/2, 0, 0), "ising")
seq.delay(100, "ising")
seq.add(pulser.Pulse(pulser.BlackmanWaveform(1000, np.pi/2), pulser.RampWaveform(1000, -np.pi/
```

In [4]:
```
seq.draw(draw_register=True)
```





In [5]:

```
backend = pulser_simulation.QutipBackend(seq)
```

In [6]:

```
import qutip
```

In [7]:

```
backend._sim_obj._hamiltonian._hamiltonian(0)
```

Out[7]: Quantum object: dims=[[2, 2, 2, 2], [2, 2, 2, 2]], shape=(16, 16), type='oper', dtype=CSR, isherm=True

$$\begin{pmatrix} 235.477 & 0.785 & 0.785 & 0 & 0.785 & \cdots & 0 & 0 & 0 & 0 & 0 \\ 0.785 & 117.738 & 0 & 0.785 & 0 & \cdots & 0 & 0 & 0 & 0 & 0 \\ 0.785 & 0 & 117.738 & 0.785 & 0 & \cdots & 0 & 0 & 0 & 0 & 0 \\ 0 & 0.785 & 0.785 & 55.406 & 0 & \cdots & 0.785 & 0 & 0 & 0 & 0 \\ 0.785 & 0 & 0 & 0 & 117.738 & \cdots & 0 & 0.785 & 0 & 0 & 0 \\ \vdots & \vdots & \vdots & \vdots & \vdots & \ddots & \vdots & \vdots & \vdots & \vdots & \vdots \\ 0 & 0 & 0 & 0.785 & 0 & \cdots & 0 & 0 & 0 & 0 & 0.785 \\ 0 & 0 & 0 & 0 & 0.785 & \cdots & 0 & 55.406 & 0.785 & 0.785 & 0 \\ 0 & 0 & 0 & 0 & 0 & \cdots & 0 & 0.785 & 0 & 0 & 0.785 \\ 0 & 0 & 0 & 0 & 0 & \cdots & 0 & 0.785 & 0 & 0 & 0.785 \\ 0 & 0 & 0 & 0 & 0 & \cdots & 0.785 & 0 & 0.785 & 0.785 & 0 \end{pmatrix}$$

```
In [8]: backend._sim_obj._hamiltonian._hamiltonian.copy()
```

```
Out[8]: QobjEvo: dims = [[2, 2, 2, 2], [2, 2, 2, 2]], shape = (16, 16), type = oper, superrep = None,
        isconstant = False, num_elements = 4
```

```
In [9]: %timeit backend.run()
```

```
41.8 ms ± 519 µs per loop (mean ± std. dev. of 7 runs, 10 loops each)
```

```
In [10]: mod_backend = pulser_simulation.QutipBackend(
             seq,
             pulser.EmulatorConfig(
                 with_modulation=True
             )
         )
```

```
In [11]: %timeit mod_backend.run()
```

```
42.9 ms ± 1.47 ms per loop (mean ± std. dev. of 7 runs, 10 loops each)
```

```
In [12]: t_backend = pulser_simulation.QutipBackend(
             seq,
             pulser.EmulatorConfig(
                 with_modulation=True,
                 noise_model=pulser.NoiseModel(
                     temperature=0.1,
                     runs=10,
                     samples_per_run=1,
                 )
             )
         )
```

```
In [13]: %timeit t_backend.run()
```

```
1.35 s ± 9.61 ms per loop (mean ± std. dev. of 7 runs, 1 loop each)
```

```
In [14]: relax_backend = pulser_simulation.QutipBackend(
             seq,
             pulser.EmulatorConfig(
                 with_modulation=True,
                 noise_model=pulser.NoiseModel(
                     relaxation_rate=0.1,
                 )
             )
         )
```

```
In [15]: relax_backend._sim_obj._hamiltonian._hamiltonian(0)
```

Out[15]: Quantum object: dims=[[2, 2, 2, 2], [2, 2, 2, 2]], shape=(16, 16), type='oper', dtype=CSR, isherm=True

$$\begin{pmatrix}
235.477 & 0.004 & 0.004 & 0 & 0.004 & \cdots & 0 & 0 & 0 & 0 & 0 \\
0.004 & 117.738 & 0 & 0.004 & 0 & \cdots & 0 & 0 & 0 & 0 & 0 \\
0.004 & 0 & 117.738 & 0.004 & 0 & \cdots & 0 & 0 & 0 & 0 & 0 \\
0 & 0.004 & 0.004 & 55.406 & 0 & \cdots & 0.004 & 0 & 0 & 0 & 0 \\
0.004 & 0 & 0 & 0 & 117.738 & \cdots & 0 & 0.004 & 0 & 0 & 0 \\
\vdots & \vdots & \vdots & \vdots & \vdots & \ddots & \vdots & \vdots & \vdots & \vdots & \vdots \\
0 & 0 & 0 & 0.004 & 0 & \cdots & 0 & 0 & 0 & 0 & 0.004 \\
0 & 0 & 0 & 0 & 0.004 & \cdots & 0 & 55.406 & 0.004 & 0.004 & 0 \\
0 & 0 & 0 & 0 & 0 & \cdots & 0 & 0.004 & 0 & 0 & 0.004 \\
0 & 0 & 0 & 0 & 0 & \cdots & 0 & 0.004 & 0 & 0 & 0.004 \\
0 & 0 & 0 & 0 & 0 & \cdots & 0.004 & 0 & 0.004 & 0.004 & 0
\end{pmatrix}$$

In [16]:

```
relax_backend._sim_obj._hamiltonian._collapse_ops
```

```
Out[16]: [Quantum object: dims=[[2, 2, 2, 2], [2, 2, 2, 2]], shape=(16, 16), type='oper', dtype=CSR, i
         sherm=False
          Qobj data =
          [[0.         0.         0.         0.         0.         0.
            0.         0.         0.         0.         0.         0.
            0.         0.         0.         0.        ]
           [0.         0.         0.         0.         0.         0.
            0.         0.         0.         0.         0.         0.
            0.         0.         0.         0.        ]
           [0.         0.         0.         0.         0.         0.
            0.         0.         0.         0.         0.         0.
            0.         0.         0.         0.        ]
           [0.         0.         0.         0.         0.         0.
            0.         0.         0.         0.         0.         0.
            0.         0.         0.         0.        ]
           [0.         0.         0.         0.         0.         0.
            0.         0.         0.         0.         0.         0.
            0.         0.         0.         0.        ]
           [0.         0.         0.         0.         0.         0.
            0.         0.         0.         0.         0.         0.
            0.         0.         0.         0.        ]
           [0.         0.         0.         0.         0.         0.
            0.         0.         0.         0.         0.         0.
            0.         0.         0.         0.        ]
           [0.         0.         0.         0.         0.         0.
            0.         0.         0.         0.         0.         0.
            0.         0.         0.         0.        ]
           [0.31622777 0.         0.         0.         0.         0.
            0.         0.         0.         0.         0.         0.
            0.         0.         0.         0.        ]
           [0.         0.31622777 0.         0.         0.         0.
            0.         0.         0.         0.         0.         0.
            0.         0.         0.         0.        ]
           [0.         0.         0.31622777 0.         0.         0.
            0.         0.         0.         0.         0.         0.
            0.         0.         0.         0.        ]
           [0.         0.         0.         0.31622777 0.         0.
            0.         0.         0.         0.         0.         0.
            0.         0.         0.         0.        ]
           [0.         0.         0.         0.         0.31622777 0.
            0.         0.         0.         0.         0.         0.
            0.         0.         0.         0.        ]
           [0.         0.         0.         0.         0.         0.31622777
            0.         0.         0.         0.         0.         0.
            0.         0.         0.         0.        ]
           [0.         0.         0.         0.         0.         0.
            0.31622777 0.         0.         0.         0.         0.
            0.         0.         0.         0.        ]
           [0.         0.         0.         0.         0.         0.
            0.         0.31622777 0.         0.         0.         0.
            0.         0.         0.         0.        ]],
          Quantum object: dims=[[2, 2, 2, 2], [2, 2, 2, 2]], shape=(16, 16), type='oper', dtype=CSR, i
         sherm=False
          Qobj data =
          [[0.         0.         0.         0.         0.         0.
            0.         0.         0.         0.         0.         0.
            0.         0.         0.         0.        ]
           [0.         0.         0.         0.         0.         0.
            0.         0.         0.         0.         0.         0.
            0.         0.         0.         0.        ]
           [0.         0.         0.         0.         0.         0.
            0.         0.         0.         0.         0.         0.
            0.         0.         0.         0.        ]
           [0.         0.         0.         0.         0.         0.
            0.         0.         0.         0.         0.         0.
```

```
   0.         0.         0.         0.        ]
  [0.31622777 0.         0.         0.         0.         0.
   0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.        ]
  [0.         0.31622777 0.         0.         0.         0.
   0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.        ]
  [0.         0.         0.31622777 0.         0.         0.
   0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.        ]
  [0.         0.         0.         0.31622777 0.         0.
   0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.        ]
  [0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.        ]
  [0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.        ]
  [0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.        ]
  [0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.        ]
  [0.         0.         0.         0.         0.         0.
   0.         0.         0.31622777 0.         0.         0.
   0.         0.         0.         0.        ]
  [0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.31622777 0.         0.
   0.         0.         0.         0.        ]
  [0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.         0.31622777 0.
   0.         0.         0.         0.        ]
  [0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.         0.         0.31622777
   0.         0.         0.         0.        ]],
 Quantum object: dims=[[2, 2, 2, 2], [2, 2, 2, 2]], shape=(16, 16), type='oper', dtype=CSR, i
sherm=False
 Qobj data =
 [[0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.        ]
  [0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.        ]
  [0.31622777 0.         0.         0.         0.         0.
   0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.        ]
  [0.         0.31622777 0.         0.         0.         0.
   0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.        ]
  [0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.        ]
  [0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.        ]
  [0.         0.         0.         0.         0.31622777 0.
   0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.        ]
  [0.         0.         0.         0.         0.         0.31622777
   0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.        ]
  [0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.         0.         0.
```

```
   0.         0.         0.         0.        ]
  [0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.        ]
  [0.         0.         0.         0.         0.         0.
   0.         0.         0.31622777 0.         0.         0.
   0.         0.         0.         0.        ]
  [0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.31622777 0.         0.
   0.         0.         0.         0.        ]
  [0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.        ]
  [0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.        ]
  [0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.         0.         0.
   0.31622777 0.         0.         0.        ]
  [0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.         0.         0.
   0.         0.31622777 0.         0.        ]],
 Quantum object: dims=[[2, 2, 2, 2], [2, 2, 2, 2]], shape=(16, 16), type='oper', dtype=CSR, i
sherm=False
 Qobj data =
 [[0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.        ]
  [0.31622777 0.         0.         0.         0.         0.
   0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.        ]
  [0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.        ]
  [0.         0.         0.31622777 0.         0.         0.
   0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.        ]
  [0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.        ]
  [0.         0.         0.         0.         0.31622777 0.
   0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.        ]
  [0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.        ]
  [0.         0.         0.         0.         0.         0.
   0.31622777 0.         0.         0.         0.         0.
   0.         0.         0.         0.        ]
  [0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.        ]
  [0.         0.         0.         0.         0.         0.
   0.         0.         0.31622777 0.         0.         0.
   0.         0.         0.         0.        ]
  [0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.        ]
  [0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.         0.31622777 0.
   0.         0.         0.         0.        ]
  [0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.        ]
  [0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.         0.         0.
```

```
  0.31622777 0.         0.         0.        ]
 [0.         0.         0.         0.         0.         0.
  0.         0.         0.         0.         0.         0.
  0.         0.         0.         0.        ]
 [0.         0.         0.         0.         0.         0.
  0.         0.         0.         0.         0.         0.
  0.         0.         0.31622777 0.        ]]]
```

In [17]:

```
%timeit relax_backend.run()
```

```
85.4 ms ± 711 µs per loop (mean ± std. dev. of 7 runs, 10 loops each)
```

In [18]:

```
qutip.Qobj([[0, 0, 1], [0, 0, 1], [1, 1, 0]])
```

Out[18]: Quantum object: dims=[[3], [3]], shape=(3, 3), type='oper', dtype=Dense, isherm=True

$$\begin{pmatrix} 0 & 0 & 1 \\ 0 & 0 & 1 \\ 1 & 1 & 0 \end{pmatrix}$$

In [19]:

```
leakage_backend = pulser_simulation.QutipBackend(
    seq,
    pulser.EmulatorConfig(
        with_modulation=True,
        noise_model=pulser.NoiseModel(
            with_leakage=True,
            eff_noise_opers=[qutip.Qobj([[0, 0, 1], [0, 0, 1], [1, 1, 0]])],
            eff_noise_rates=[0.1]
        )
    )
)
```

In [20]:

```
leakage_backend._sim_obj._hamiltonian._hamiltonian(0)
```

Out[20]: Quantum object: dims=[[3, 3, 3, 3], [3, 3, 3, 3]], shape=(81, 81), type='oper', dtype=CSR, isherm=True

$$\begin{pmatrix} 235.477 & 0.004 & 0 & 0.004 & 0 & \cdots & 0 & 0 & 0 & 0 & 0 \\ 0.004 & 117.738 & 0 & 0 & 0.004 & \cdots & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 117.738 & 0 & 0 & \cdots & 0 & 0 & 0 & 0 & 0 \\ 0.004 & 0 & 0 & 117.738 & 0.004 & \cdots & 0 & 0 & 0 & 0 & 0 \\ 0 & 0.004 & 0 & 0.004 & 55.406 & \cdots & 0 & 0 & 0 & 0 & 0 \\ \vdots & \vdots & \vdots & \vdots & \vdots & \ddots & \vdots & \vdots & \vdots & \vdots & \vdots \\ 0 & 0 & 0 & 0 & 0 & \cdots & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & \cdots & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & \cdots & 0 & 0 & 0 & 0.004 & 0 \\ 0 & 0 & 0 & 0 & 0 & \cdots & 0 & 0 & 0.004 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & \cdots & 0 & 0 & 0 & 0 & 0 \end{pmatrix}$$

In [21]:

```
leakage_backend._sim_obj._hamiltonian._collapse_ops
```

```
Out[21]: [Quantum object: dims=[[3, 3, 3, 3], [3, 3, 3, 3]], shape=(81, 81), type='oper', dtype=CSR, i
         sherm=True
          Qobj data =
          [[0. 0. 0. ... 0. 0. 0.]
           [0. 0. 0. ... 0. 0. 0.]
           [0. 0. 0. ... 0. 0. 0.]
           ...
           [0. 0. 0. ... 0. 0. 0.]
           [0. 0. 0. ... 0. 0. 0.]
           [0. 0. 0. ... 0. 0. 0.]],
          Quantum object: dims=[[3, 3, 3, 3], [3, 3, 3, 3]], shape=(81, 81), type='oper', dtype=CSR, i
         sherm=True
          Qobj data =
          [[0. 0. 0. ... 0. 0. 0.]
           [0. 0. 0. ... 0. 0. 0.]
           [0. 0. 0. ... 0. 0. 0.]
           ...
           [0. 0. 0. ... 0. 0. 0.]
           [0. 0. 0. ... 0. 0. 0.]
           [0. 0. 0. ... 0. 0. 0.]],
          Quantum object: dims=[[3, 3, 3, 3], [3, 3, 3, 3]], shape=(81, 81), type='oper', dtype=CSR, i
         sherm=True
          Qobj data =
          [[0. 0. 0. ... 0. 0. 0.]
           [0. 0. 0. ... 0. 0. 0.]
           [0. 0. 0. ... 0. 0. 0.]
           ...
           [0. 0. 0. ... 0. 0. 0.]
           [0. 0. 0. ... 0. 0. 0.]
           [0. 0. 0. ... 0. 0. 0.]],
          Quantum object: dims=[[3, 3, 3, 3], [3, 3, 3, 3]], shape=(81, 81), type='oper', dtype=CSR, i
         sherm=True
          Qobj data =
          [[0.         0.         0.31622777 ... 0.         0.         0.        ]
           [0.         0.         0.31622777 ... 0.         0.         0.        ]
           [0.31622777 0.31622777 0.         ... 0.         0.         0.        ]
           ...
           [0.         0.         0.         ... 0.         0.         0.31622777]
           [0.         0.         0.         ... 0.         0.         0.31622777]
           [0.         0.         0.         ... 0.31622777 0.31622777 0.        ]]]
```

```
In [22]: leakage_backend._sim_obj.initial_state
```

Out[22]: Quantum object: dims=[[3, 3, 3, 3], [1, 1, 1, 1]], shape=(81, 1), type='ket', dtype=CSR

$$\begin{pmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ \vdots \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{pmatrix}$$

```
In [23]: %timeit leakage_backend.run()
```

```
1.03 s ± 11.3 ms per loop (mean ± std. dev. of 7 runs, 1 loop each)
```

```
In [24]: leakage_backend_with_init = pulser_simulation.QutipBackend(
             seq,
```

```
    pulser.EmulatorConfig(
        with_modulation=True,
        noise_model=pulser.NoiseModel(
            with_leakage=True,
            eff_noise_opers=[qutip.Qobj([[0, 0, 1], [0, 0, 1], [1, 1, 0]])],
            eff_noise_rates=[0.1]
        ),
        initial_state=np.kron(np.kron(np.kron([0, 1, 0], [1, 0, 0]), [1, 0, 0]), [1, 0, 0])
    )
)
```

In [25]:

```
leakage_backend_with_init._sim_obj.initial_state
```

Out[25]: Quantum object: dims=[[3, 3, 3, 3], [1, 1, 1, 1]], shape=(81, 1), type='ket', dtype=CSR

$$\begin{pmatrix}0\\0\\0\\0\\0\\\vdots\\0\\0\\0\\0\\0\end{pmatrix}$$

In [26]:

```
%timeit leakage_backend_with_init.run()
```

```
1.03 s ± 11.4 ms per loop (mean ± std. dev. of 7 runs, 1 loop each)
```