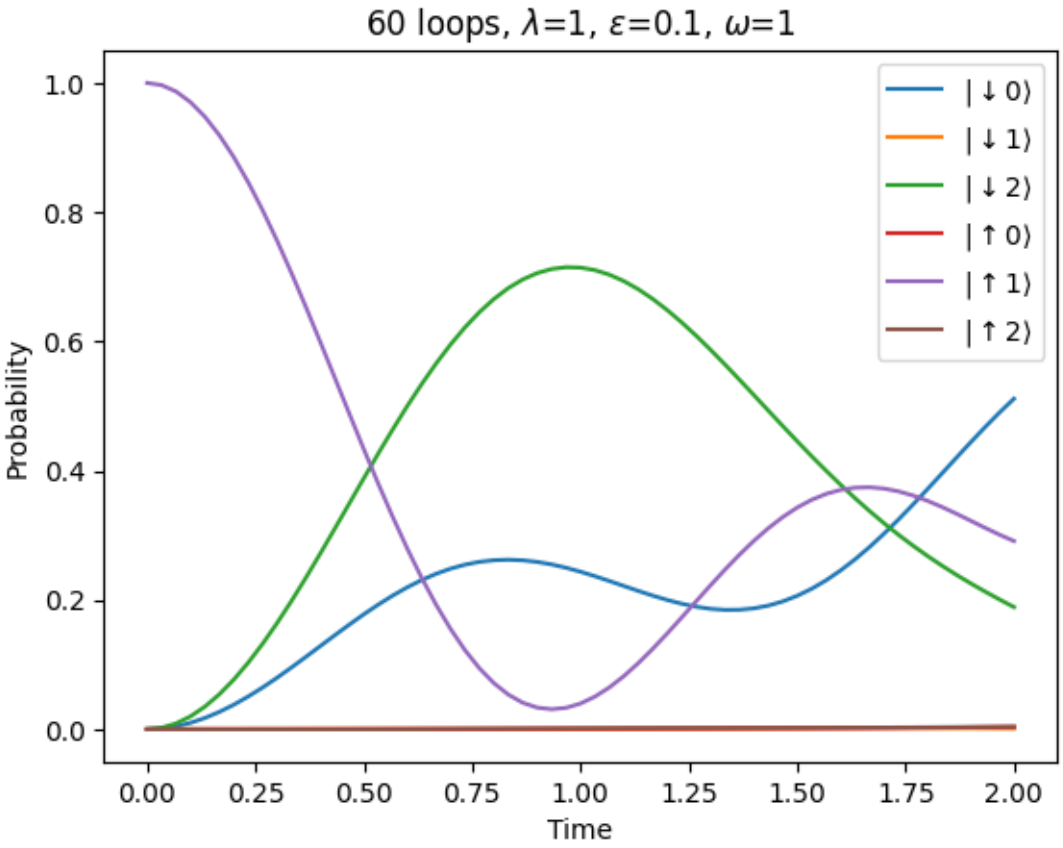
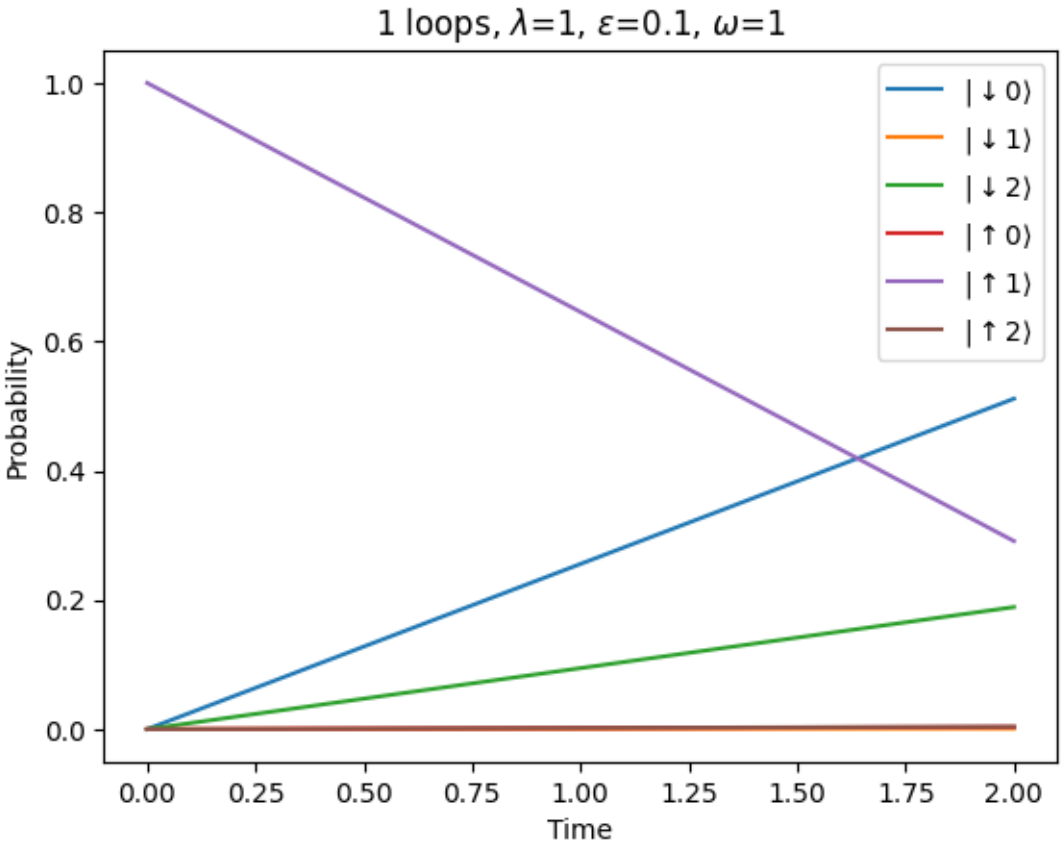
spin-boson-parameters

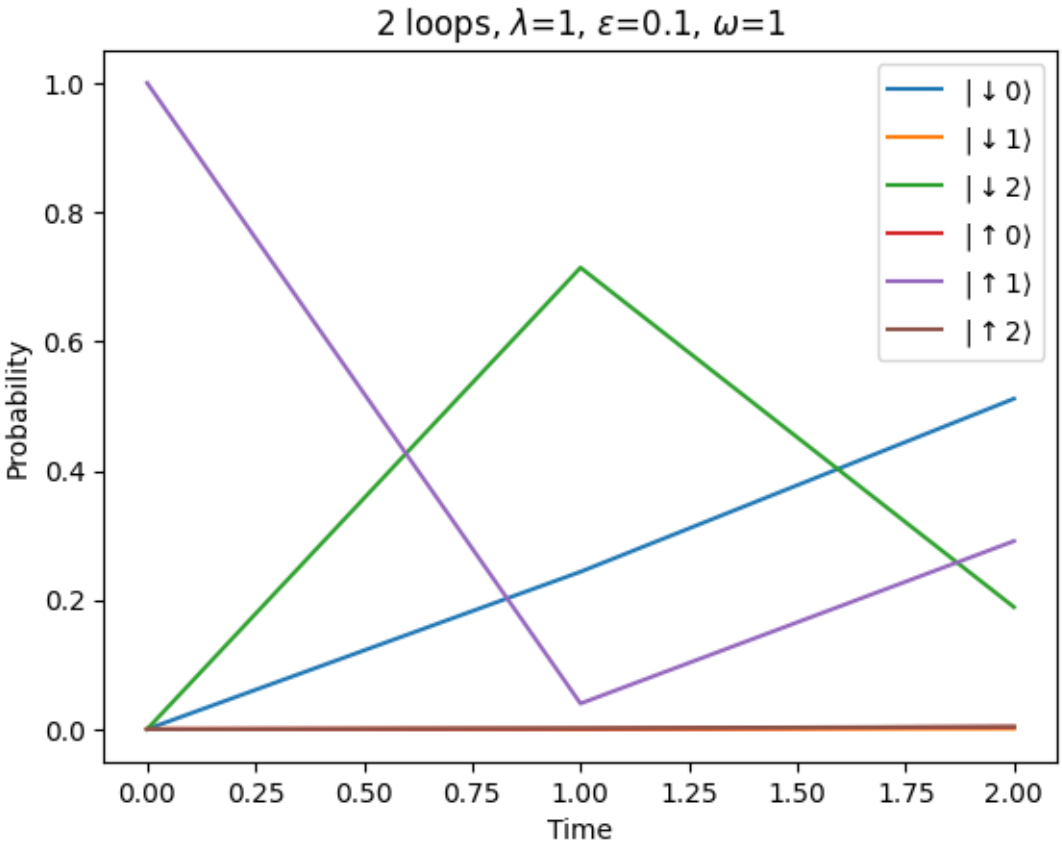
April 21, 2023

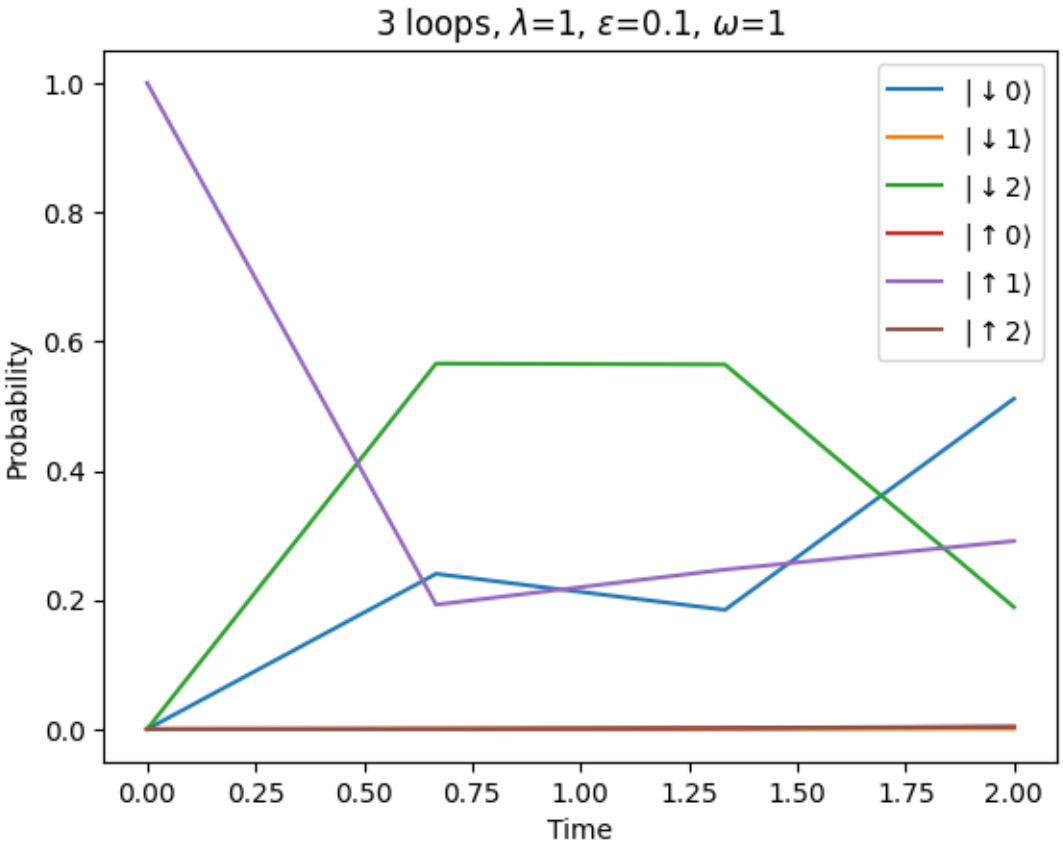
[ ]:
```
import numpy as np

# widget
%matplotlib inline

from spin_boson import plot_all
```

[ ]:
```
# initial state
# spin up (excited), one boson
initial = np.kron(np.array([0, 1]), np.array([0, 1, 0]))

# time 0, ..., t
t = 2

# parameters
# epsilon: spin x-field strength
# omega: harmonic oscillator (boson) frequency
# lambd: spin-boson coupling strength
params = [0.1, 1, 1] # epsilon, omega, lambda

plot_all(t, *params, initial)
```

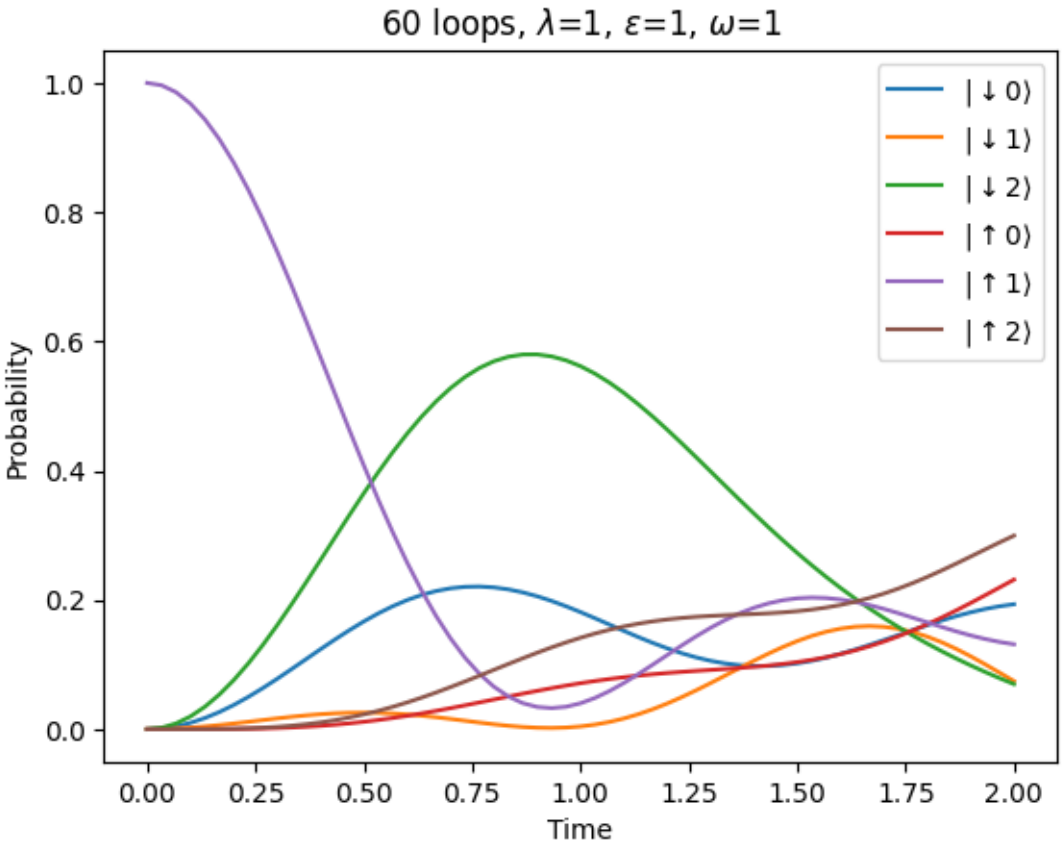

60 loops, λ=1, ε=0.1, ω=1
Probability
Time
0.0
0.2
0.4
0.6
0.8
1.0
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
| ↓ 0⟩
| ↓ 1⟩
| ↓ 2⟩
| ↑ 0⟩
| ↑ 1⟩
| ↑ 2⟩

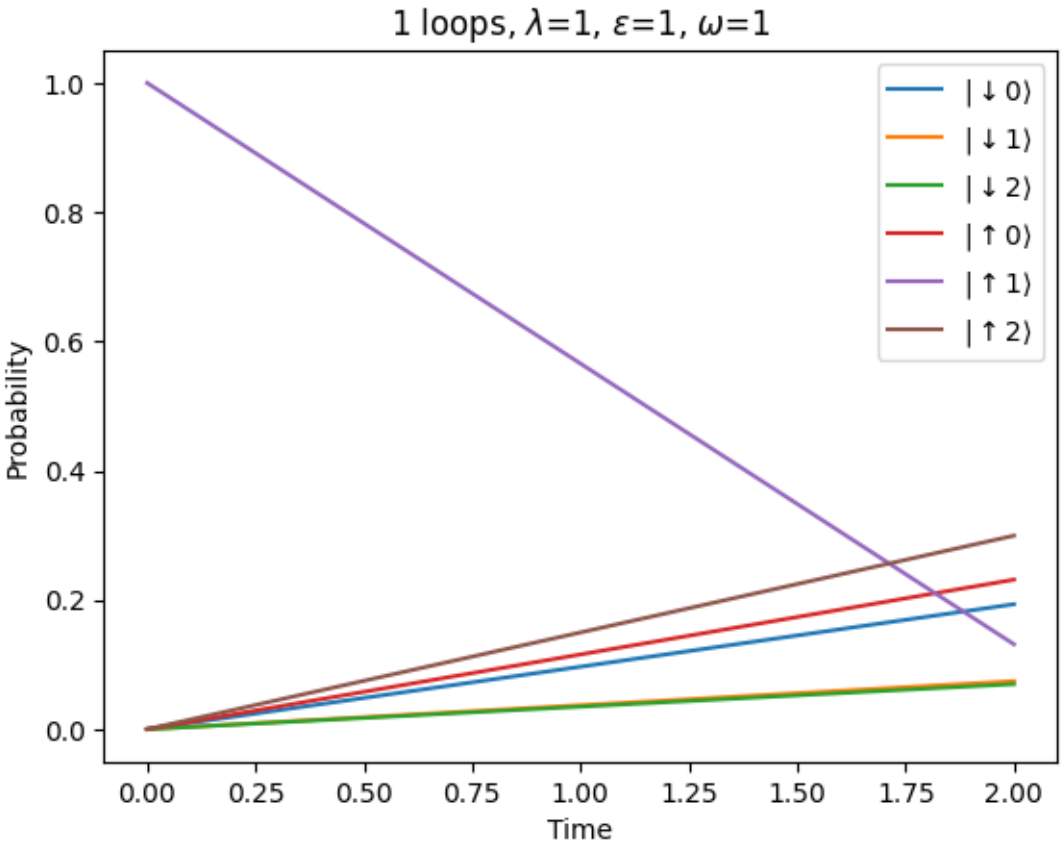

1 loops, λ=1, ε=0.1, ω=1
Probability
Time
1.0
0.8
0.6
0.4
0.2
0.0
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
| ↓ 0⟩
| ↓ 1⟩
| ↓ 2⟩
| ↑ 0⟩
| ↑ 1⟩
| ↑ 2⟩

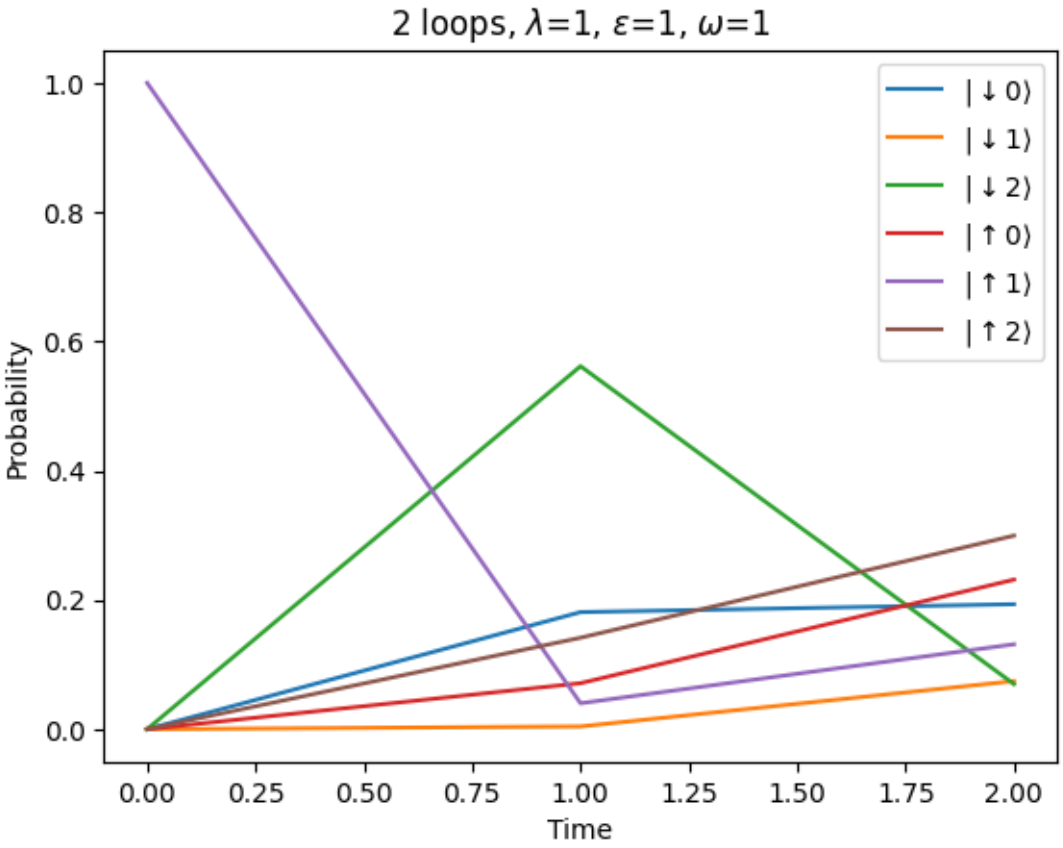

2 loops, λ=1, ε=0.1, ω=1
Probability
Time
0.0
0.2
0.4
0.6
0.8
1.0
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
| ↓ 0⟩
| ↓ 1⟩
| ↓ 2⟩
| ↑ 0⟩
| ↑ 1⟩
| ↑ 2⟩

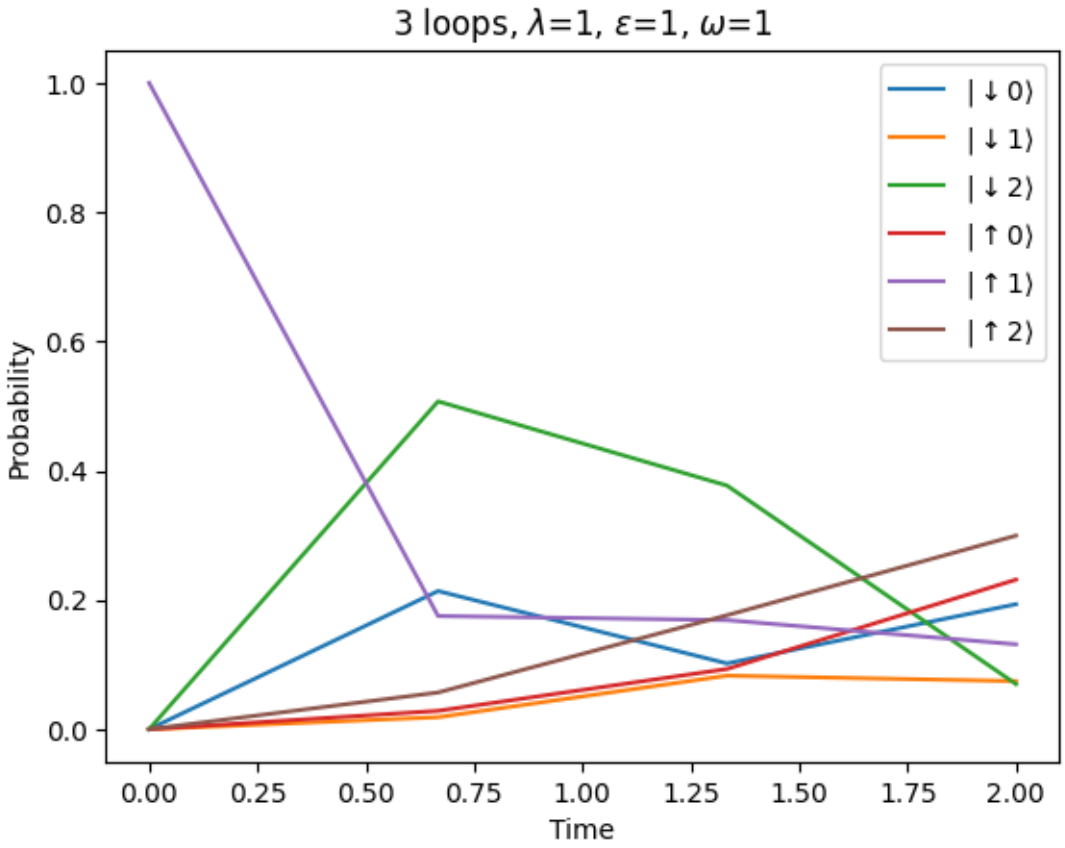


[ ]:
```
params = [1, 1, 1] # epsilon, omega, lambda
plot_all(t, *params, initial)
```

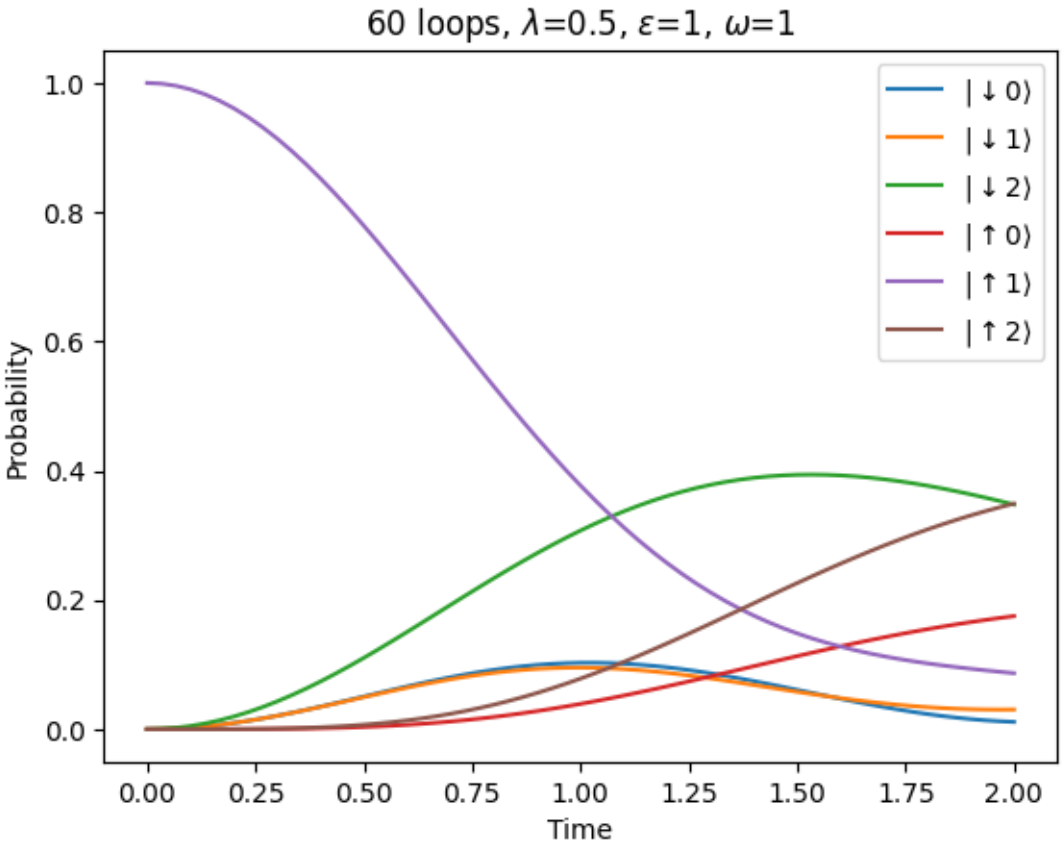

60 loops, λ=1, ε=1, ω=1
Probability
Time
0.0
0.2
0.4
0.6
0.8
1.0
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
| ↓ 0⟩
| ↓ 1⟩
| ↓ 2⟩
| ↑ 0⟩
| ↑ 1⟩
| ↑ 2⟩

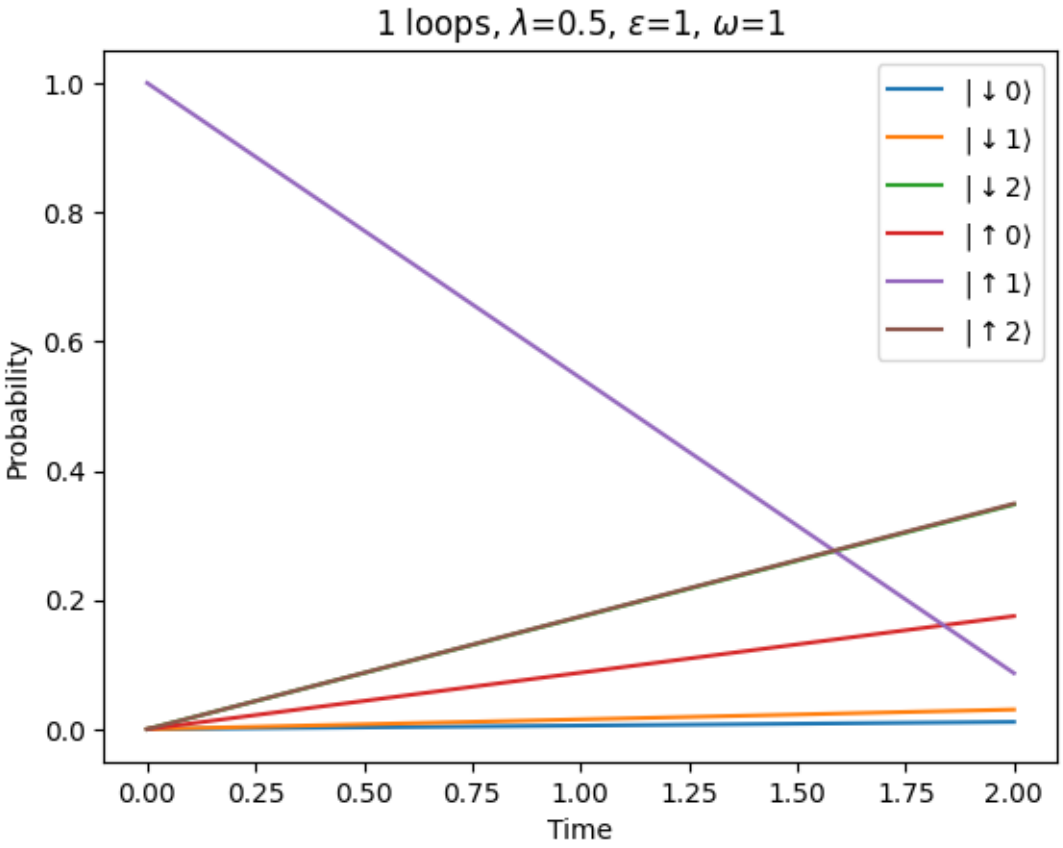

1 loops, λ=1, ε=1, ω=1
Probability
Time
0.0
0.2
0.4
0.6
0.8
1.0
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
| ↓ 0⟩
| ↓ 1⟩
| ↓ 2⟩
| ↑ 0⟩
| ↑ 1⟩
| ↑ 2⟩

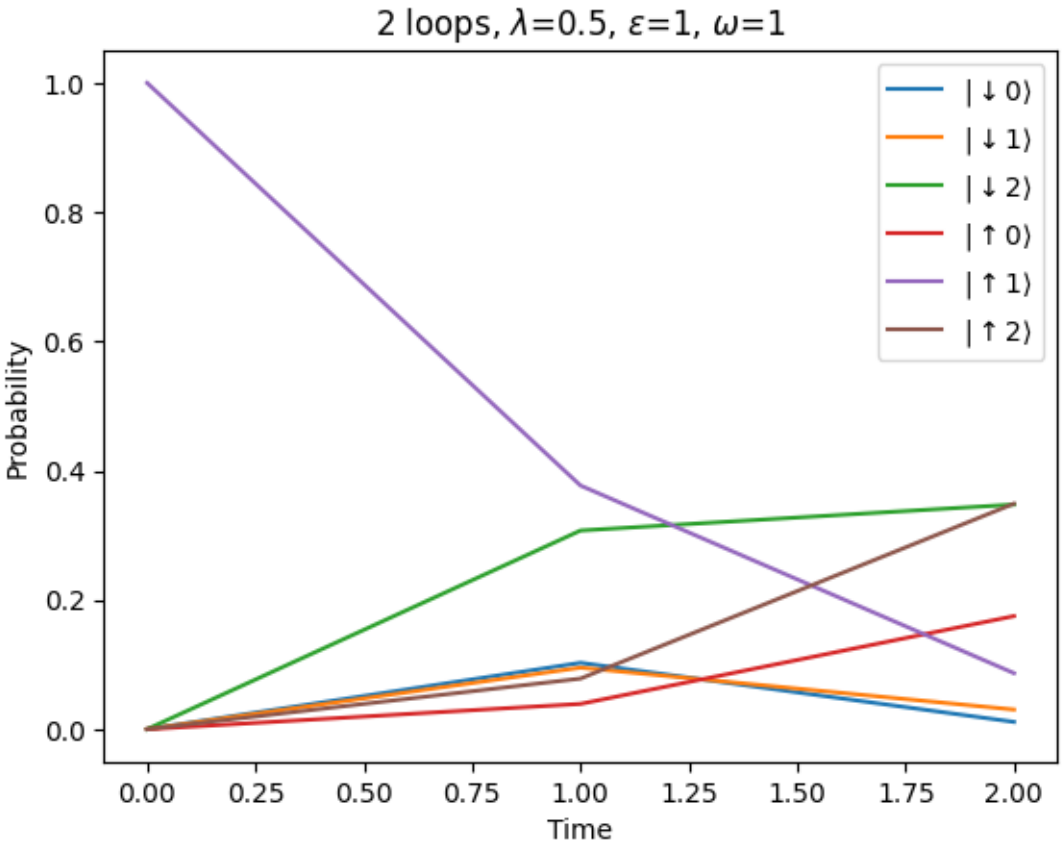

2 loops, λ=1, ε=1, ω=1
Probability
Time
1.0
0.8
0.6
0.4
0.2
0.0
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
| ↓ 0⟩
| ↓ 1⟩
| ↓ 2⟩
| ↑ 0⟩
| ↑ 1⟩
| ↑ 2⟩

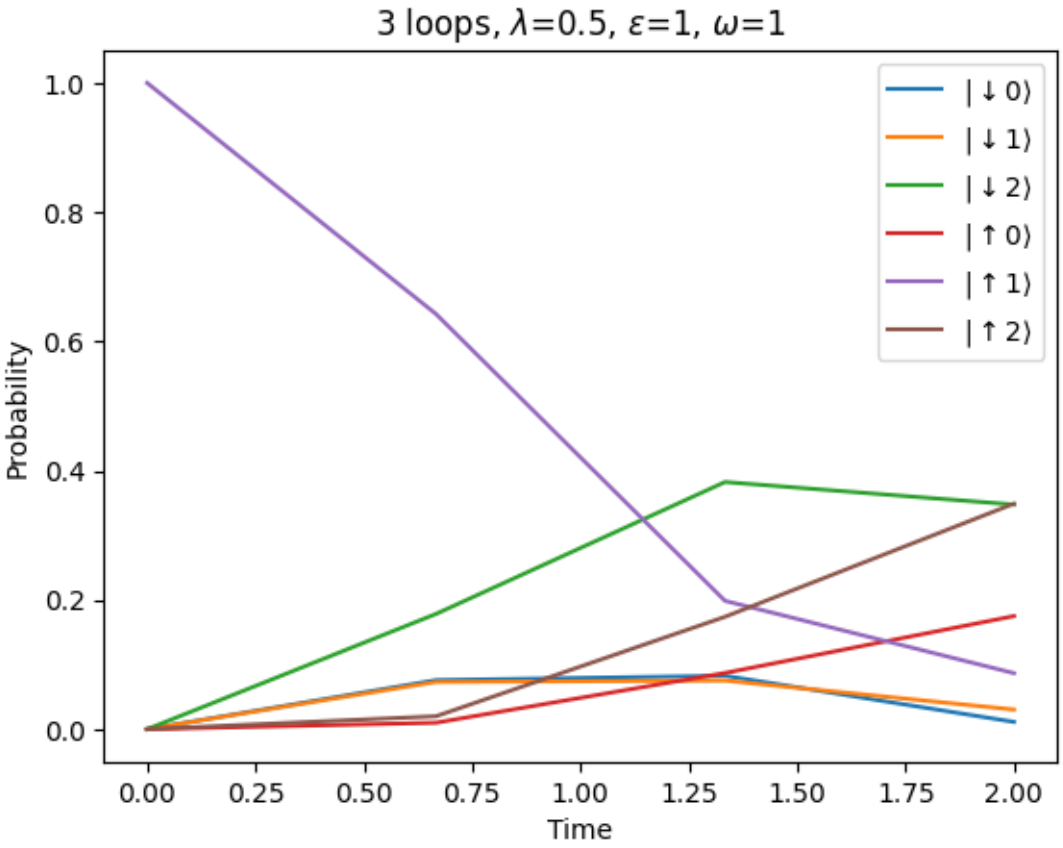


[ ]:
```
params = [1, 1, 0.5] # epsilon, omega, lambda
plot_all(t, *params, initial)
```


60 loops, λ=0.5, ε=1, ω=1
Probability
Time
1.0
0.8
0.6
0.4
0.2
0.0
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
| ↓ 0⟩
| ↓ 1⟩
| ↓ 2⟩
| ↑ 0⟩
| ↑ 1⟩
| ↑ 2⟩


1 loops, λ=0.5, ε=1, ω=1
Probability
Time
0.0
0.2
0.4
0.6
0.8
1.0
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
| ↓ 0⟩
| ↓ 1⟩
| ↓ 2⟩
| ↑ 0⟩
| ↑ 1⟩
| ↑ 2⟩


2 loops, λ=0.5, ε=1, ω=1
Probability
Time
1.0
0.8
0.6
0.4
0.2
0.0
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
| ↓ 0⟩
| ↓ 1⟩
| ↓ 2⟩
| ↑ 0⟩
| ↑ 1⟩
| ↑ 2⟩


3 loops, λ=0.5, ε=1, ω=1
Probability
Time
0.0
0.2
0.4
0.6
0.8
1.0
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
| ↓ 0⟩
| ↓ 1⟩
| ↓ 2⟩
| ↑ 0⟩
| ↑ 1⟩
| ↑ 2⟩