Introduction_QuantumSystem_CoupledStates

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1 PyOR Quantum

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1.0.2 Introduction to Coupled States

[1]:
```
SourcePath = '/media/HD2/Vineeth/PostDoc_Simulations/Github/PyOR_V1/Source'
import sys
sys.path.append(SourcePath)

from PythonOnResonance_MagneticResonance import MagneticResonance
from PythonOnResonance_Quantum import QunObj, QuantumLibrary, QuantumSystem

import time
import numpy as np
import matplotlib.pyplot as plt
from matplotlib import rc
%matplotlib ipympl
import sympy as sp
from sympy import *
```

[2]:
```
SpinList = {"I": 1/2,"S": 1/2,"A": 1/2}

QS = QuantumSystem(SpinList)
QLib = QuantumLibrary()

QS.SpinOperator(PrintDefault=False)
```

1.0.3 Zeeman State

[3]:
```
# Zeeman states of all spins
X1 = QS.StateZeeman({"I": 1/2,"S": 1/2,"A": 1/2})
X1.matrix
```

[3]:

$$\begin{bmatrix} 1.0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}$$

[4]:
```
# Zeeman states of first two spins
X2 = QS.StateZeeman({"I": 1/2,"S": 1/2})
X2.matrix
```

[4]:
$$\begin{bmatrix} 1.0 \\ 0 \\ 0 \\ 0 \end{bmatrix}$$

[5]:
```
# Zeeman states of first spin
X3 = QS.StateZeeman({"I": 1/2})
X3.matrix
```

[5]:
$$\begin{bmatrix} 1.0 \\ 0 \end{bmatrix}$$

1.0.4 Coupled State

[6]:
```
# Three uncouple spins
X4 = QS.States([{"I": 1/2},{"S": 1/2},{"A": -1/2}])
X4.matrix
```

[6]:
$$\begin{bmatrix} 0 \\ 1.0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}$$

[7]:
```
# Two uncoupled spins
X5 = QS.States([{"I": 1/2},{"S": 1/2}])
X5.matrix
```

[7]:
$$\begin{bmatrix} 1.0 \\ 0 \\ 0 \\ 0 \end{bmatrix}$$

[8]:
```
# One uncoupled spin
X6 = QS.States([{"I": 1/2}])
X6.matrix
```

[8]:
$$\begin{bmatrix} 1.0 \\ 0 \end{bmatrix}$$

[9]:
```
# Two coupled spins: Triplet
X7 = QS.States([{"New" : {"l" : 1, "m" : 0},"Old" : {"S": 1/2,"A": 1/2}}])
X7.matrix
```

[9]:
$$\begin{bmatrix} 0 \\ 0.707106781186548 \\ 0.707106781186547 \\ 0 \end{bmatrix}$$

[10]:
```
# One uncoupled spin and Two coupled spins
X8 = QS.States([{"I": 1/2},{"New" : {"l" : 1, "m" : 0},"Old" : {"S": 1/2,"A": 1/
↪2}}])
X8.matrix
```

[10]:
$$\begin{bmatrix} 0 \\ 0.707106781186548 \\ 0.707106781186547 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}$$

[11]:
```
# Checking: Kronecker product of X6 and X7
X6.Tensor(X7).matrix
```

[11]:
$$\begin{bmatrix} 0 \\ 0.707106781186548 \\ 0.707106781186547 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}$$

[12]:
```
# Two coupled spins: Triplet
X9 = QS.States([{"New" : {"l" : 1, "m" : -1},"Old" : {"S": 1/2,"A": 1/2}}])
X9.matrix
```

[12]:

$$\begin{bmatrix} 0 \\ 0 \\ 0 \\ 1.0 \end{bmatrix}$$

[13]:
```
# Two coupled spins: Triplet
X10 = QS.States([{"New" : {"l" : 1, "m" : 1},"Old" : {"S": 1/2,"A": 1/2}}])
X10.matrix
```

[13]:
$$\begin{bmatrix} 1.0 \\ 0 \\ 0 \\ 0 \end{bmatrix}$$

[14]:
```
# Two coupled spins: Singlet
X11 = QS.States([{"New" : {"l" : 0, "m" : 0},"Old" : {"S": 1/2,"A": 1/2}}])
X11.matrix
```

[14]:
$$\begin{bmatrix} 0 \\ -0.707106781186547 \\ 0.707106781186548 \\ 0 \end{bmatrix}$$