In[1]:= `Needs["SpinDynamica`"]`

```
SpinDynamica version 3.0.1 loaded
```

ModifyBuiltIn: The following built–in routines have been modified in SpinDynamica:
{Chop, Dot, Duration, Exp, Expand, ExpandAll, NumericQ, Plus, Power, Simplify, Times, WignerD}.
Evaluate ??*symbol* to generate the additional definitions for *symbol*.

In[2]:= `SetSpinSystem[2]`

SetSpinSystem: the spin system has been set to $\{\{1, \frac{1}{2}\}, \{2, \frac{1}{2}\}\}$

SetBasis: the state basis has been set to ZeemanBasis$[\{\{1, \frac{1}{2}\}, \{2, \frac{1}{2}\}\}$, BasisLabels → Automatic].

bases

ZeemanBasis

In[3]:= `Basis[]`

Out[3]= ZeemanBasis$[\{\{1, \frac{1}{2}\}, \{2, \frac{1}{2}\}\}$, BasisLabels → Automatic]

In[4]:= `BasisKets[]`

Out[4]= $\{|\alpha\alpha\rangle, |\beta\alpha\rangle, |\alpha\beta\rangle, |\beta\beta\rangle\}$

In[5]:= `BasisBras[]`

Out[5]= $\{\langle\alpha\alpha|, \langle\beta\alpha|, \langle\alpha\beta|, \langle\beta\beta|\}$

In[6]:= `MatrixRepresentation[opI["y"]] // MatrixForm`

Out[6]//MatrixForm=

$$\begin{pmatrix} 0 & -\frac{i}{2} & -\frac{i}{2} & 0 \\ \frac{i}{2} & 0 & 0 & -\frac{i}{2} \\ \frac{i}{2} & 0 & 0 & -\frac{i}{2} \\ 0 & \frac{i}{2} & \frac{i}{2} & 0 \end{pmatrix}$$

SingletTripletBasis

In[7]:= `SetBasis[SingletTripletBasis[]]`

SetBasis: the state basis has been set to SingletTripletBasis$[\{\{1, \frac{1}{2}\}, \{2, \frac{1}{2}\}\}$, BasisLabels → Automatic].

In[8]:= `BasisKets[]`

Out[8]= $\left\{\frac{-|\beta\alpha\rangle + |\alpha\beta\rangle}{\sqrt{2}}, |\alpha\alpha\rangle, \frac{|\beta\alpha\rangle + |\alpha\beta\rangle}{\sqrt{2}}, |\beta\beta\rangle\right\}$

In[9]:= `BasisBras[]`

Out[9]= $\left\{\frac{-\langle\beta\alpha| + \langle\alpha\beta|}{\sqrt{2}}, \langle\alpha\alpha|, \frac{\langle\beta\alpha| + \langle\alpha\beta|}{\sqrt{2}}, \langle\beta\beta|\right\}$

In[10]:=
```
MatrixRepresentation[opI["y"]] // MatrixForm
```

Out[10]//MatrixForm=

$$\begin{pmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & -\frac{i}{\sqrt{2}} & 0 \\ 0 & \frac{i}{\sqrt{2}} & 0 & -\frac{i}{\sqrt{2}} \\ 0 & 0 & \frac{i}{\sqrt{2}} & 0 \end{pmatrix}$$

Eigenbasis

In[11]:=
```
SetBasis[Eigenbasis[opI["x"]]]
```

CheckBasis: State basis is orthonormal.

SetBasis: the state basis has been set to Eigenbasis$\left[I_{1x} + I_{2x}, \left\{\left\{1, \frac{1}{2}\right\}, \left\{2, \frac{1}{2}\right\}\right\}, \text{BasisLabels} \to \text{Automatic}\right]$.

In[12]:=
```
BasisKets[]
```

Out[12]= $\left\{\frac{|\beta\beta\rangle}{2} - \frac{|\beta\alpha\rangle}{2} - \frac{|\alpha\beta\rangle}{2} + \frac{|\alpha\alpha\rangle}{2}, \frac{|\beta\beta\rangle}{2} + \frac{|\beta\alpha\rangle}{2} + \frac{|\alpha\beta\rangle}{2} + \frac{|\alpha\alpha\rangle}{2}, \frac{|\beta\beta\rangle}{\sqrt{2}} - \frac{|\alpha\alpha\rangle}{\sqrt{2}}, -\frac{|\beta\alpha\rangle}{\sqrt{2}} + \frac{|\alpha\beta\rangle}{\sqrt{2}}\right\}$

In[13]:=
```
BasisBras[]
```

Out[13]= $\left\{\frac{\langle\beta\beta|}{2} - \frac{\langle\beta\alpha|}{2} - \frac{\langle\alpha\beta|}{2} + \frac{\langle\alpha\alpha|}{2}, \frac{\langle\beta\beta|}{2} + \frac{\langle\beta\alpha|}{2} + \frac{\langle\alpha\beta|}{2} + \frac{\langle\alpha\alpha|}{2}, \frac{\langle\beta\beta|}{\sqrt{2}} - \frac{\langle\alpha\alpha|}{\sqrt{2}}, -\frac{\langle\beta\alpha|}{\sqrt{2}} + \frac{\langle\alpha\beta|}{\sqrt{2}}\right\}$

In[14]:=
```
MatrixRepresentation[opI["y"]] // MatrixForm
```

Out[14]//MatrixForm=

$$\begin{pmatrix} 0 & 0 & \frac{i}{\sqrt{2}} & 0 \\ 0 & 0 & -\frac{i}{\sqrt{2}} & 0 \\ -\frac{i}{\sqrt{2}} & \frac{i}{\sqrt{2}} & 0 & 0 \\ 0 & 0 & 0 & 0 \end{pmatrix}$$

In[15]:=
```
MatrixRepresentation[opI["x"]] // MatrixForm
```

Out[15]//MatrixForm=

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

BasisLabels

In[16]:=
```
? BasisLabels
```

BasisLabels is an option for the Hilbert space bases. If *BasisLabels→Automatic* (default), the Kets and Bras may be referred to using integers running from 1 to the basis dimension. The option *BasisLabels→{a,b,c..}* allows the integers or strings *{a,b,c..}* to be used to refer to the Kets and Bras. The operation *BasisLabels*[*basis*] may also be used to obtain the set of state labels defined for a particular basis.

In[17]:=
```
SetBasis[]
```

SetBasis: the state basis has been set to ZeemanBasis$\left[\left\{\left\{1, \frac{1}{2}\right\}, \left\{2, \frac{1}{2}\right\}\right\}, \text{BasisLabels} \to \text{Automatic}\right]$.

In[18]:=
```
BasisLabels[]
```

Out[18]= {1, 2, 3, 4}

In[19]:=
```
Ket[1]
```

Out[19]= $|\alpha\alpha\rangle$

In[20]:=
```
Bra[3]
```

Out[20]= $<\alpha\beta|$

In[21]:=
```
SetBasis[ZeemanBasis[BasisLabels → {0, 1, 2, 3}]]
```

SetBasis: the state basis has been set to ZeemanBasis$\left[\left\{\left\{1, \frac{1}{2}\right\}, \left\{2, \frac{1}{2}\right\}\right\}, \text{BasisLabels} \to \{0, 1, 2, 3\}\right]$.

In[22]:=
```
Ket[0]
```

Out[22]= $|\alpha\alpha\rangle$

In[23]:=
```
Bra[3]
```

Out[23]= $<\beta\beta|$