```
Needs["SpinDynamica`"]
```

spherical tensor operators

```
? opT
```

opT[j,{1,μ}] defines a first−rank spherical tensor operator for spin j.

opT[{1,μ}] defaults to opT[1,{1,μ}].
opT[{j,k},{2,μ}] defines a second−rank spherical tensor operator for spins j and k.
opT[2,μ] defaults to opT[{1,2},{2,μ}]
opT[{{j,λ_j},{k,λ_k}..},{Λ,M}] generates a Λth rank ISTO by coupling together
    the interactions {{j,λ_j},{k,λ_k}..} where j is a symbol identifying the interaction and λ_j is its rank.
In cases where there are many possible couplings the form opT[{{j,λ_j},{k,λ_k}..},{Λ,M},n]
    must be used where n is an integer identifying the coupling scheme.
opT[{j,k..},{Λ,M}] defaults to opT[{{j,1},{k,1}..},{Λ,M}].
The option Normalize−>True may be set to generate STOs normalized in the current state basis.

single spin-1/2

```
SetSpinSystem[1]
```

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

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

```
opT[1, {1, 0}]
```

I_{1z}

```
opT[1, {2, 0}]
```

opT::singlespinranktoohigh : spin system does not support a single−spin irreducible spherical tensor operator of rank 2

0

```
opT[1, {1, 1}]
```

$$-\frac{\mathrm{I}_1^+}{\sqrt{2}}$$

```
opT[1, {1, -1}]
```

$$\frac{\mathrm{I}_1^-}{\sqrt{2}}$$

single spin-3/2

```
SetSpinSystem[{{1, 3 / 2}}]
```

SetSpinSystem::set : the spin system has been set to $\left\{\left\{1, \frac{3}{2}\right\}\right\}$

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

```
opT[1, {1, 0}]
```

$$I_{1z}$$

```
opT[1, {2, 0}]
```

$$-\frac{I_1^-.I_1^+}{2\sqrt{6}}-\frac{I_1^+.I_1^-}{2\sqrt{6}}+\sqrt{\frac{2}{3}}\ I_{1z}.I_{1z}$$

```
opT[1, {2, 2}]
```

$$\frac{1}{2}\ I_1^+.I_1^+$$

```
opT[1, {3, 0}]
```

$$-\frac{I_1^-.I_1^+.I_{1z}}{2\sqrt{10}}-\frac{I_1^-.I_{1z}.I_1^+}{2\sqrt{10}}-\frac{I_1^+.I_1^-.I_{1z}}{2\sqrt{10}}-\frac{I_1^+.I_{1z}.I_1^-}{2\sqrt{10}}-\frac{I_{1z}.I_1^-.I_1^+}{2\sqrt{10}}-\frac{I_{1z}.I_1^+.I_1^-}{2\sqrt{10}}+\sqrt{\frac{2}{5}}\ I_{1z}.I_{1z}.I_{1z}$$

```
opT[1, {3, 3}]
```

$$-\frac{I_1^+.I_1^+.I_1^+}{2\sqrt{2}}$$

spin-1/2 pairs

```
SetSpinSystem[2]
```

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

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

```
opT[1, {1, 0}]
```

$$I_{1z}$$

```
opT[{1, 2}, {2, 0}]
```

$$-\frac{I_1^-.I_2^+}{2\sqrt{6}}-\frac{I_1^+.I_2^-}{2\sqrt{6}}+\sqrt{\frac{2}{3}}\ I_{1z}.I_{2z}$$

```
opT[{1, 2}, {1, 1}]
```

$$-\frac{1}{2}\ I_1^+.I_{2z}+\frac{1}{2}\ I_{1z}.I_2^+$$

```
opT[{1, 2}, {2, 2}]
```

$$\frac{1}{2}\ I_1^+.I_2^+$$

3 spins-1/2

```
SetSpinSystem[3]
```

SetSpinSystem::set : the spin system has been set to $\left\{\left\{1,\frac{1}{2}\right\},\left\{2,\frac{1}{2}\right\},\left\{3,\frac{1}{2}\right\}\right\}$

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

```
opT[1, {1, 0}]
```

$$I_{1z}$$

```
opT[{1, 2}, {2, 0}]
```

$$-\frac{I_1^-.I_2^+}{2\sqrt{6}}-\frac{I_1^+.I_2^-}{2\sqrt{6}}+\sqrt{\frac{2}{3}}\ I_{1z}.I_{2z}$$

```
opT[{1, 2}, {1, 1}]
```

$$-\frac{1}{2}\ I_1^+.I_{2z}+\frac{1}{2}\ I_{1z}.I_2^+$$

```
opT[{1, 2}, {2, 2}]
```

$$\frac{1}{2}\ I_1^+.I_2^+$$

```
opT[{1, 2, 3}, {3, 3}]
```

$$-\frac{I_1^+.I_2^+.I_3^+}{2\sqrt{2}}$$

```
opT[{1, 2, 3}, {3, 2}]
```

$$\frac{I_1^+.I_2^+.I_{3z}}{2\sqrt{3}}+\frac{I_1^+.I_{2z}.I_3^+}{2\sqrt{3}}+\frac{I_{1z}.I_2^+.I_3^+}{2\sqrt{3}}$$

```
opT[{1, 2, 3}, {2, 2}]
```

opT::multiple :

There are 2 operators with this specification. A list of all possibilities has been returned. Specify a single operator using the form opT[interactions,{Lam,M},index] where index is an integer.

$$\left\{\frac{I_1^+.I_{2\,z}.I_3^+}{2\sqrt{2}}-\frac{I_{1\,z}.I_2^+.I_3^+}{2\sqrt{2}},\ \frac{I_1^+.I_2^+.I_{3\,z}}{\sqrt{6}}-\frac{I_1^+.I_{2\,z}.I_3^+}{2\sqrt{6}}-\frac{I_{1\,z}.I_2^+.I_3^+}{2\sqrt{6}}\right\}$$

```
opT[{1, 2, 3}, {2, 2}, 1]
```

$$\frac{I_1^+.I_{2\,z}.I_3^+}{2\sqrt{2}}-\frac{I_{1\,z}.I_2^+.I_3^+}{2\sqrt{2}}$$

```
opT[{1, 2, 3}, {2, 2}, 2]
```

$$\frac{I_1^+.I_2^+.I_{3\,z}}{\sqrt{6}}-\frac{I_1^+.I_{2\,z}.I_3^+}{2\sqrt{6}}-\frac{I_{1\,z}.I_2^+.I_3^+}{2\sqrt{6}}$$