Jones Calculus

Jones Vectors

- **Linear Horizontal**

$$lh = \begin{pmatrix} 1 \\ 0 \end{pmatrix};$$

- **Linear Vertical**

$$lv = \begin{pmatrix} 0 \\ 1 \end{pmatrix};$$

- **Linear at +45 degrees**

$$lp45 = \frac{1}{\sqrt{2}} \begin{pmatrix} 1 \\ 1 \end{pmatrix};$$

- **Linear at -45 degrees**

$$lm45 = \frac{1}{\sqrt{2}} \begin{pmatrix} 1 \\ -1 \end{pmatrix};$$

- **Right Circular**

$$rc = \frac{1}{\sqrt{2}} \begin{pmatrix} 1 \\ -i \end{pmatrix};$$

- **Left Circular**

$$lc = \frac{1}{\sqrt{2}} \begin{pmatrix} 1 \\ i \end{pmatrix};$$

- **Right Elliptical**

$$re[ax\_, ay\_] := \frac{1}{\sqrt{ax^2 + ay^2}} \begin{pmatrix} ax \\ -i\, ay \end{pmatrix}$$

- **Left Elliptical**

$$le[ax\_, ay\_] := \frac{1}{\sqrt{ax^2 + ay^2}} \begin{pmatrix} ax \\ i\, ay \end{pmatrix}$$

Jones Matrices

- **Horizontal linear polarizer**

$$hlp = \begin{pmatrix} 1 & 0 \\ 0 & 0 \end{pmatrix};$$

- **Vertical linear polarizer**

$$vlp = \begin{pmatrix} 0 & 0 \\ 0 & 1 \end{pmatrix};$$

- **Linear polarizer at + 45 degrees**

```
lpp45 = 1/2 {{1, 1}, {1, 1}};
```

- **Linear polarizer at - 45 degrees**

```
lpm45 = 1/2 {{1, -1}, {-1, 1}};
```

- **Quarter-wave plate with fast axis vertical**

```
qfav = e^(i π/4) {{1, 0}, {0, -i}};
```

- **Quarter-wave plate with fast axis horizontal**

```
qfah = e^(-i π/4) {{1, 0}, {0, i}};
```

- **Retarder with fast axis vertical**

```
rfav[ϕ_] := e^(i ϕ/2) {{1, 0}, {0, e^(-i ϕ)}}
```

- **Retarder with fast axis horizontal**

```
rfah[ϕ_] := e^(-i ϕ/2) {{1, 0}, {0, e^(i ϕ)}}
```

Rotation Matrix

```
rot[θ_] := {{Cos[θ], Sin[θ]}, {-Sin[θ], Cos[θ]}}

Rotated Matrix = rot[-θ] R[0 °] rot[θ];

OutputPolarization = rot[-θ] R[0 °] rot[θ] InputPolarization;
```

- **Calculation of matrix of a retarder of retardation ϕ having a fast axis at an angle θ from the horizontal**

```
rrot[ϕ_, θ_] := FullSimplify[rot[-θ].rfah[ϕ].rot[θ]];
        MatrixForm[rrot[ϕ, θ]]
```

$$\begin{pmatrix} e^{-\frac{i\phi}{2}}\left(\text{Cos}[\theta]^2 + e^{i\phi}\,\text{Sin}[\theta]^2\right) & -i\,\text{Sin}[2\theta]\,\text{Sin}\left[\frac{\phi}{2}\right] \\ -i\,\text{Sin}[2\theta]\,\text{Sin}\left[\frac{\phi}{2}\right] & e^{-\frac{i\phi}{2}}\left(e^{i\phi}\,\text{Cos}[\theta]^2 + \text{Sin}[\theta]^2\right) \end{pmatrix}$$