Detection of State of Polarization (SOP) using Polarizer and QWP

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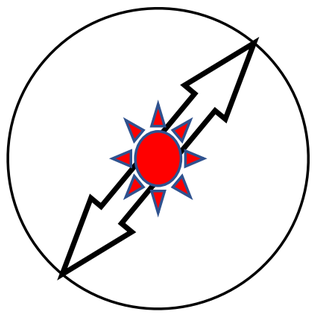
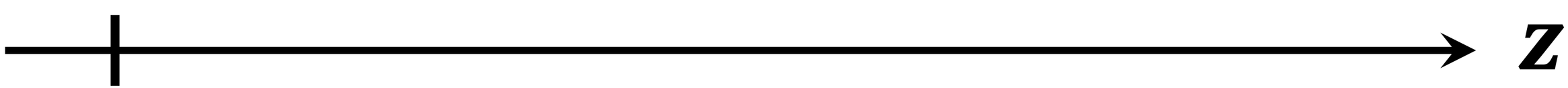
Possible to identify the following SOP

- Linearly polarized (LP)
- Circularly polarized (CP)
- Elliptically polarized (EP)
- Unpolarized (UP)
- LP + UP
- CP + UP
- EP + UP

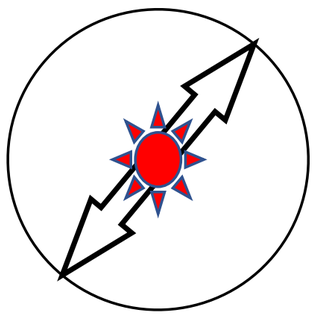
Identification of Linearly polarized light



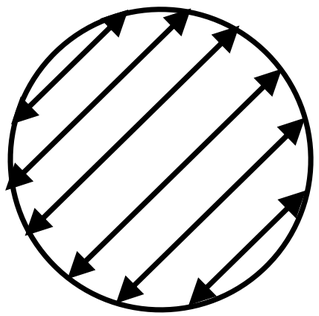
LP



Identification of Linearly polarized light

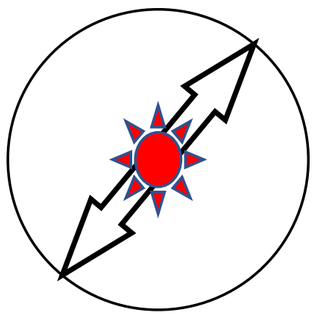


LP

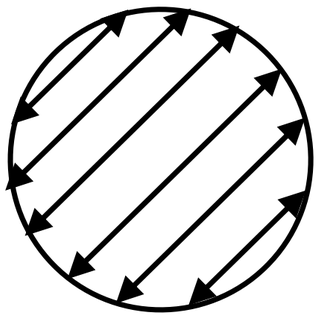


Polarizer at 0°

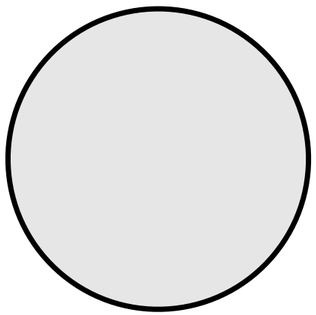
Identification of Linearly polarized light



LP

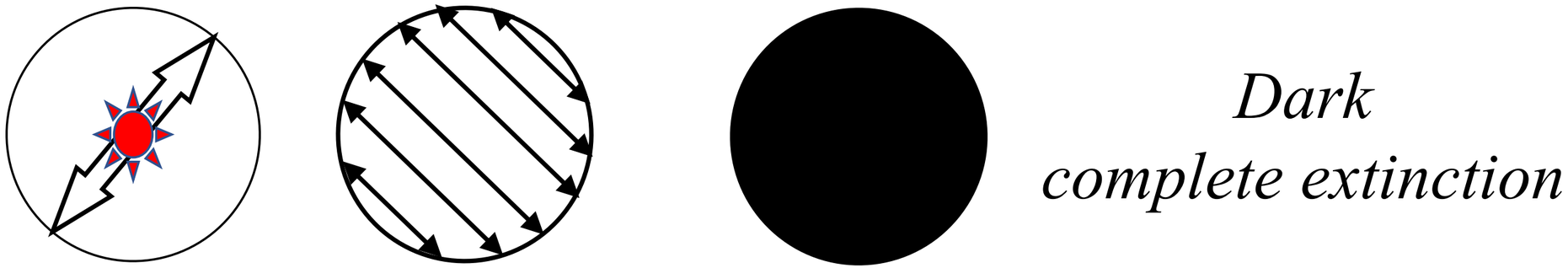


Polarizer at 0°



Screen: Bright

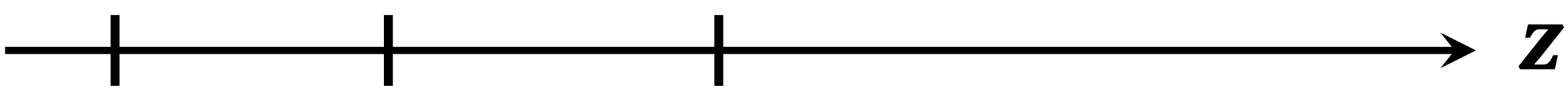
Identification of Linearly polarized light



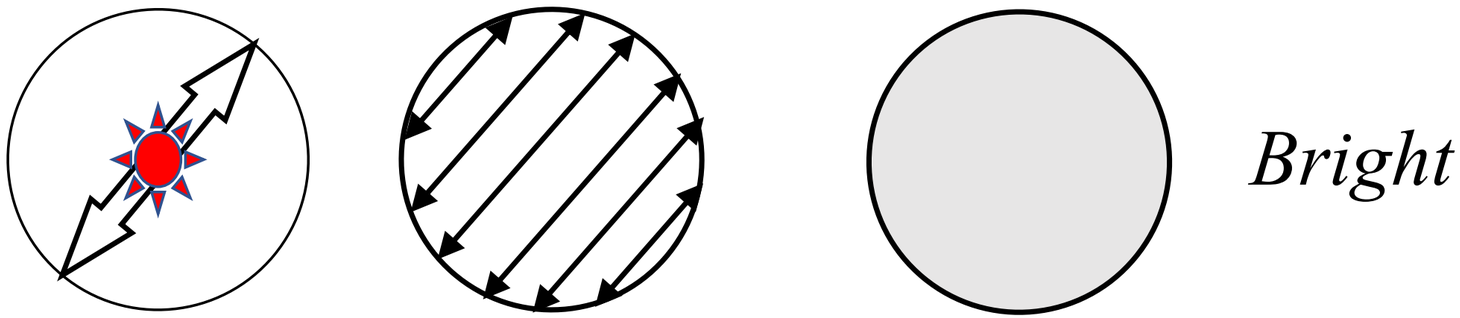
Dark
complete extinction

LP

Polarizer at 90°



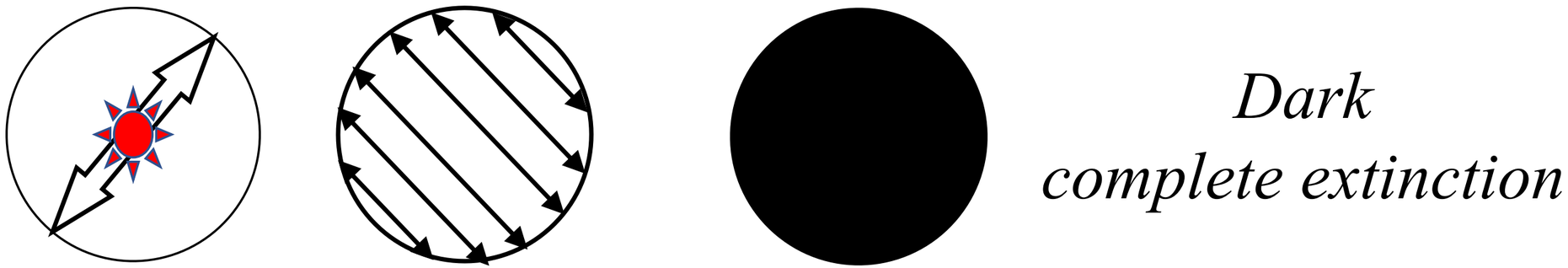
Identification of Linearly polarized light



Bright

LP *Polarizer at* 180°

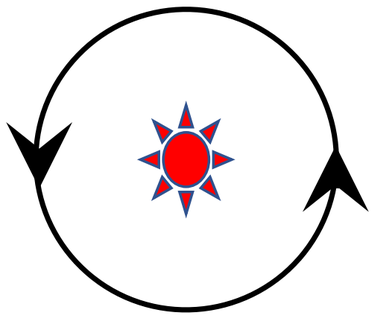
Identification of Linearly polarized light



Dark
complete extinction

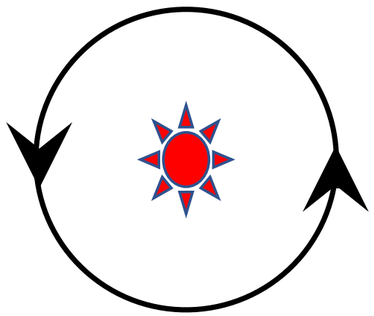
LP *Polarizer at* 270°

Identification of Circularly and / or unpolarized light

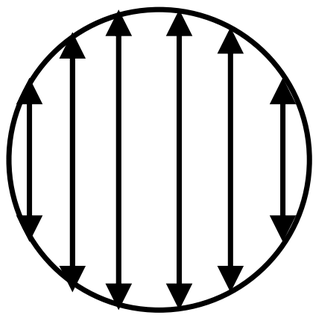


CP

Identification of Circularly and / or unpolarized light

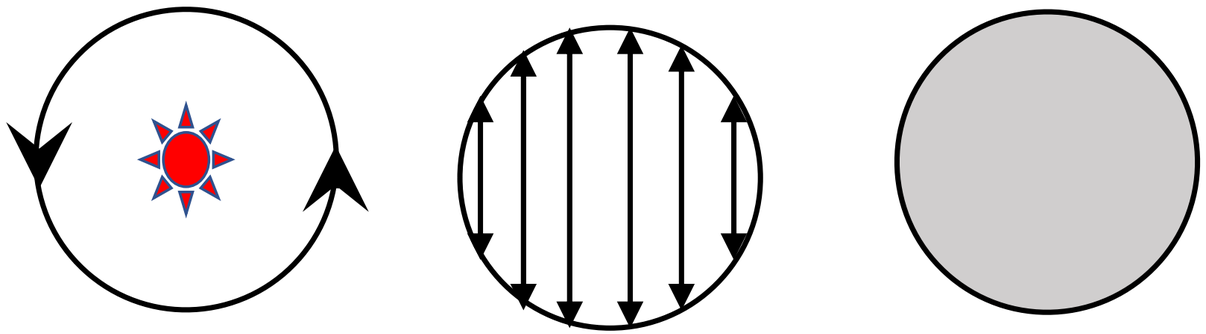


CP



Polarizer at 0°

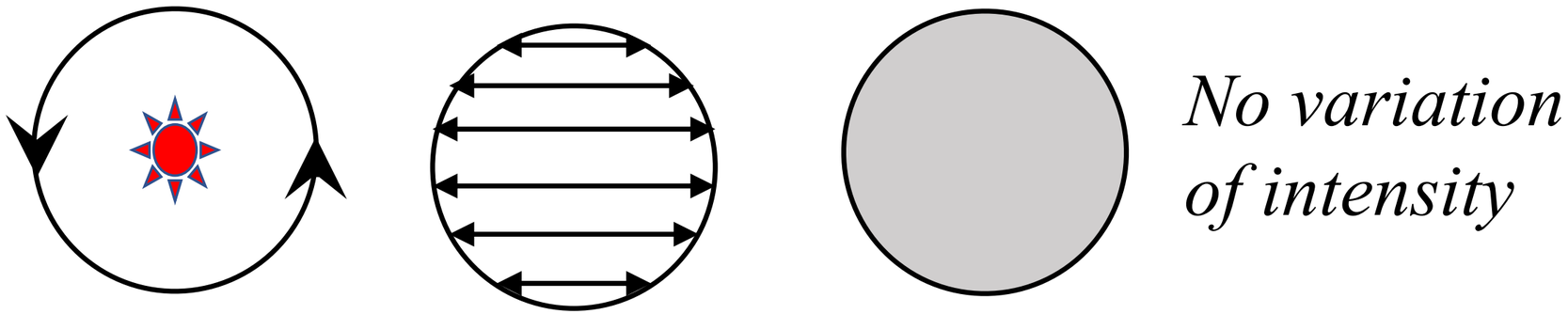
Identification of Circularly and / or unpolarized light



CP

Polarizer at 0°

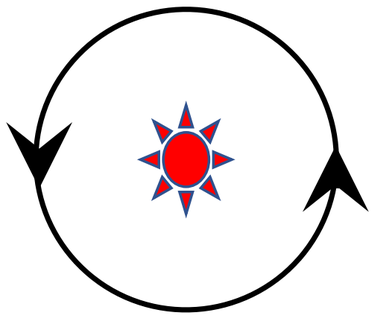
Identification of Circularly and / or unpolarized light



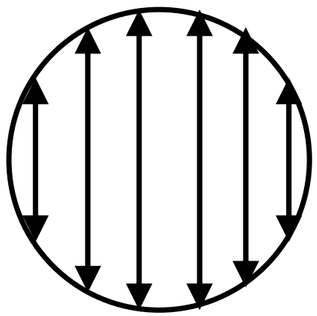
No variation of intensity

CP *Polarizer at* 90°

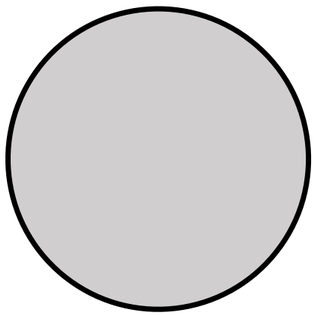
Identification of Circularly and / or unpolarized light



CP

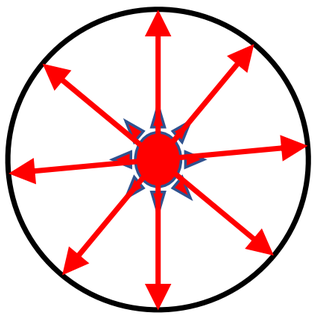


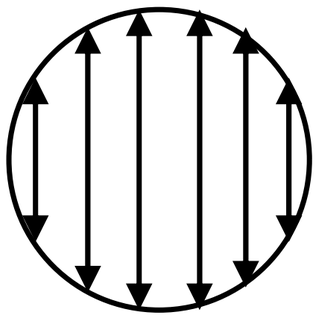
Polarizer at 180°

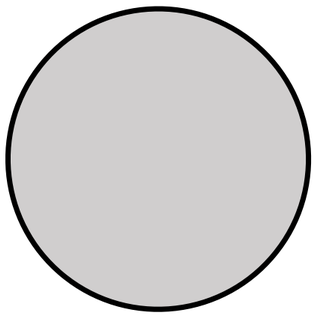


No variation of intensity

Identification of Circularly and / or unpolarized light

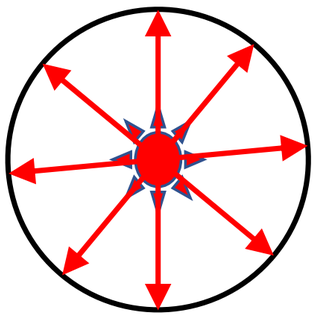




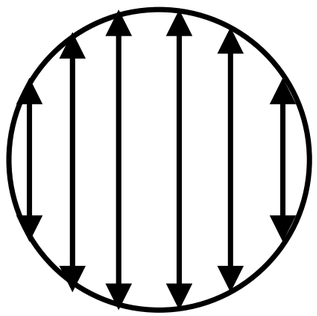


UP

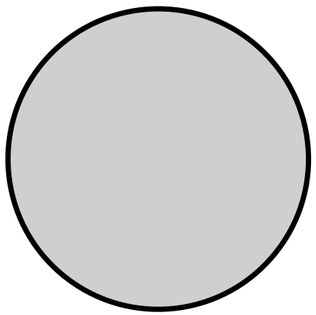
Identification of Circularly and / or unpolarized light



UP



Polarizer rotated by 180^o



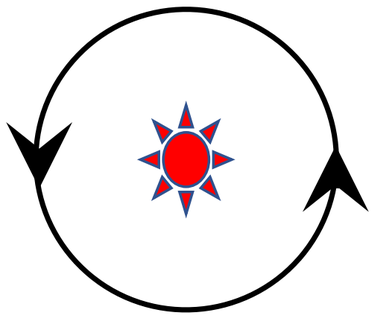
No variation of intensity

- In the above two cases intensity variation not observed for Circularly and Unpolarized light.

- If no variation of intensity is observed then, the light can be,

  - Circularly polarized (CP)
    or
  - Unpolarized (UP)
    or
  - Combination of CP and UP

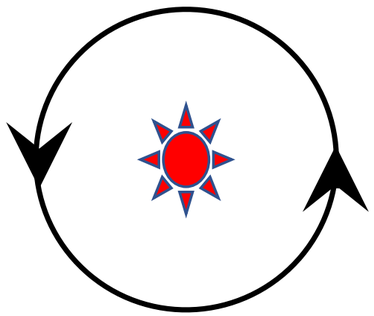
Confirmation test for CP



CP

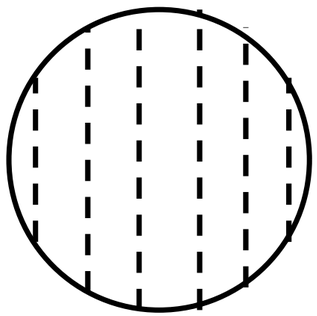
$\begin{pmatrix} 1 \\ i \end{pmatrix}$

Confirmation test for CP



CP

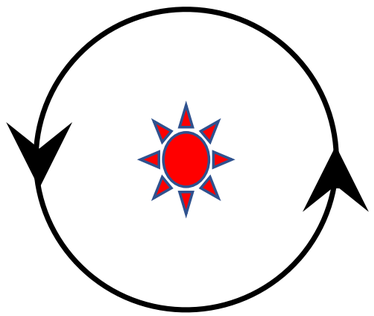
$$\begin{pmatrix} 1 \\ i \end{pmatrix}$$



QWP

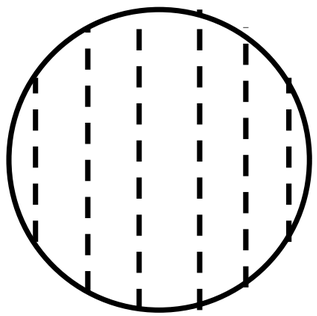
$$\begin{pmatrix} 1 & 0 \\ 0 & -i \end{pmatrix}$$

Confirmation test for CP



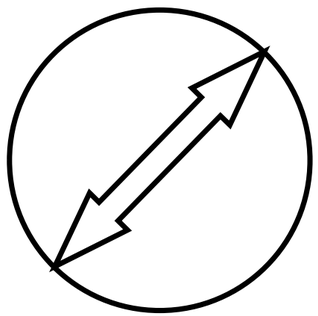
CP

$$\begin{pmatrix} 1 \\ i \end{pmatrix}$$



QWP

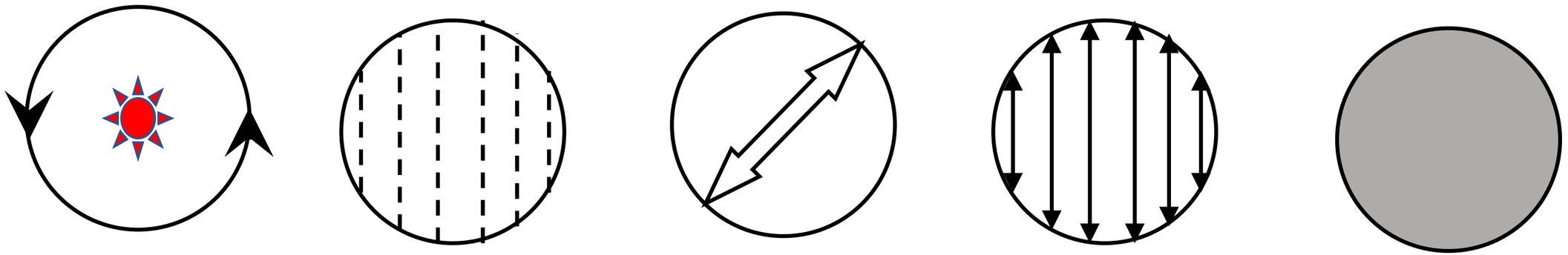
$$\begin{pmatrix} 1 & 0 \\ 0 & -i \end{pmatrix}$$



LP

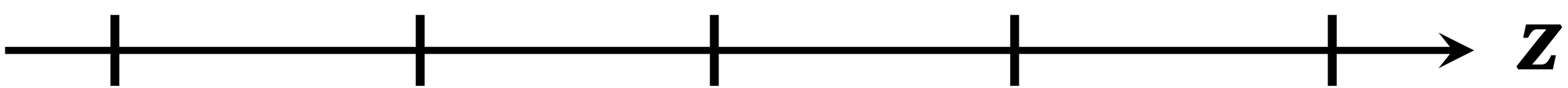
$$\begin{pmatrix} 1 \\ 1 \end{pmatrix}$$

Confirmation test for CP

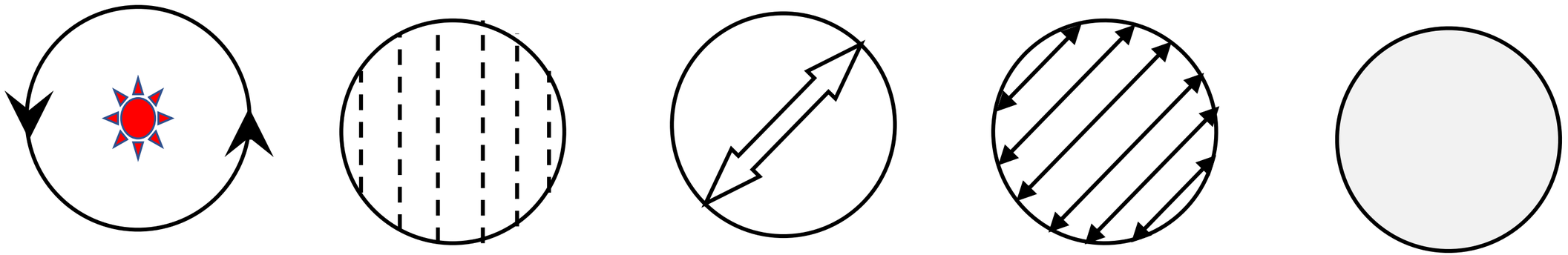


CP *QWP* *LP* *Polarizer* *Screen*

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



Confirmation test for CP



CP

$$\begin{pmatrix} 1 \\ i \end{pmatrix}$$

QWP

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

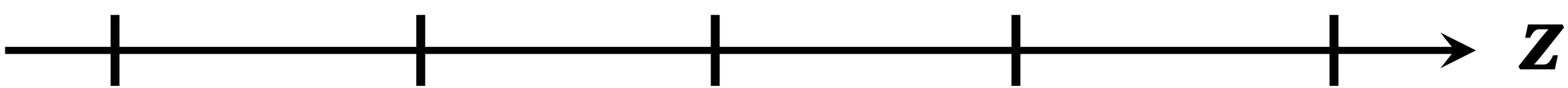
LP

$$\begin{pmatrix} 1 \\ 1 \end{pmatrix}$$

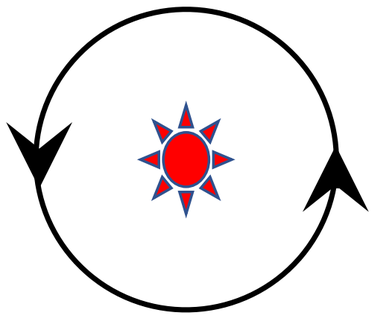
Polarizer

0^o

Bright

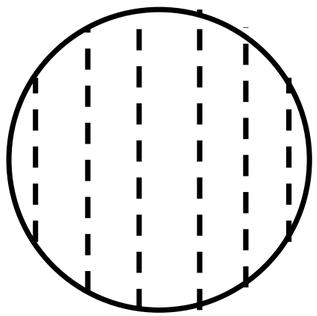


Confirmation test for CP



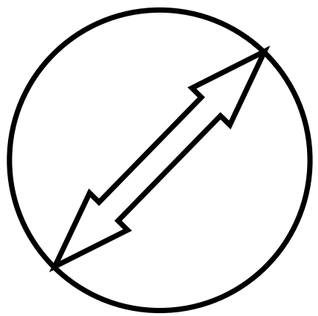
CP

$$\begin{pmatrix} 1 \\ i \end{pmatrix}$$



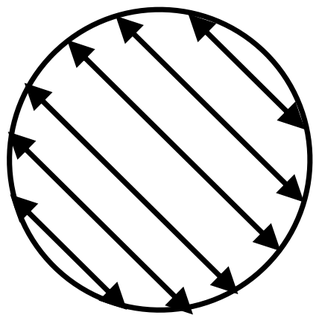
QWP

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



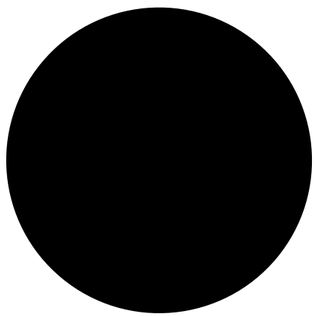
LP

$$\begin{pmatrix} 1 \\ 1 \end{pmatrix}$$



Polarizer

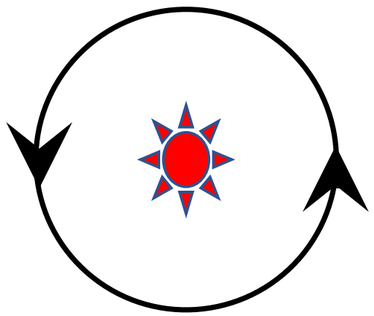
90^o



Dark

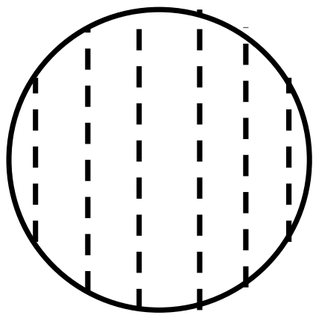
complete extinction

Confirmation test for CP



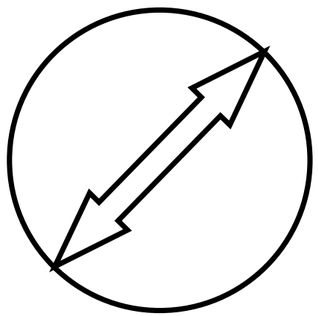
CP

$$\begin{pmatrix} 1 \\ i \end{pmatrix}$$



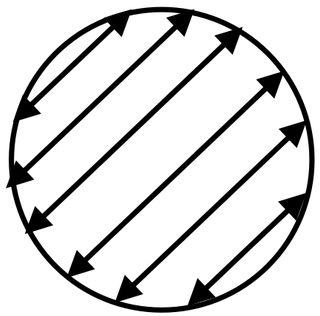
QWP

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



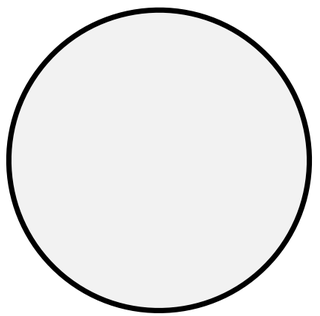
LP

$$\begin{pmatrix} 1 \\ 1 \end{pmatrix}$$



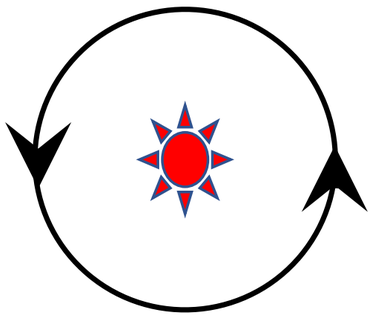
Polarizer

180^o



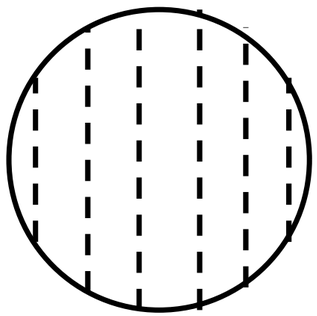
Bright

Confirmation test for CP



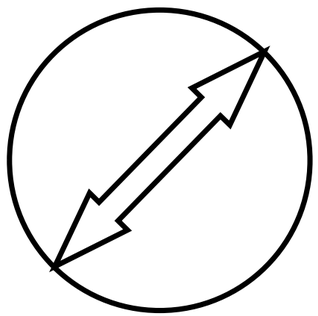
CP

$$\begin{pmatrix} 1 \\ i \end{pmatrix}$$



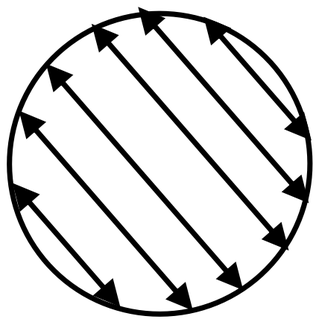
QWP

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



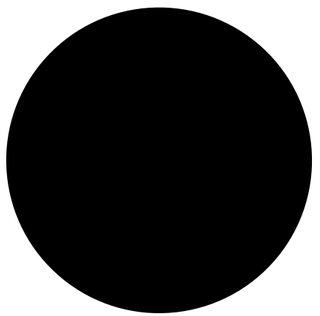
LP

$$\begin{pmatrix} 1 \\ 1 \end{pmatrix}$$



Polarizer

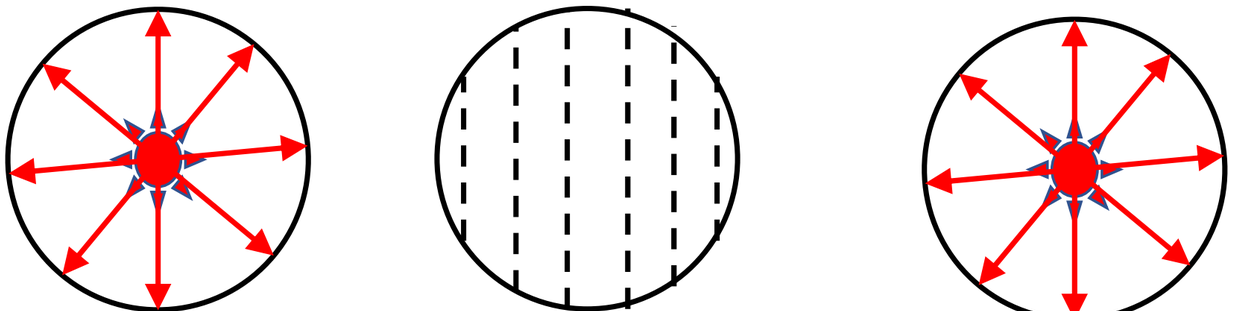
270^o



Dark

complete extinction

Confirmation test for UP

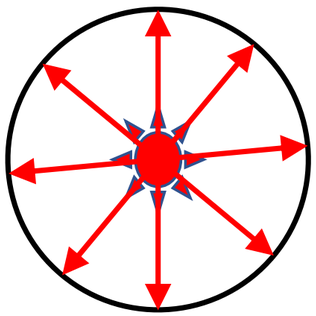


UP *QWP* *UP*

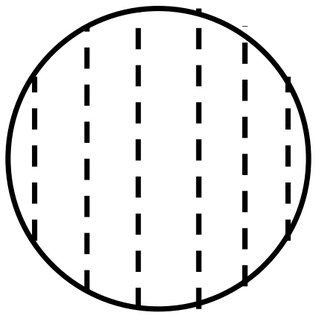
$$\begin{pmatrix} 1 & 0 \\ 0 & -i \end{pmatrix}$$

UP → *QWP* → *UP*

Confirmation test for UP

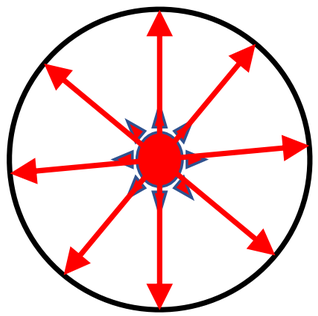


UP

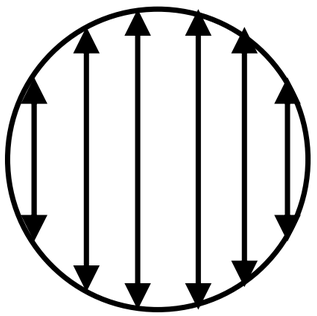


QWP

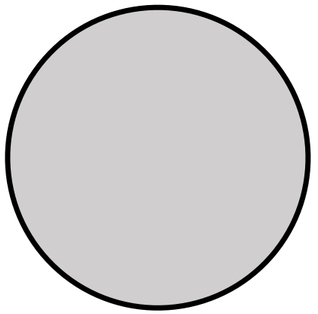
$$\begin{pmatrix} 1 & 0 \\ 0 & -i \end{pmatrix}$$



UP

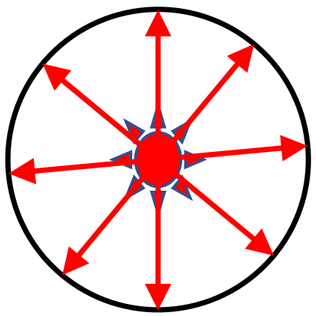


Polarizer

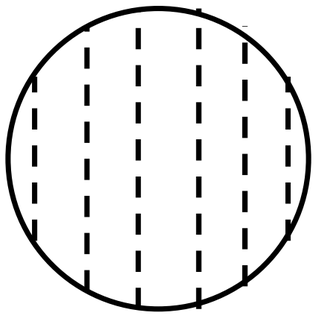


UP → [*QWP*] → *UP*

Confirmation test for UP

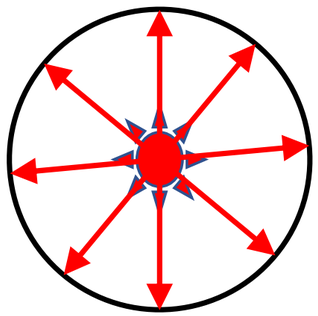


UP

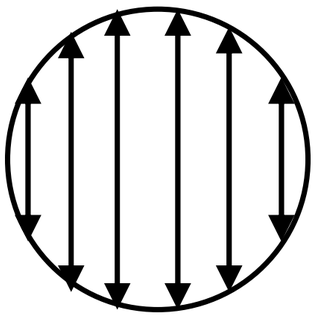


QWP

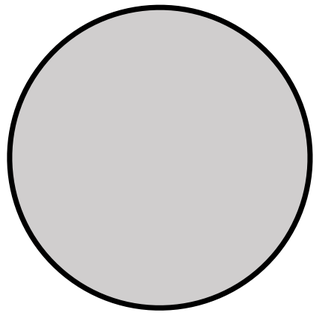
$$\begin{pmatrix} 1 & 0 \\ 0 & -i \end{pmatrix}$$



UP



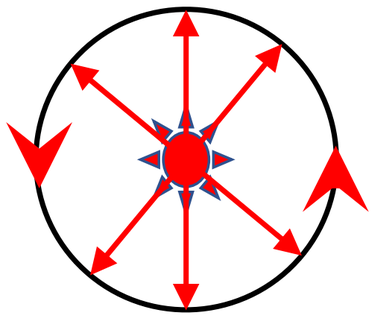
Polarizer rotated by 180^0



No intensity variation

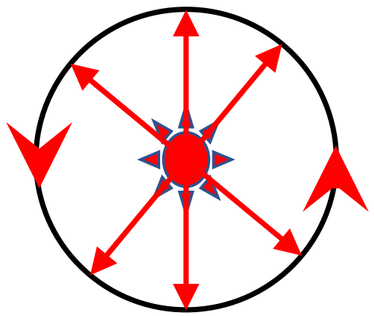
UP → *QWP* → *UP*

Mixture of CP and UP

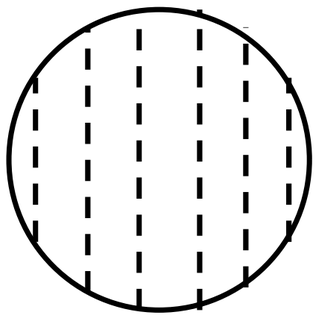


CP+UP

Mixture of CP and UP

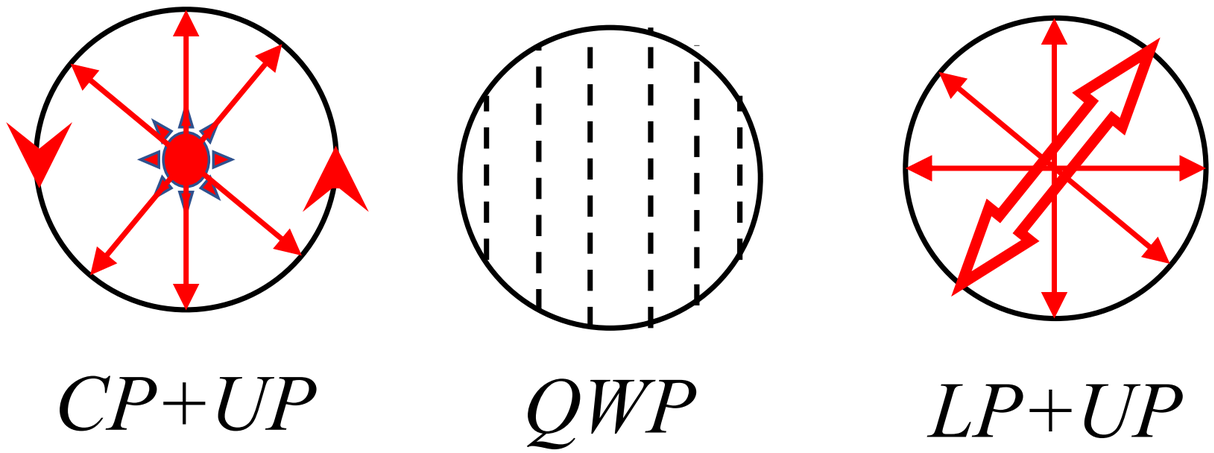


CP+UP



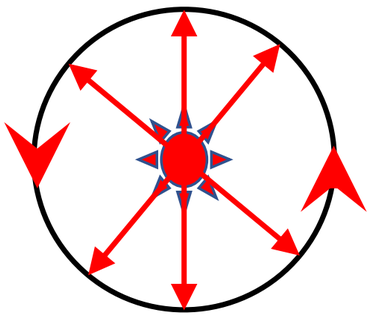
QWP

Mixture of CP and UP

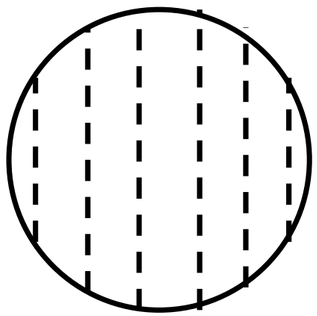


CP+UP *QWP* *LP+UP*

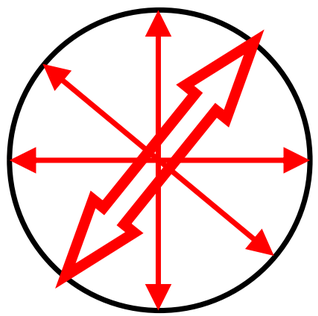
Mixture of CP and UP



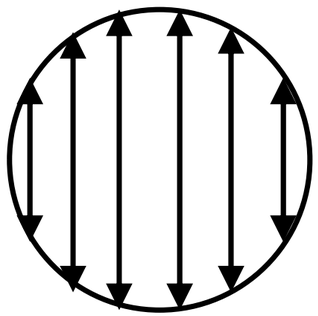
CP+UP



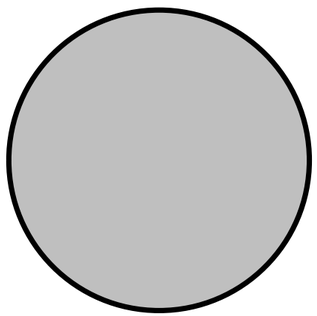
QWP



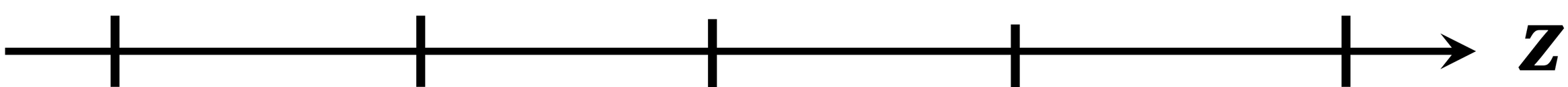
LP+UP



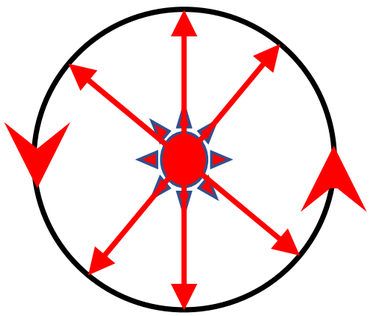
Polarizer



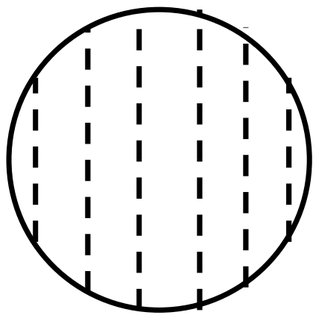
Screen



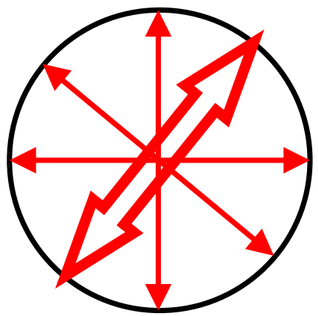
Mixture of CP and UP



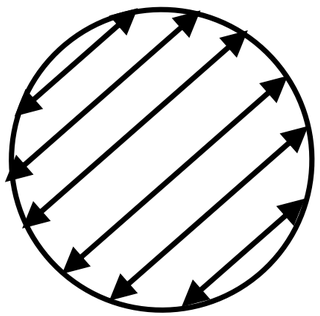
CP+UP



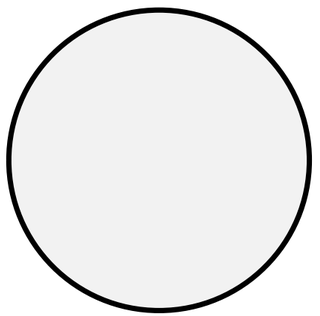
QWP



LP+UP

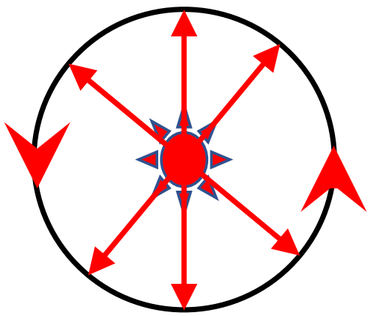


Polarizer
0^o

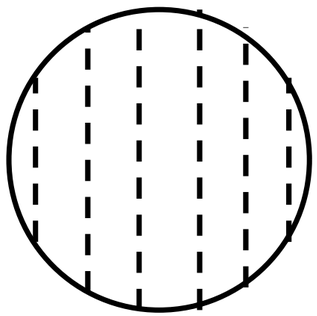


Maximum intensity

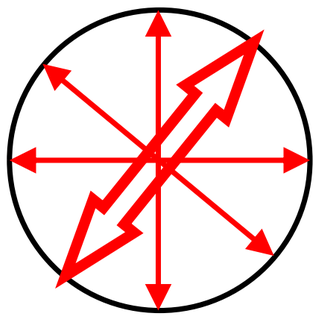
Mixture of CP and UP



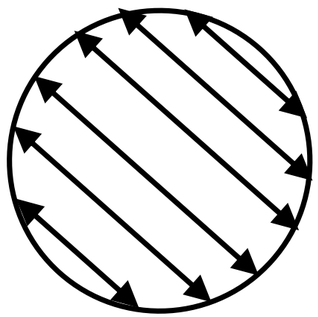
CP+UP



QWP

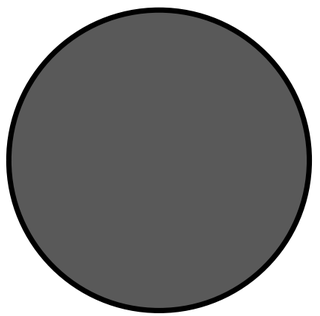


LP+UP

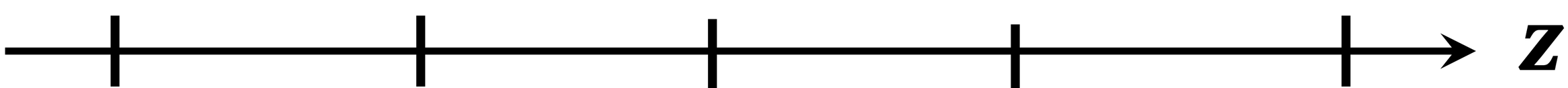


Polarizer

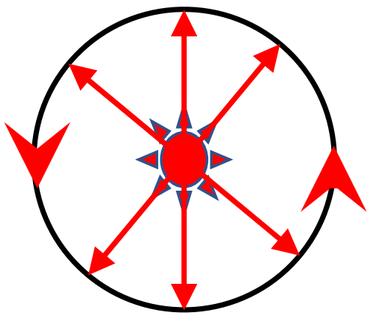
90^o



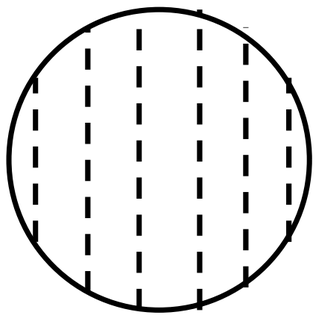
Minimum intensity



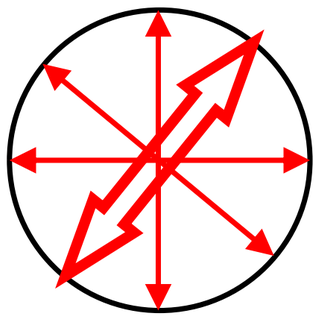
Mixture of CP and UP



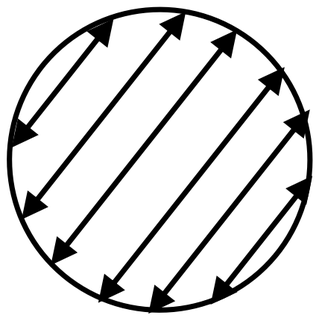
CP+UP



QWP

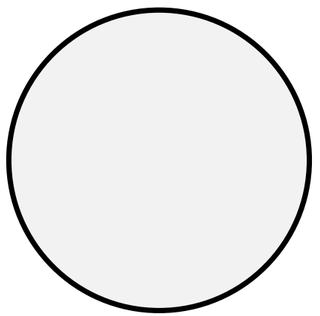


LP+UP

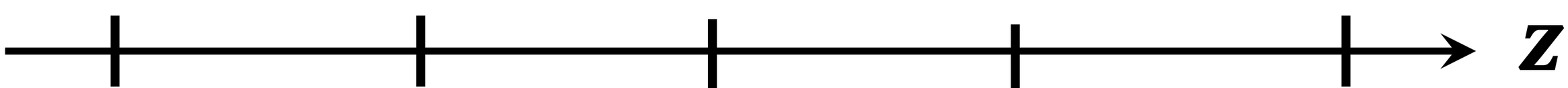


Polarizer

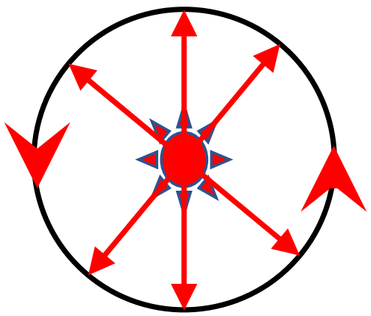
180^o



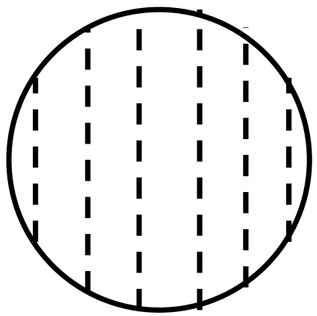
Maximum intensity



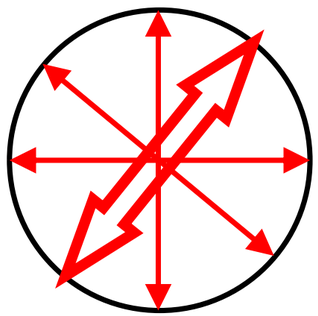
Mixture of CP and UP



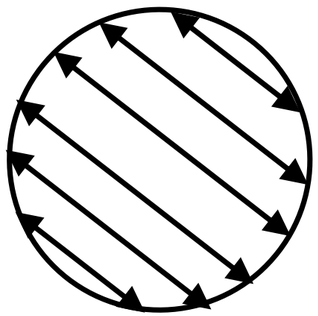
CP+UP



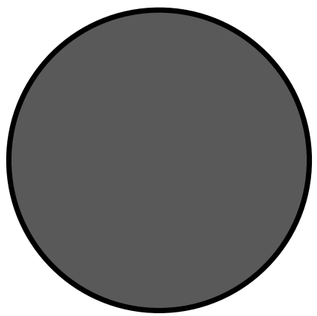
QWP



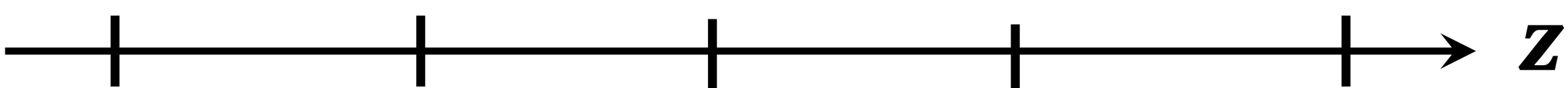
LP+UP



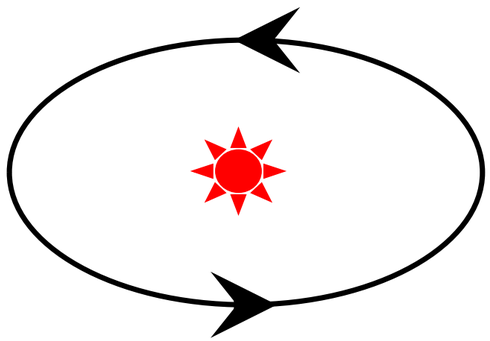
Polarizer
270^o



Minimum intensity

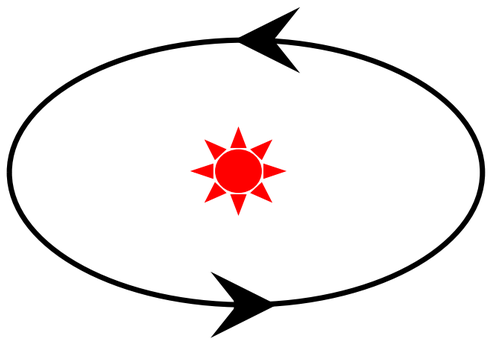


Elliptically polarized light

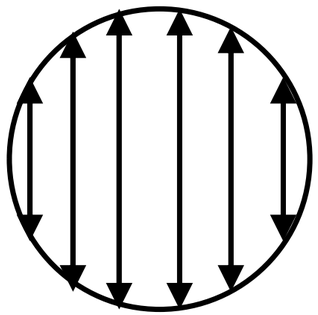


EP

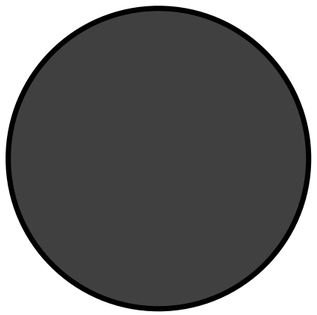
Elliptically polarized light



EP

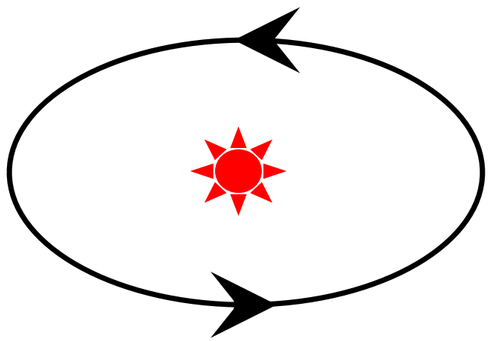


Polaroid
0^o

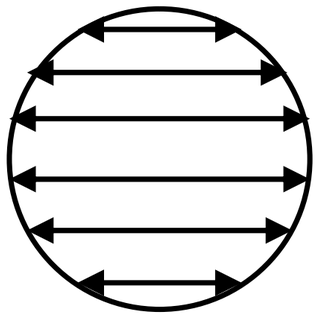


Minimum intensity

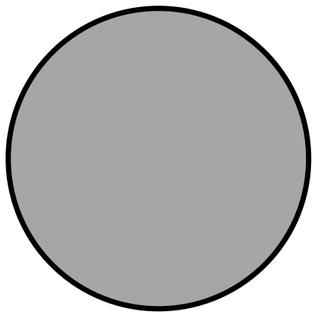
Elliptically polarized light



EP

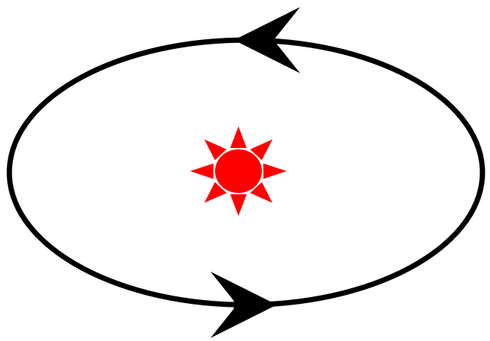


Polaroid
90^o

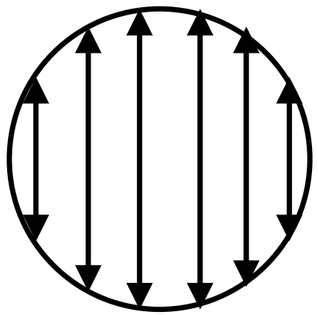


Maximum intensity

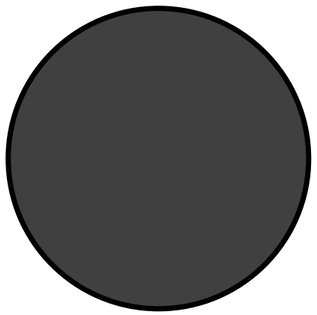
Elliptically polarized light



EP

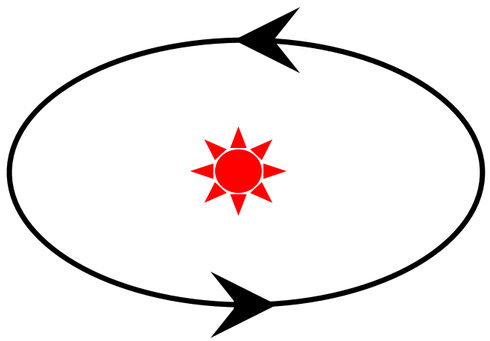


Polaroid
180^o

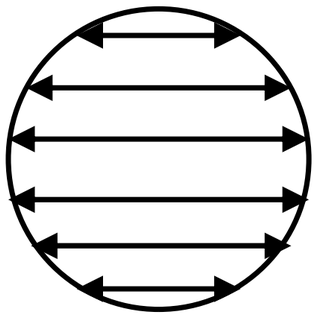


Minimum intensity

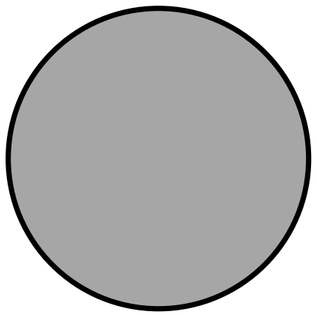
Elliptically polarized light



EP

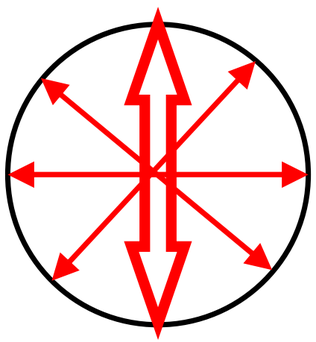


Polaroid
270^o

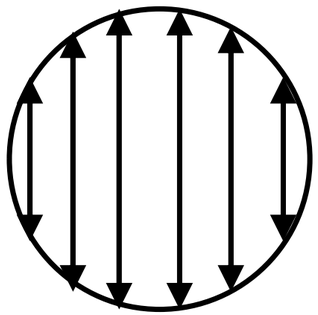


Maximum intensity

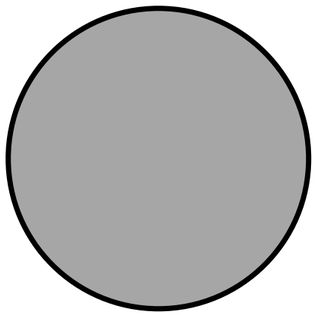
LP + UP light



LP+UP

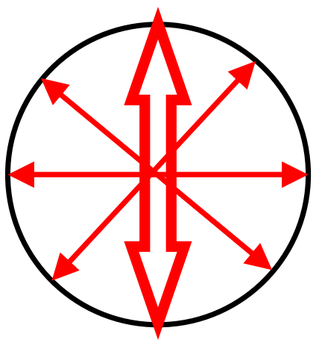


Polaroid
0^o

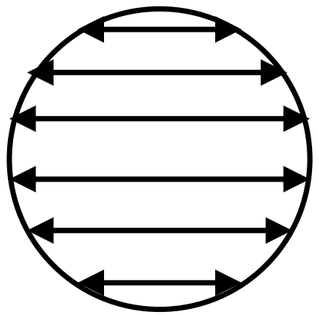


Maximum intensity

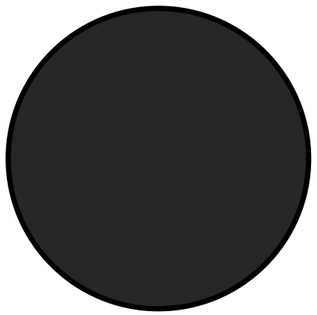
LP + UP light



LP+UP

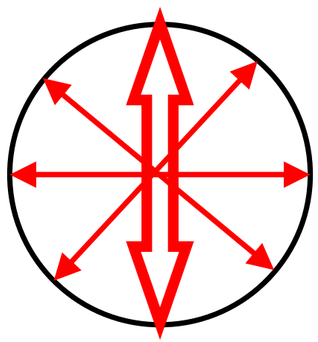


Polaroid
90^o

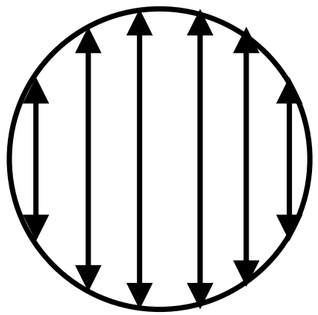


Minimum intensity

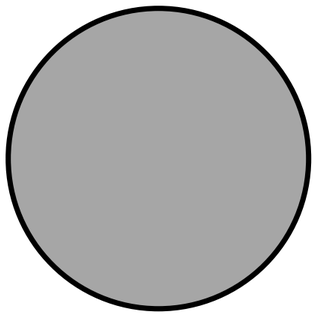
LP + UP light



LP+UP

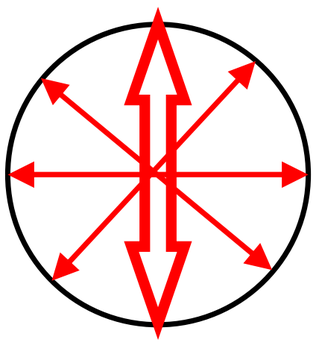


Polaroid
180^o

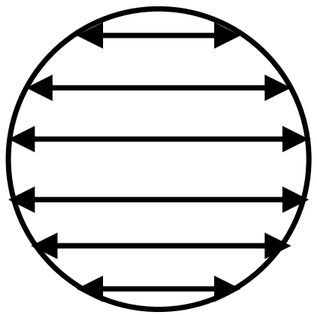


Maximum intensity

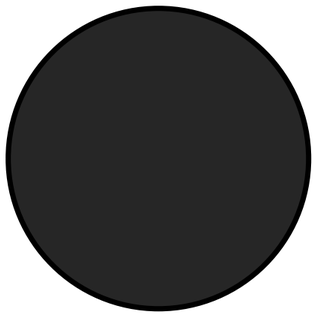
LP + UP light



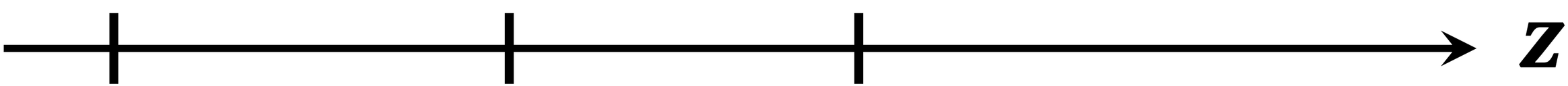
LP+UP



Polaroid
270^{o}



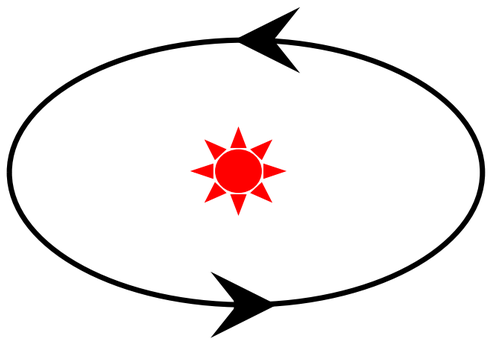
Minimum intensity



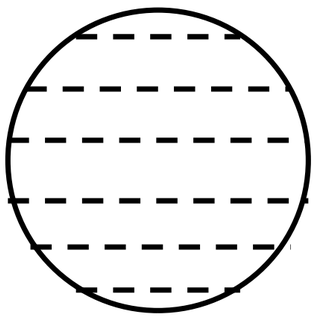
Full rotation of polarizer : Two maxima and two minima

- Elliptically polarized (EP)
  or
- EP + UP
  or
- LP + UP

Confirmation of EP



EP



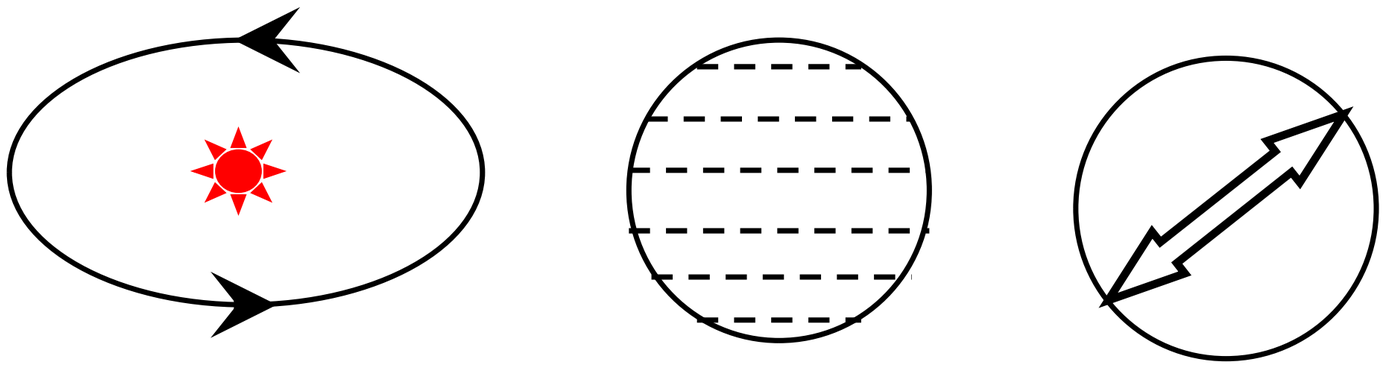
QWP

optic axis along

maximum intensity

$$\begin{pmatrix} a \\ ib \end{pmatrix} \qquad \begin{pmatrix} 1 & 0 \\ 0 & -i \end{pmatrix}$$

Confirmation of EP



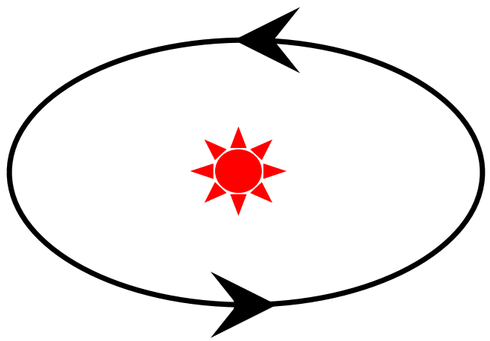
EP

QWP
optic axis along
maximum intensity

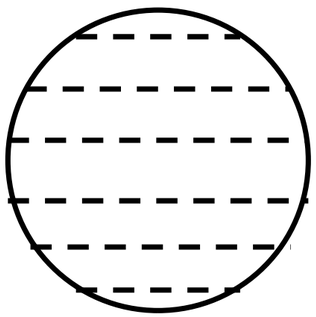
LP

$$\begin{pmatrix} a \\ ib \end{pmatrix} \qquad \begin{pmatrix} 1 & 0 \\ 0 & -i \end{pmatrix} \qquad \begin{pmatrix} a \\ b \end{pmatrix}$$

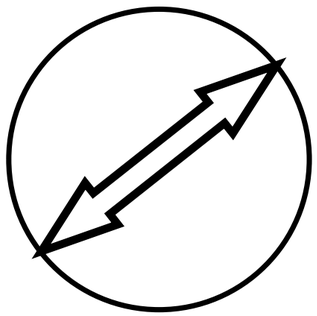
Confirmation of EP



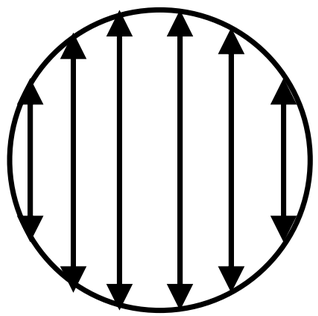
EP



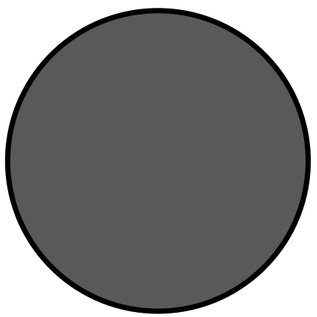
QWP
optic axis along
maximum intensity



LP

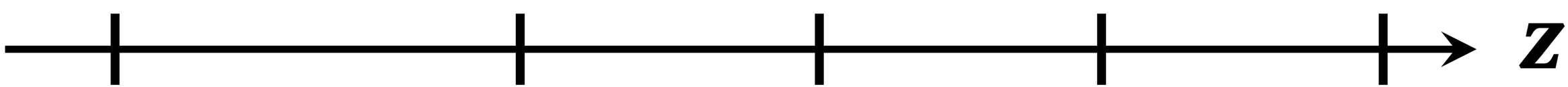


Polarizer

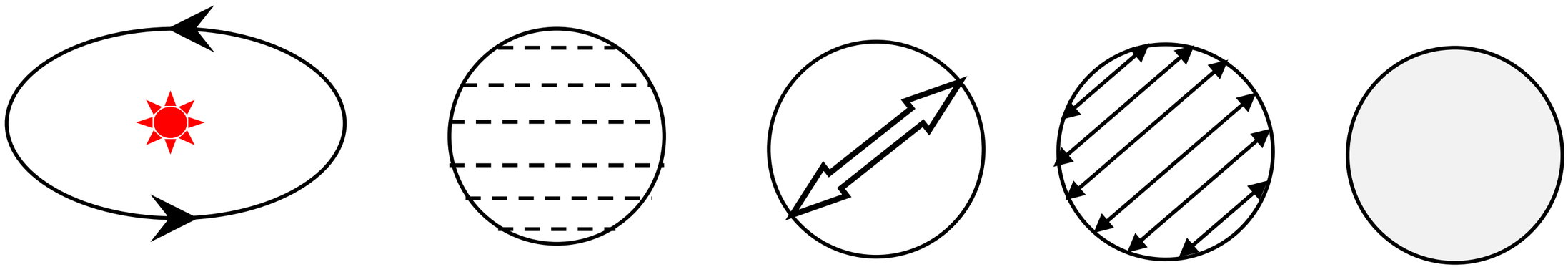


Screen

$$\begin{pmatrix} a \\ ib \end{pmatrix} \qquad \begin{pmatrix} 1 & 0 \\ 0 & -i \end{pmatrix} \qquad \begin{pmatrix} a \\ b \end{pmatrix}$$



Confirmation of EP



EP

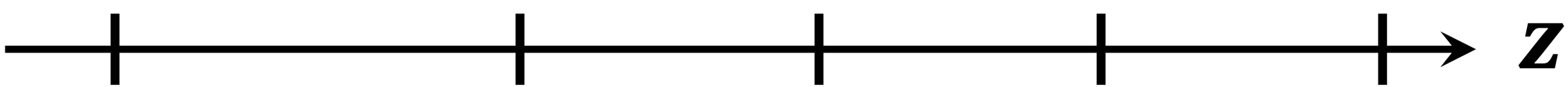
QWP
optic axis along
maximum intensity

LP

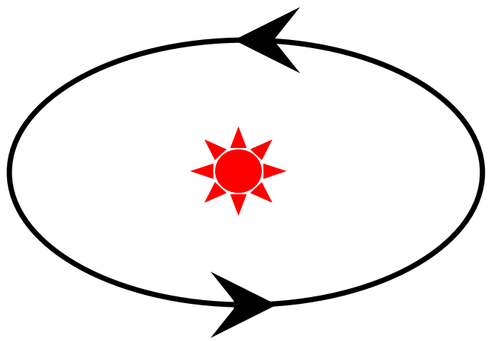
Polarizer
0^o

Bright

$$\begin{pmatrix} a \\ ib \end{pmatrix} \qquad \begin{pmatrix} 1 & 0 \\ 0 & -i \end{pmatrix} \qquad \begin{pmatrix} a \\ b \end{pmatrix}$$

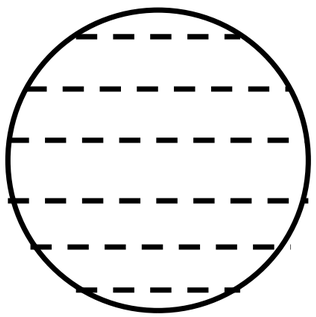


Confirmation of EP



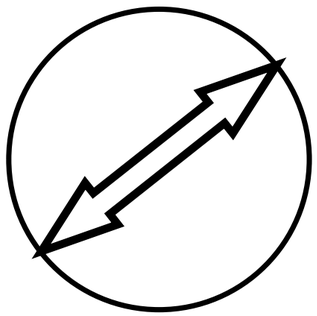
EP

$$\begin{pmatrix} a \\ ib \end{pmatrix}$$



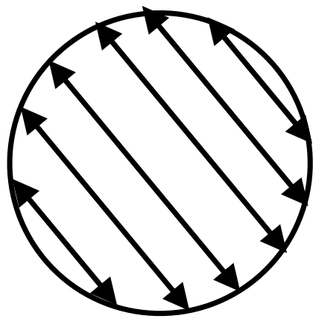
QWP
optic axis along
maximum intensity

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

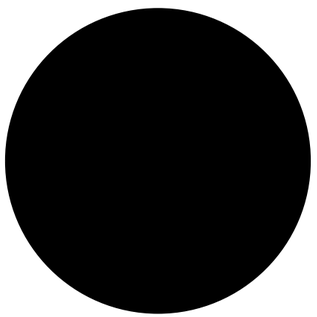


LP

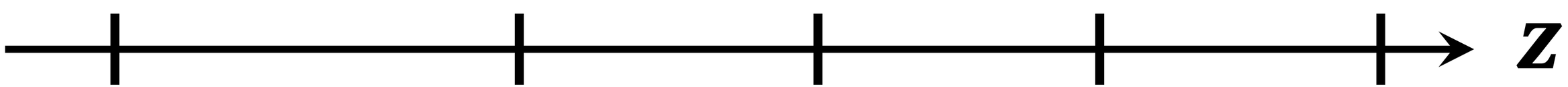
$$\begin{pmatrix} a \\ b \end{pmatrix}$$



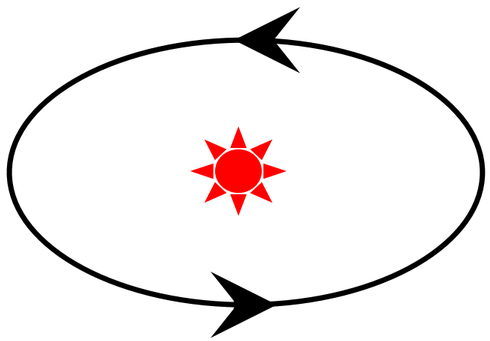
Polarizer
90^o



Dark
complete
extinction

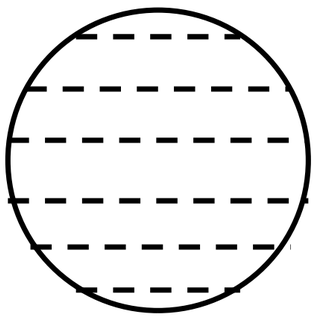


Confirmation of EP



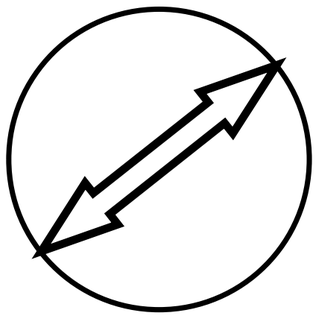
EP

$\begin{pmatrix} a \\ ib \end{pmatrix}$



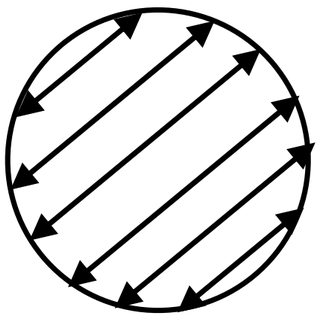
QWP
optic axis along
maximum intensity

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

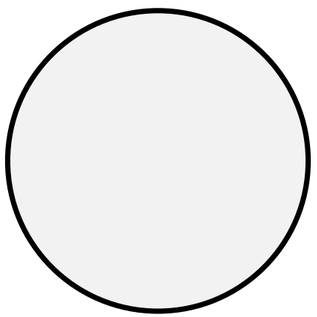


LP

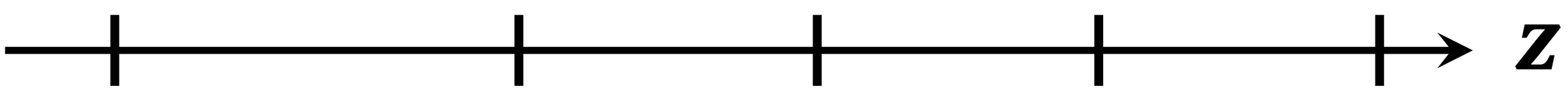
$\begin{pmatrix} a \\ b \end{pmatrix}$



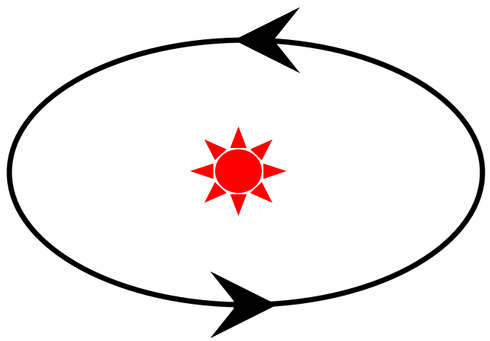
Polarizer
180^o



Bright

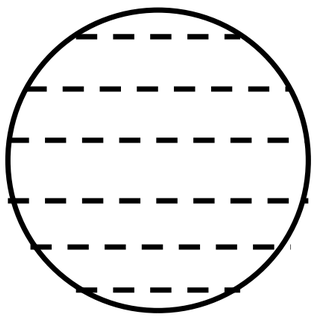


Confirmation of EP



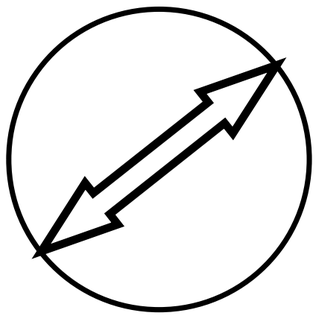
EP

$$\begin{pmatrix} a \\ ib \end{pmatrix}$$



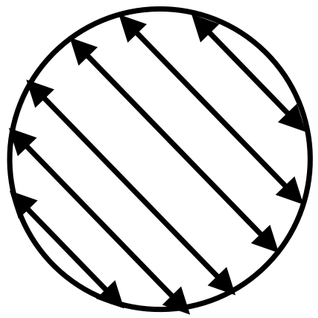
QWP
optic axis along
maximum intensity

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

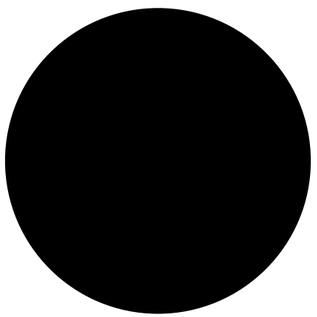


LP

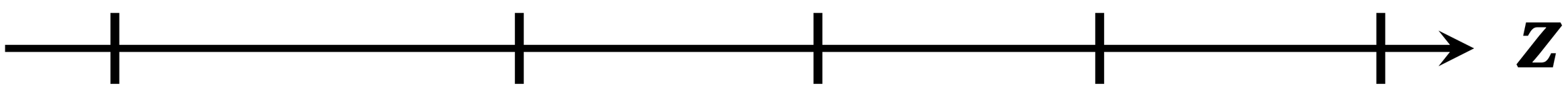
$$\begin{pmatrix} a \\ b \end{pmatrix}$$



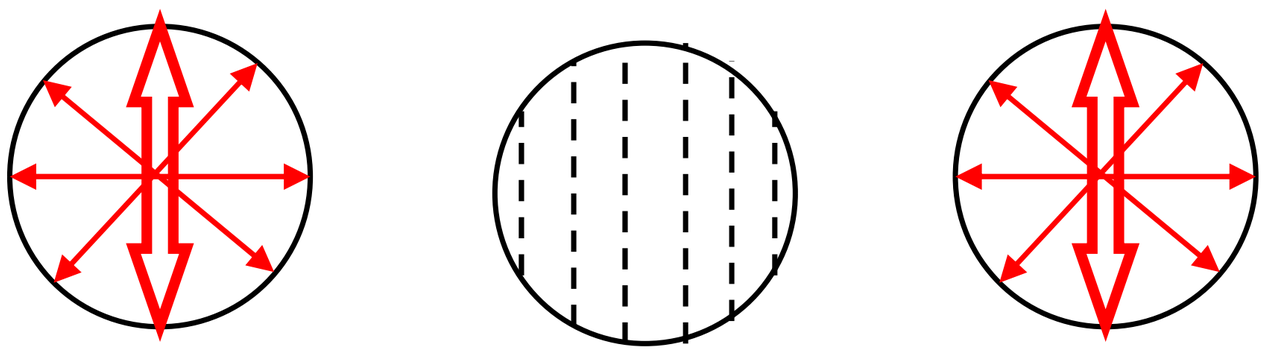
Polarizer
270^o



Dark
complete
extinction



LP + UP light



LP+UP

QWP
optic axis along
maximum intensity

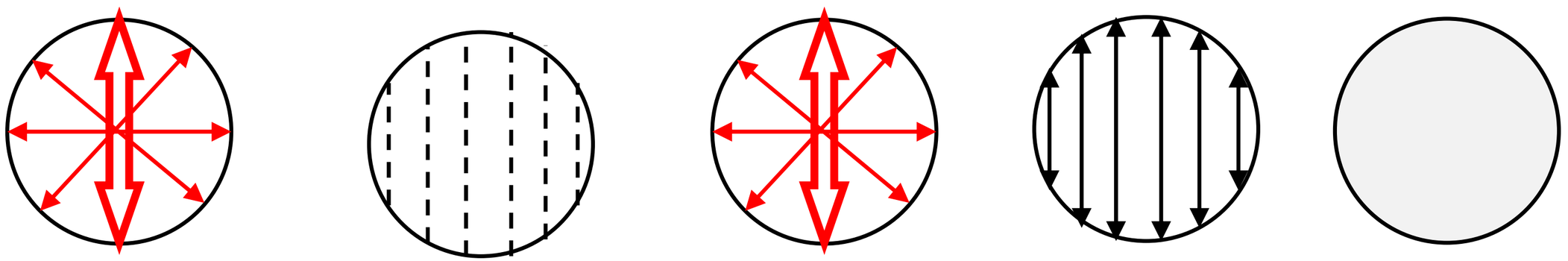
LP+UP

$\begin{pmatrix}1\\0\end{pmatrix} + |UP\rangle$

$\begin{pmatrix}1 & 0\\0 & \pm i\end{pmatrix}$

$\begin{pmatrix}1\\0\end{pmatrix} + |UP\rangle$

LP + UP light



LP+UP

QWP
optic axis along
maximum intensity

LP+UP

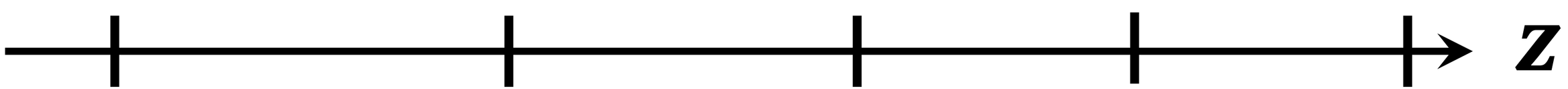
Polarizer
0^o

Maximum
intensity
same orientation
of Polarizer
without QWP

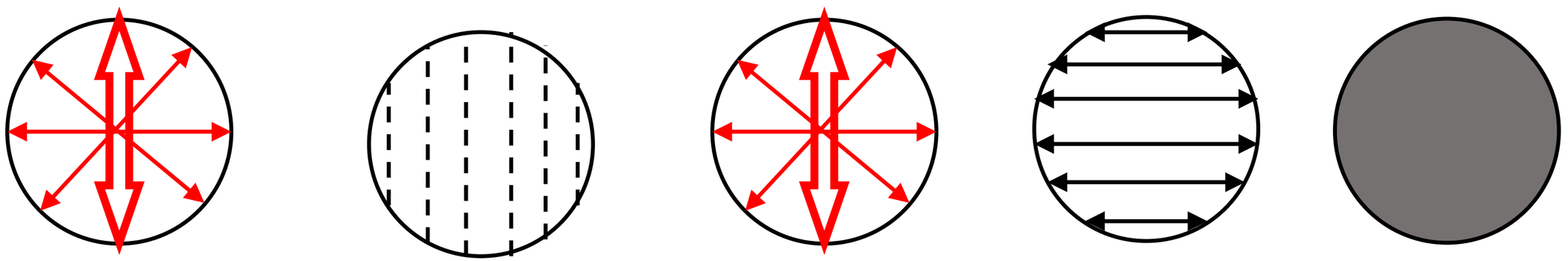
$\begin{pmatrix}1\\0\end{pmatrix} + |UP\rangle$

$\begin{pmatrix}1 & 0\\0 & \pm i\end{pmatrix}$

$\begin{pmatrix}1\\0\end{pmatrix} + |UP\rangle$



LP + UP light



LP+UP

QWP
optic axis along
maximum intensity

LP+UP

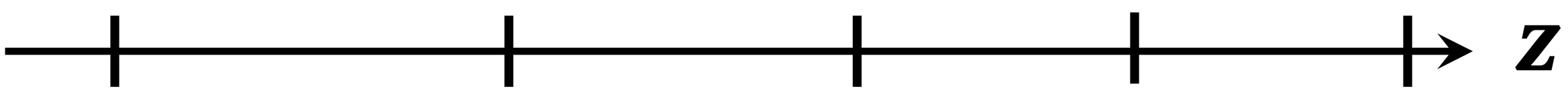
Polarizer
90^o

Minimum
intensity
same orientation
of Polarizer
without QWP

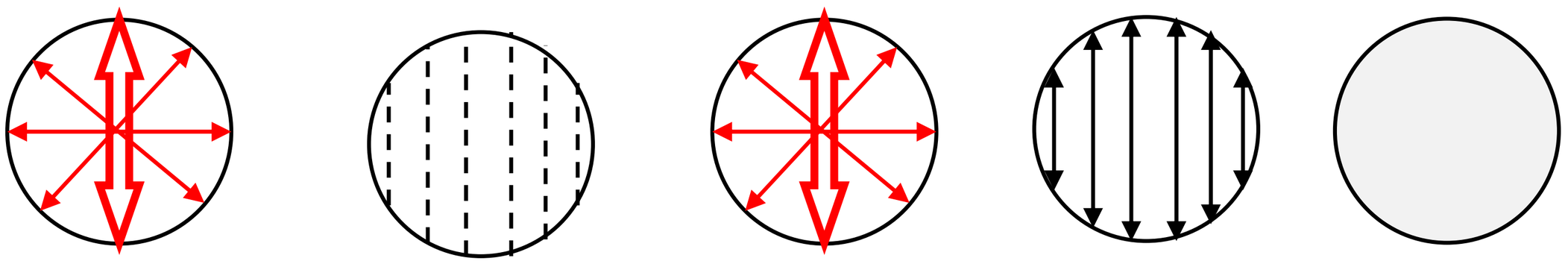
$\begin{pmatrix}1\\0\end{pmatrix} + |UP\rangle$

$\begin{pmatrix}1 & 0\\0 & \pm i\end{pmatrix}$

$\begin{pmatrix}1\\0\end{pmatrix} + |UP\rangle$



LP + UP light



LP+UP

QWP
optic axis along
maximum intensity

LP+UP

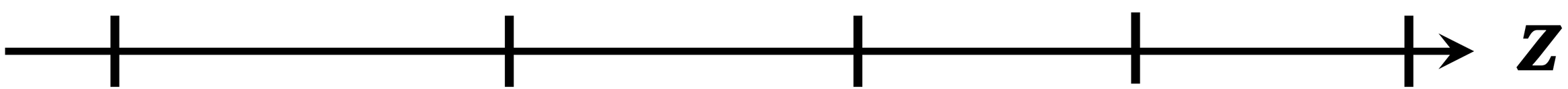
Polarizer
180^o

Maximum
intensity
same orientation
of Polarizer
without QWP

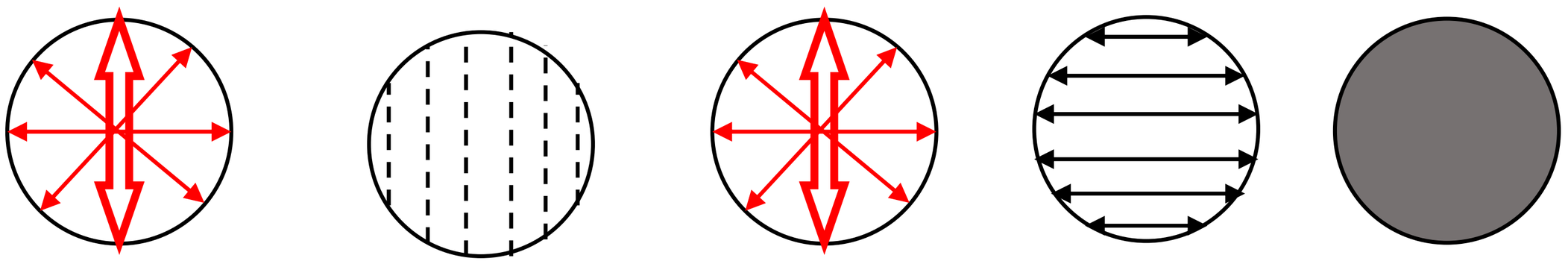
$\begin{pmatrix}1\\0\end{pmatrix} + |UP\rangle$

$\begin{pmatrix}1 & 0\\0 & \pm i\end{pmatrix}$

$\begin{pmatrix}1\\0\end{pmatrix} + |UP\rangle$



LP + UP light



LP+UP

QWP
optic axis along
maximum intensity

LP+UP

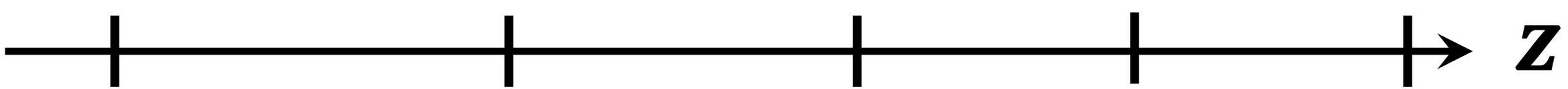
Polarizer
270^o

Minimum
intensity
same orientation
of Polarizer
without QWP

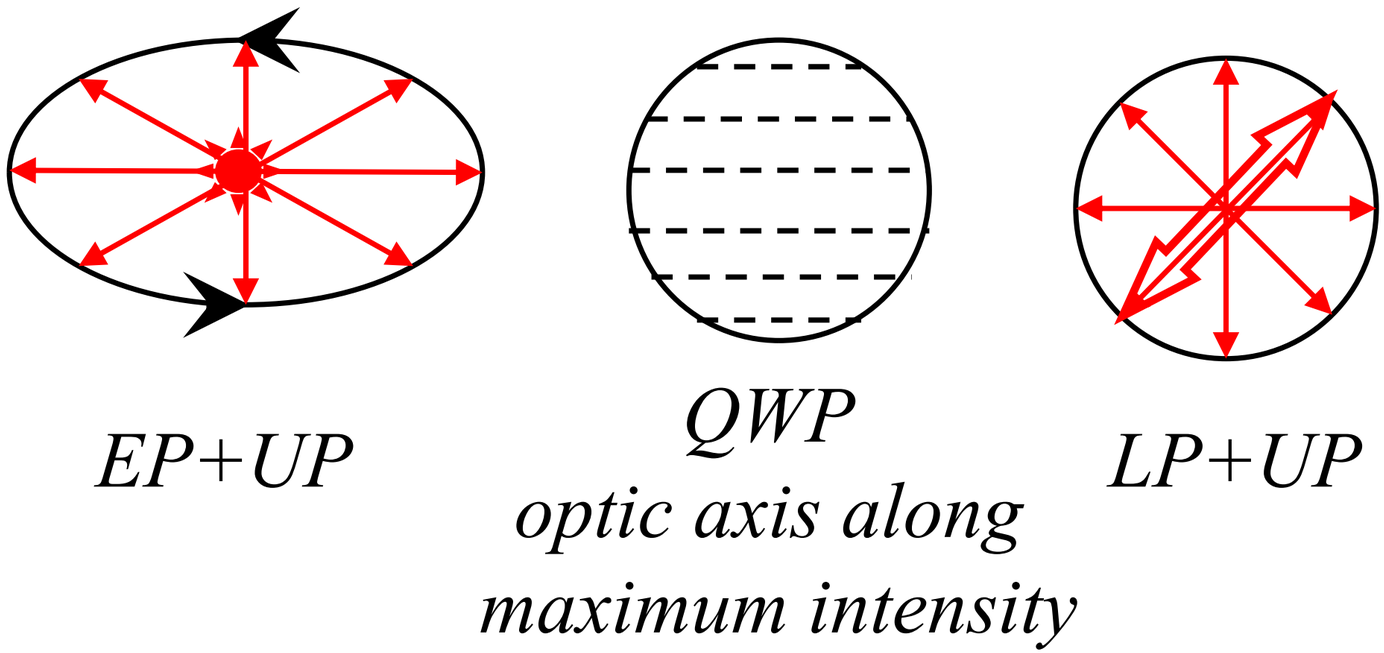
$\begin{pmatrix}1\\0\end{pmatrix} + |UP\rangle$

$\begin{pmatrix}1 & 0\\0 & \pm i\end{pmatrix}$

$\begin{pmatrix}1\\0\end{pmatrix} + |UP\rangle$



EP + UP detection

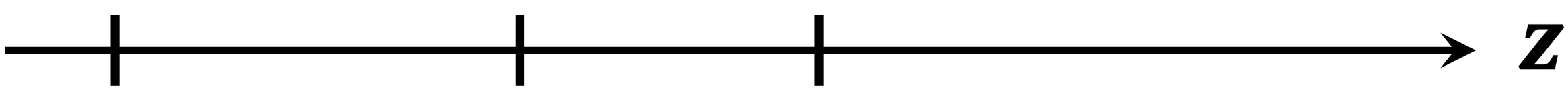


EP+UP

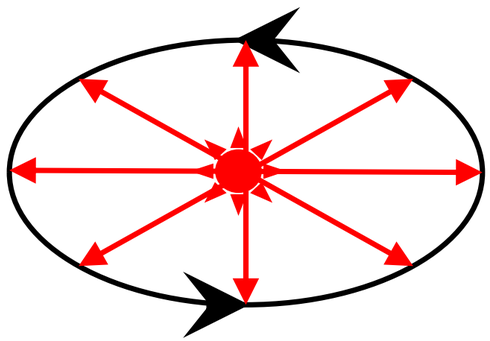
QWP
optic axis along
maximum intensity

LP+UP

$\begin{pmatrix} a \\ ib \end{pmatrix} + |UP\rangle$ $\begin{pmatrix} 1 & 0 \\ 0 & -i \end{pmatrix}$ $\begin{pmatrix} a \\ b \end{pmatrix} + |UP\rangle$

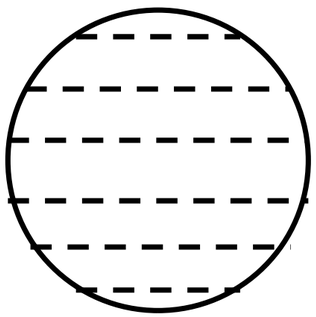


EP + UP detection



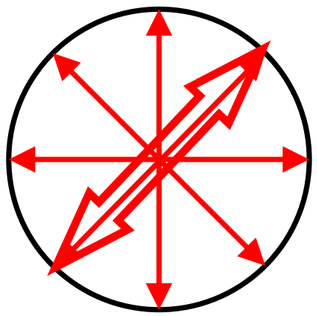
EP+UP

$\begin{pmatrix} a \\ ib \end{pmatrix} + |UP\rangle$



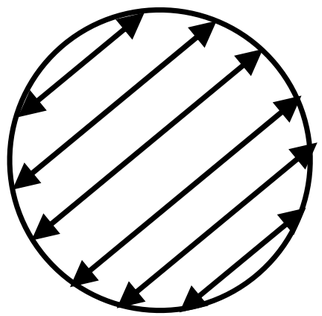
QWP
optic axis along
maximum intensity

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

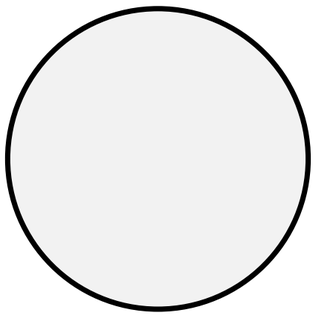


LP+UP

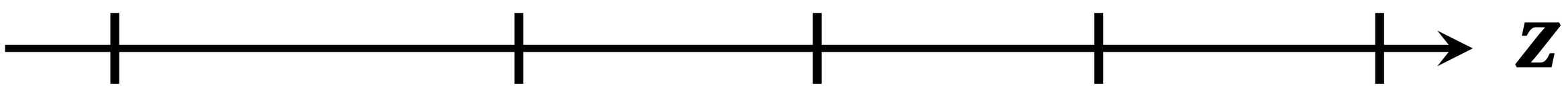
$\begin{pmatrix} a \\ b \end{pmatrix} + |UP\rangle$



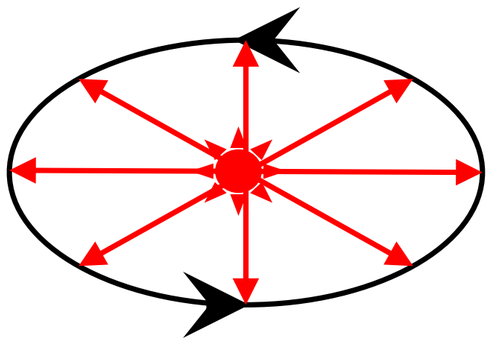
Polarizer
0^o
not along
major axis



Maximum
intensity
not same
orientation
of Polarizer
without QWP

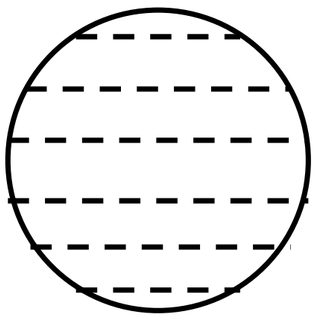


EP + UP detection



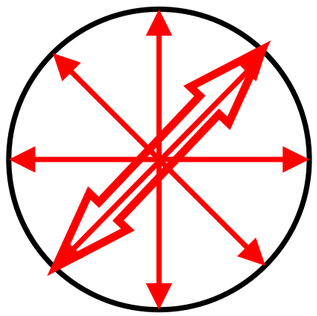
EP+UP

$\begin{pmatrix} a \\ ib \end{pmatrix} + |UP\rangle$



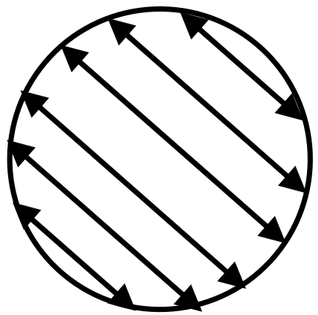
QWP
optic axis along
maximum intensity

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

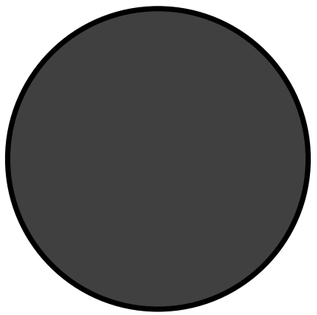


LP+UP

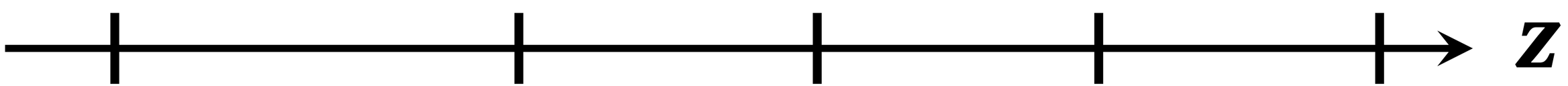
$\begin{pmatrix} a \\ b \end{pmatrix} + |UP\rangle$



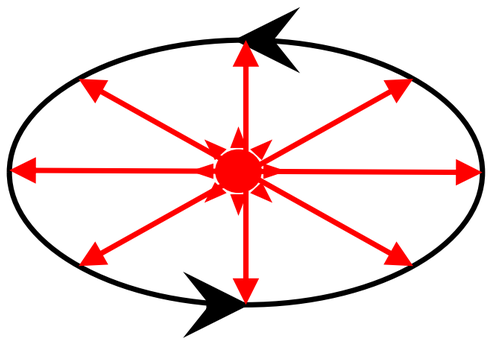
Polarizer
90^o
not along
minor axis



Minimum
intensity
not same
orientation
of Polarizer
without QWP

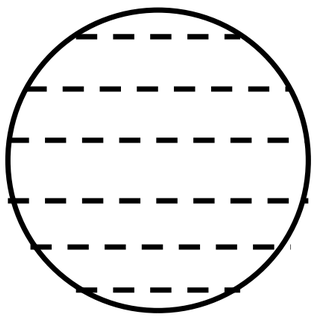


EP + UP detection



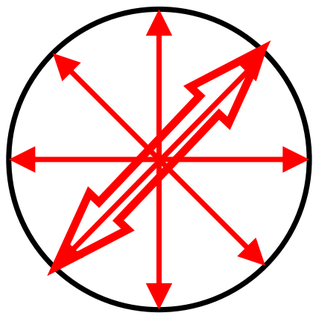
EP+UP

$\begin{pmatrix} a \\ ib \end{pmatrix} + |UP\rangle$



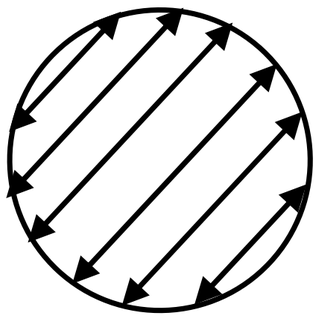
QWP
optic axis along
maximum intensity

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

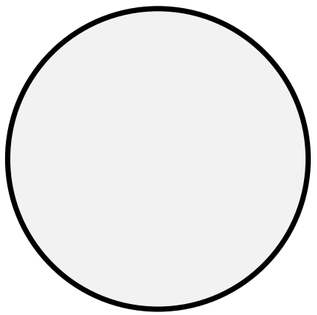


LP+UP

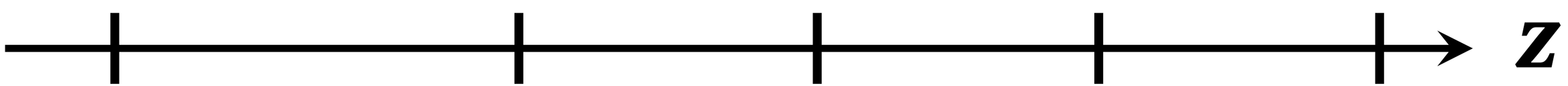
$\begin{pmatrix} a \\ b \end{pmatrix} + |UP\rangle$



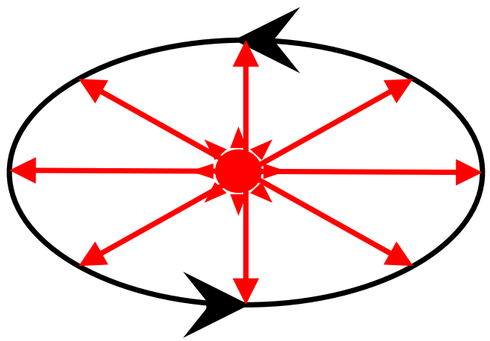
Polarizer
180^o
not along
major axis



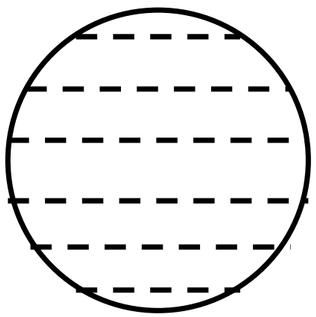
Maximum
intensity
not same
orientation
of Polarizer
without QWP



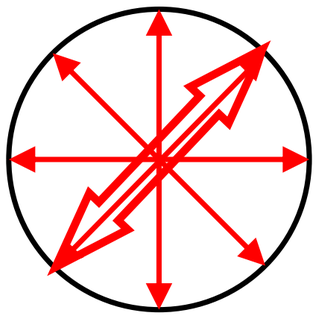
EP + UP detection



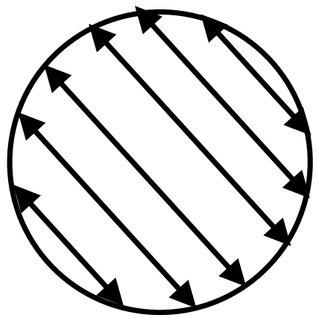
EP+UP



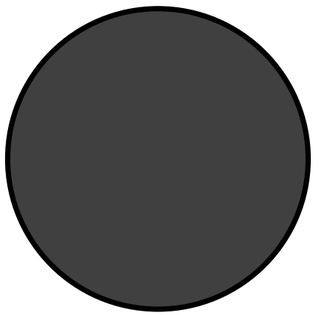
QWP
optic axis along
maximum intensity



LP+UP



Polarizer
270^o
not along
minor axis



Minimum
intensity
not same
orientation
of Polarizer
without QWP

$\begin{pmatrix} a \\ ib \end{pmatrix} + |UP\rangle$

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

$\begin{pmatrix} a \\ b \end{pmatrix} + |UP\rangle$