



Second lecture

Quarter-Wave plates

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Quarter-Wave plates

Quarter-wave plates are used to turn linearly polarized light into circularly polarized light and vice versa. To do this, the wave plate must be oriented so that equal amounts of fast and slow waves are excited. This is achieved by orienting an incident linearly polarized wave at 45° to the fast (or slow) axis, as shown in Figure 1.

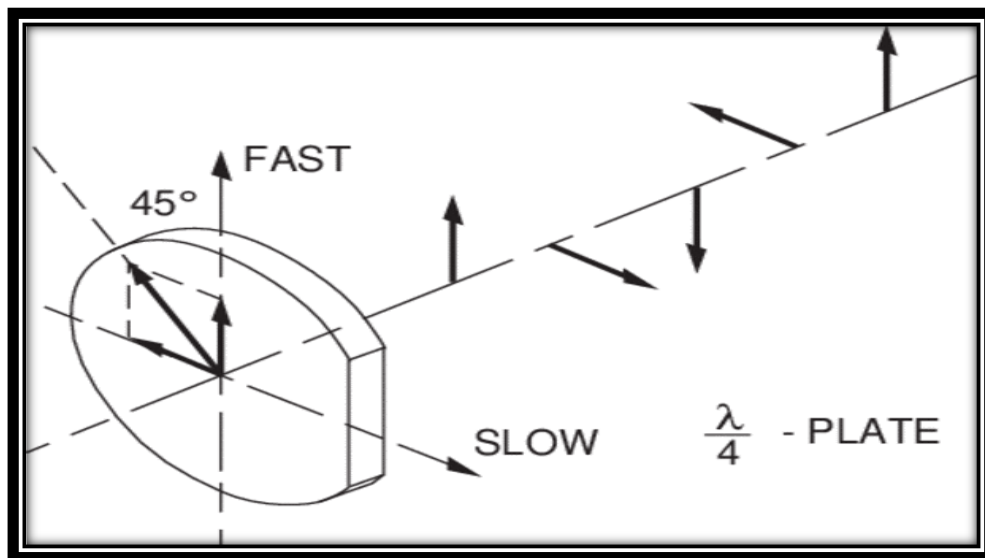
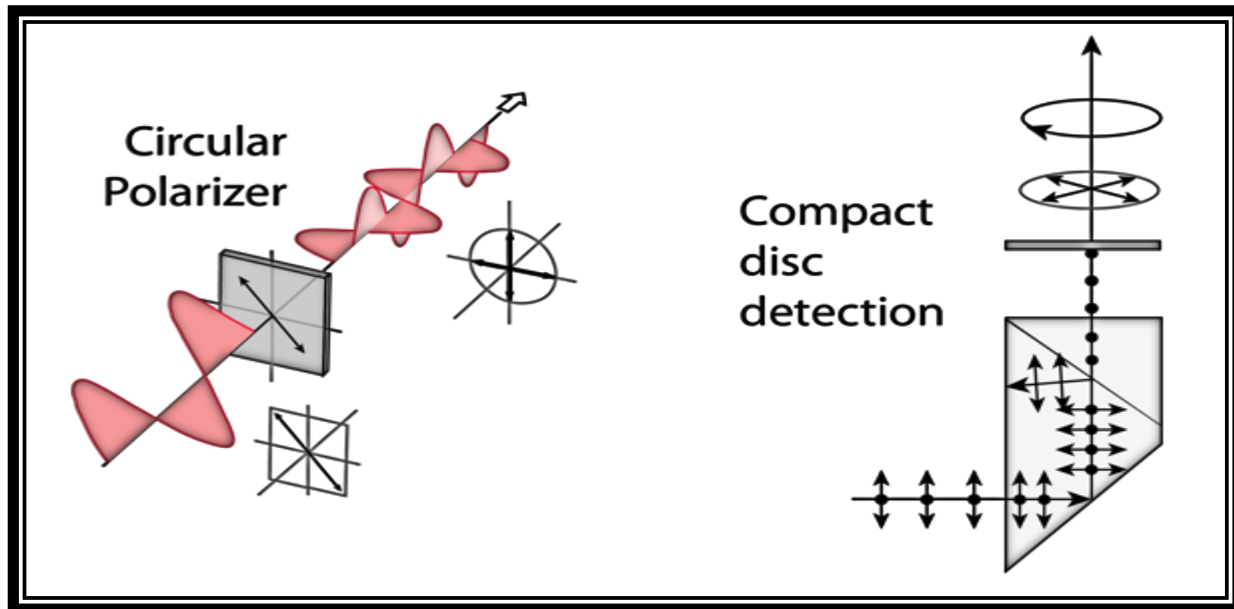
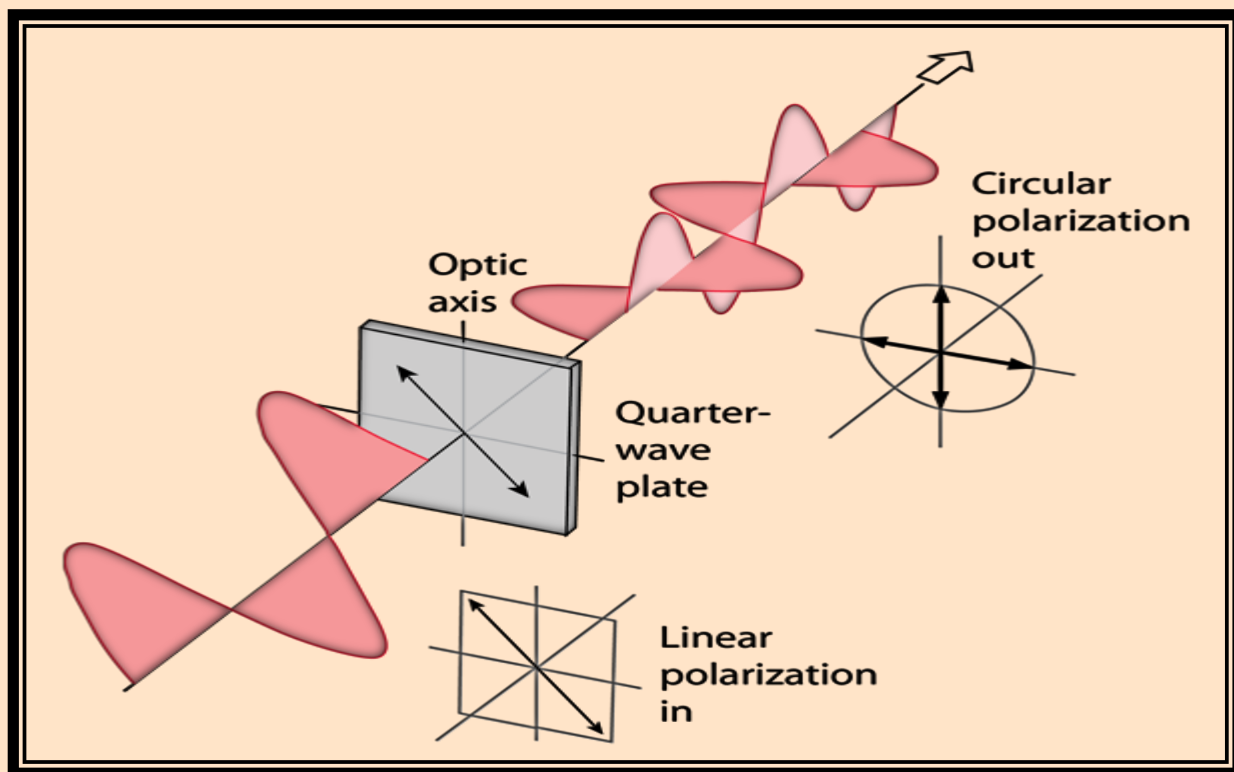


Figure 1. Turning linearly polarized light into circularly polarized light.

Quarter-Wave Plate Applications



Linear to Circular Polarization



If linearly polarized light is incident on a quarter-wave plate at 45° to the optic axis, then the light is divided into two equal electric field components. One of these is retarded by a quarter wavelength by the plate. This produces circularly polarized light. Incident circularly polarized light will be changed to linearly polarized light.

Wave plate Applications

The two most common applications of wave plates have been mentioned: rotating the plane of polarization with a half-wave plate and creating circular polarization with a quarter-wave plate. A quarter-wave plate can also be used to create plane-polarization from circular polarization — just reverse the direction of light propagation in Figure 4. The operation of a wave plate and a summary of how quarter and half wave plates convert one polarization state to another are shown in Figure 4.

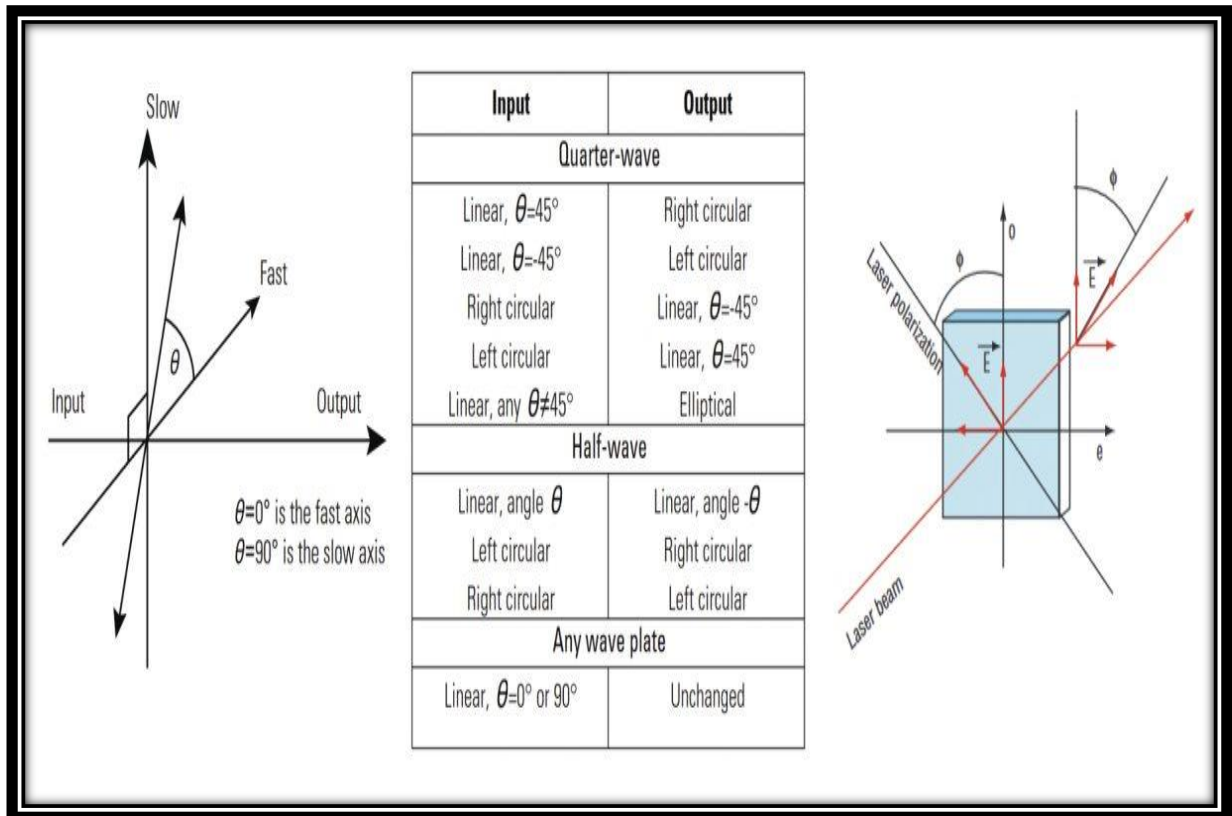


Figure 4. Summary of how quarter and half wave plates convert one polarization state to another.

Optical Isolation

A quarter-wave plate can be used in an optical isolator, that is, a device that eliminates undesired reflections. Such a device uses a quarter-wave plate and a linear polarizer or polarizing beam splitter cube.

Polarization Cleanup

Often an optical system will require several reflections from metal or dielectric mirrors. There is no change in the polarization state of the reflection if the beam is incident normally on the mirrors, or if the plane of polarization lies in or normal to the plane of incidence.

However, if the polarization direction makes some angle with the plane of incidence, then the reflection often makes a small phase shift between the parallel and perpendicular components. This is particularly true for metal mirrors, which always have some loss.

Why Photonics is so Important Today

- Photonics are so common in our day-to-day lives that their utilization likely now passes us by. The technology provides an incredible opportunity for the design and manufacturing industry, helping to provide more accurate, faster results while also transforming the telecommunications industry.
- Photonic devices can transmit huge volumes of data in an instant, and technology plays a key role in how we access the internet and connect with people. The technology also helps with taking pictures, playing computer games, printing and scanning products at checkout.
- The modern world that we know would not exist without this ground-breaking technology, which is everywhere. Yet, we are still just at the start of the photonic revolution, and the potential it provides for the future is incredibly exciting.

The possibilities for the future appear almost endless as technology continues to develop and evolve, and the utilization of photonics is going to play a vital part in the innovation of many fields.