

Waveplate

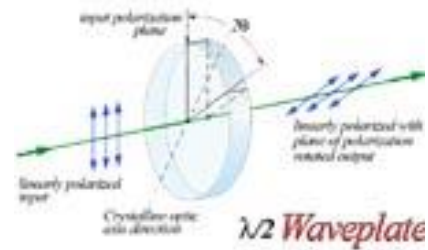
Waveplate (wave plate, retardation plate or phase shifter) is made from material which exhibit birefringence, the most common waveplate material is crystal quartz. The velocities of the extraordinary and ordinary rays through the birefringent materials vary inversely with their refractive indices. The difference in velocities gives rise to a phase difference when the two beams recombine. In the case of an incident linearly polarized beam this is given by $\Delta\phi = 2\pi d(n_e - n_o) / \lambda$ ($\Delta\phi$ -phase difference; d -thickness of waveplate; n_e, n_o -refractive indices of extraordinary and ordinary rays respectively; λ -wavelength). At any specific wavelength the phase difference is governed by the thickness of the retarder.



Half waveplate

The thickness of a half waveplate is such that the phase difference is $1/2$ -wavelength (true-zero order) or some multiple of $1/2$ -wavelength $[(2n+1)\lambda/2, \text{multiple order}]$.

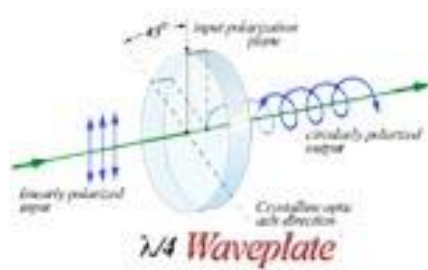
A linearly polarized beam incident on a half waveplate emerges as a linearly polarized beam but rotates such that its angle to the optical axis is twice that of the incident beam. Therefore, half waveplates can be used as continuously adjustable polarization rotators. Half waveplates are used in rotating the plane of polarization, electro-optic modulation and as a variable ratio beamsplitter when used in conjunction with a polarization cube.

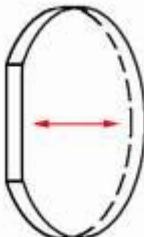
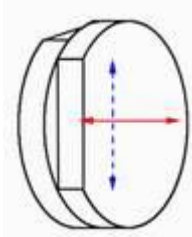
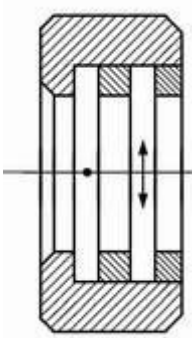
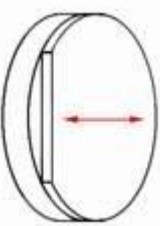
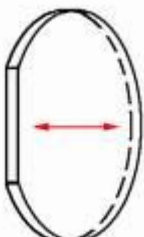


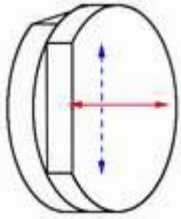
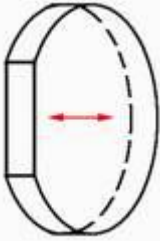
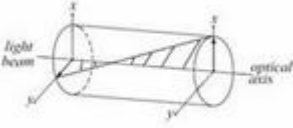
Quarter waveplate

The thickness of the quarter waveplate is such that the phase difference is $1/4$ wavelength ($\lambda/4$, true-zero order) or some multiple of $1/4$ wavelength $[(2n+1)\lambda/4, \text{multiple order}]$.

If the angle q (between the electric field vector of the incident linearly polarized beam and the retarder principal plane) of the quarter waveplate is 45° , the emergent beam is circularly polarized. When a quarter waveplate is double passed, i.e. by mirror reflection, it acts as a half waveplate and rotates the plane of polarization to a certain angle. Quarter waveplates are used in creating circular polarization from linear or linear polarization from circular, ellipsometry, optical pumping, suppressing unwanted reflection and optical isolation.



Waveplate		Illustration	Properties and Application
Low-order Waveplate			Its properties are much better than the multi-order waveplate because of its thinner thickness (less than 0.5mm). Better temperature (380C), wavelength (1.5nm) and incident angle (4.50) bandwidth and high damage threshold make it widely used in common application. Also, it is economical.
Zero order waveplate	Cemented waveplate Optical contacted waveplate		It is constructed of two multi-order waveplates with their axis crossed. Thus, it performs as a zero-order waveplate because of the effect of two plates counteracting each other. It has wide temperature bandwidth and wavelength bandwidth properties. Because it is cemented, the damage threshold must be considered (about 10MW/cm2) when used.
	Air spaced waveplate		Its performance is as good as cemented zero order waveplate. Additionally, the air spaced construction enables it is suitable for the high power laser application. The damage threshold is more than 500MW/cm2.
True Zero order Waveplate	Cemented		The true zero order waveplate means that the thickness of waveplate is very thin (less than 0.1mm) which make the true zero-order waveplate excellent in temperature, wavelength and incident angle (about 20deg.) bandwidth. Therefore, it is excellent choice for the highly accurate application. It is cemented with a block of glass which is limited to low and medium power application.
	Single Plate		In order to enable the waveplate suitable for high damage threshold (more than 1GW/cm2) application: Simphoton provides a single plate of true zero-order waveplate *The thickness of this waveplate means handling can be difficult, we can provide mounts upon request.

Achromatic Waveplate		Achromatic waveplate is similar to Zero-order waveplate except that the two plates are made from different materials, such as crystal quartz and magnesium fluoride. Since the dispersion of the birefringence can be different for the two materials, it is possible to specify the retardation values at a wavelength range. Hence, the retardation of the resulting waveplate can be made to low sensitivity to wavelength change.
Double Wavelength Waveplate		In fact, it is a low order or multi-order waveplate, but which is suitable for two different wavelengths with different retardation. The dual-wavelength waveplate is often applied in laser harmonic generation.
Polarization Rotator		The polarization plane of linearly polarized light will be rotated by crystal quartz.

Custom designed waveplate is available.

Metal ring mount and AR coating is available upon request.