# The Application of Optical Prism

The angle, position, and number of surfaces of a prism help define the type and function. To understand how the most popular prisms work and how each can best be used in light reflection and refraction applications, consider right angle prisms, roof prisms, and combination prisms.

**RIGHT ANGLE PRISM**

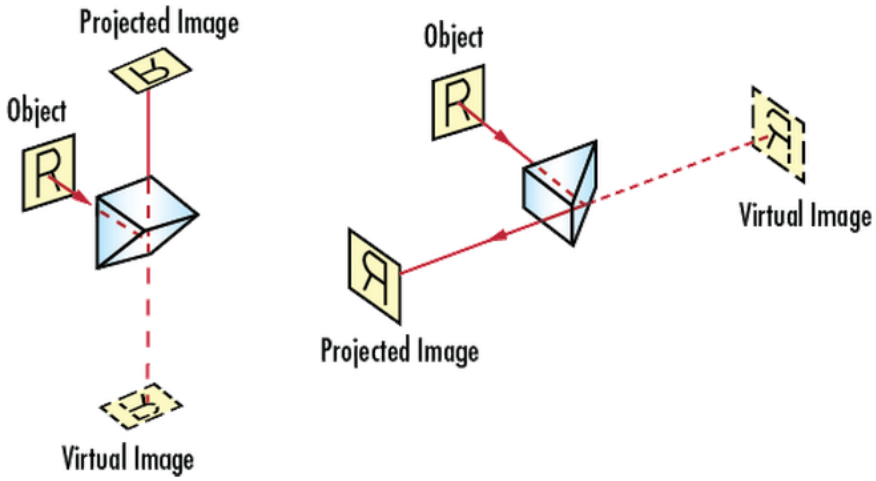


**Figure 1:** 45° - 90° - 45° as a Right Angle Prism Showing Inversion (Left) and Reversion (Right)

By far the most commonly used prism is the 45° – 90° – 45° prism, known popularly as the right angle prism. It can be used in many ways to achieve different results pertaining to image parity or deviation and is named so for the angles on its triangular faces. The most common application of the 45° – 90° – 45° prism is to treat it as a right angle prism, which has only a single reflection that deviates the incident ray by 90°. The produced image will then become left-handed, but depending upon the position of the prism, can be inverted or reverted (Figure 1).

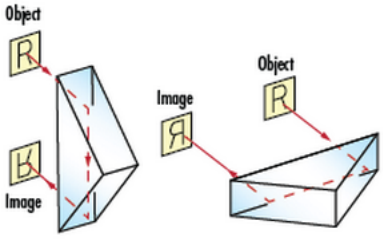


**Figure 2:** Fixed 180° Rotation with a Porro System

Using the hypotenuse face of the prism rather than the leg faces allows for another configuration known as the porro prism. This produces a right-handed image since two reflections occur. The ray's direction is reversed when using a porro prism since the object enters and the image exits the same face. The position of the prism determines whether a rotation or just a deviation occurs (Figure 2).

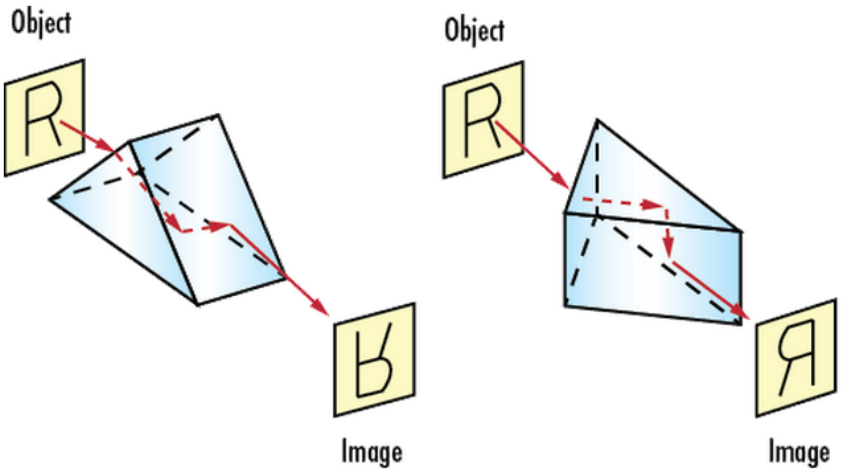


**Figure 3:** 180° Rotation with a Pechan-Roof Prism

Lastly, a 45° – 90° – 45° prism can also be used as a dove prism. A dove prism rotates the image 180°, but since only one reflection occurs, it will become either reverted or inverted depending on the position of the prism (Figure 3).

#### ROOF PRISM

A prism roof consists of two reflecting surfaces located 90° from each other. It is equivalent in function when compared to any other reflecting surface, except handedness does not change. A good example of this is the amici (roof) prism, which is basically a right angle prism with a roof. Under this configuration, a deviation of 90° still occurs, but without changing parity. A roof prism is often used in conjunction with other prisms in order to achieve the desired parity.

#### COMBINATION PRISMS

Many combination prisms are possible with slight adjustments to the orientation and/or coating applied to the surfaces of the individual prisms used. Ultimately, the application dictates the type of combination necessary. Consider the most well-known combination prisms: porro system, Pechan (roof) prism, and beamsplitters.

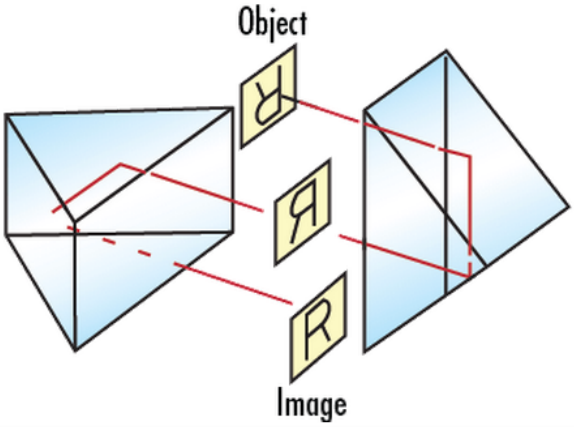


**Figure 4:** Fixed 180° Rotation with a Porro System

A porro prism is often used in combination with itself to create a porro system (Figure 4) with a total of four reflections. Due to its ability to produce an upside down image rotated 180° from the original while maintaining right-handedness, this type of image erection prism is extremely useful for binocular and telescope applications. It is important to keep in mind that the ray path does become displaced, a fact that must be taken into account when adjusting the rest of the optical components used with a porro system, such as an objective lens and eyepiece for binoculars.

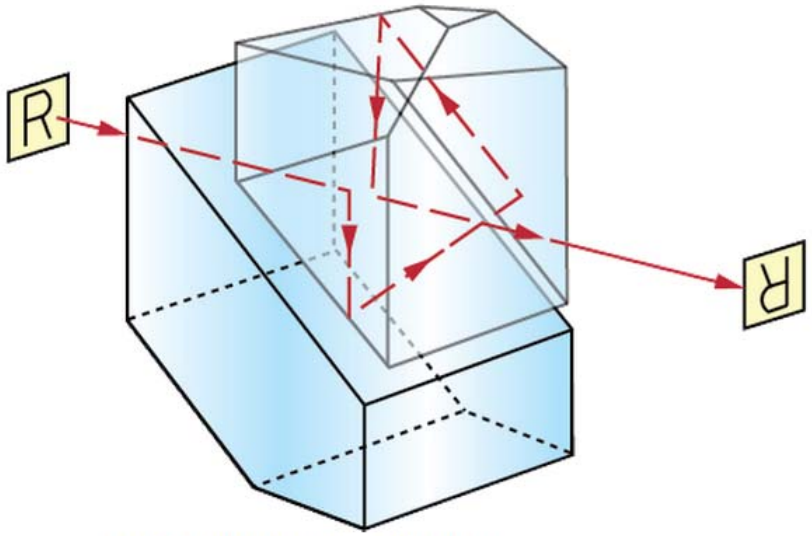


**Figure 5:** 180° Rotation with a Pechan-Roof Prism

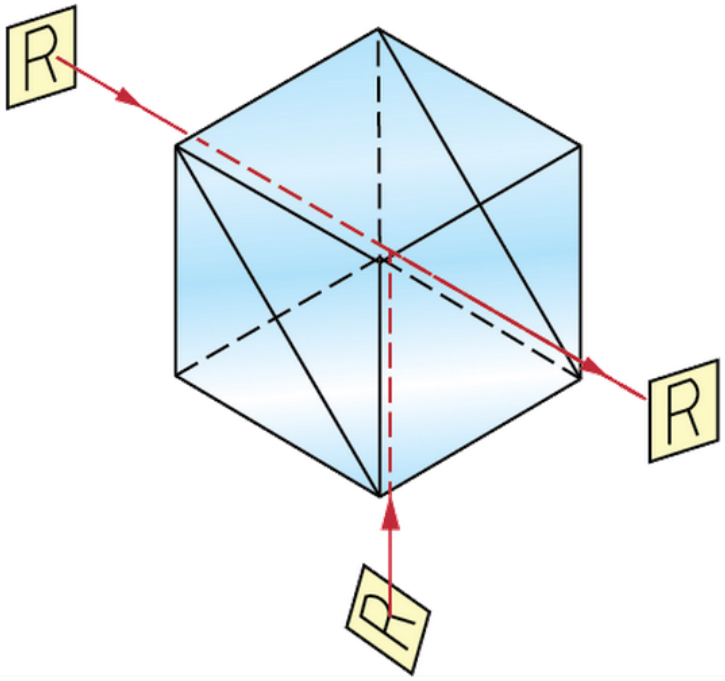


**Figure 6:** Cube Beamsplitter

Edmund Optics manufactures prisms in a range of geometries for simple dispersion to complex, multi optical element applications. Understanding the optical theories behind each specific geometry helps one select the best prism or combination of prisms for any application.