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What are Beamsplitters?

Beamsplitter Construction | **Types of Beamsplitters**

Beamsplitters are optical components used to split incident light at a designated ratio into two separate beams. Additionally, beamsplitters can be used in reverse to combine two different beams into a single one. Beamsplitters are often classified according to their construction: **cube** or **plate** (Table 1).

Table 1: Comparison of Cube and Plate Beamsplitters

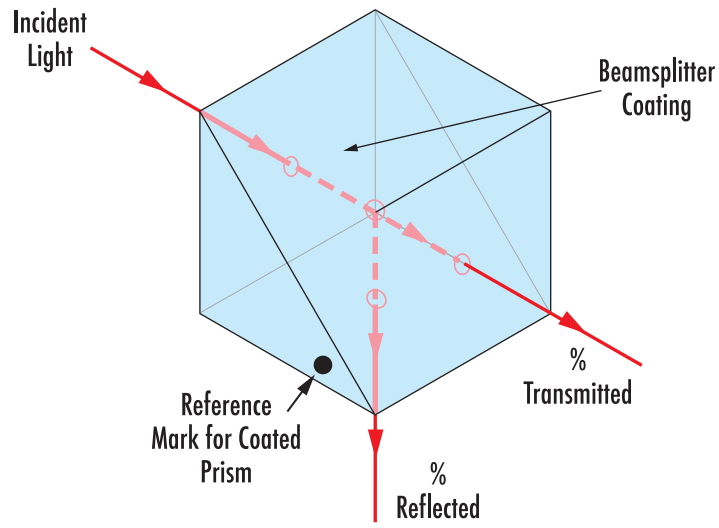
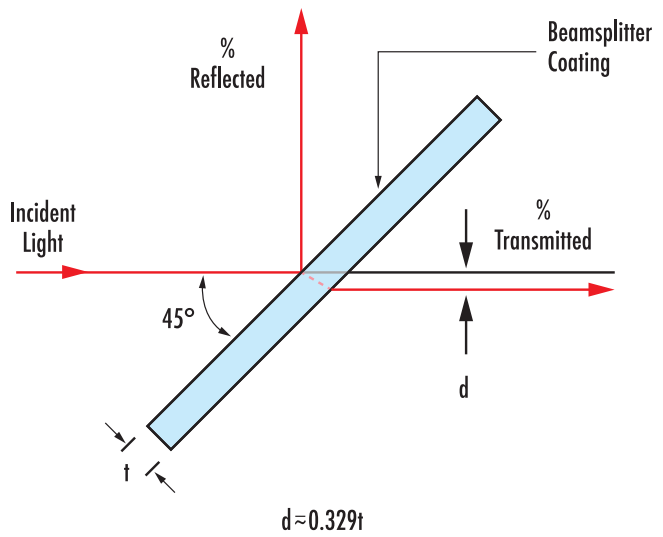
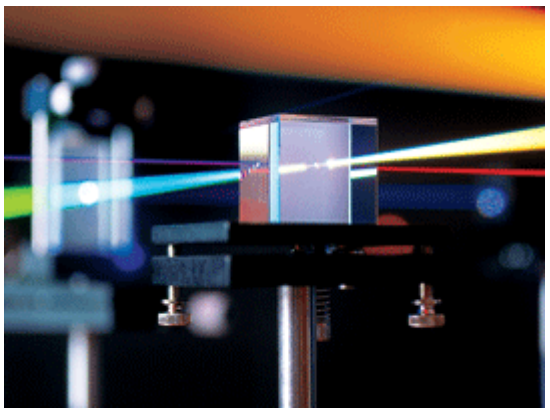
Cube Beamsplitters	Plate Beamsplitters
 ***Figure 1:*** *Cube Beamsplitter*	 ***Figure 2:*** *Plate Beamsplitter*
Cube beamsplitters are constructed using two typically right angle prisms (Figure 1). The hypotenuse surface of one prism is coated, and the two prisms are cemented together so that they form a cubic shape. To avoid damaging the cement, it is recommended that the light be transmitted into the coated prism, which often features a reference mark on the ground surface.	**Plate beamsplitters** consist of a thin, flat glass plate that has been coated on the first surface of the substrate (Figure 2). Most plate beamsplitters feature an anti-reflection coating on the second surface to remove unwanted Fresnel reflections. Plate beamsplitters are often designed for a 45° AOI. For substrates with a 1.5 index of refraction and a 45° AOI, beam shift distance (d) can be approximated using the equation in Figure 2.

Table 2: Beamsplitter Construction

	Advantages	Disadvantages
Cube Beamsplitters	• Easy Integration with 0° AOI • No Beam Shift • Equal Reflected and Transmitted Optical Path Lengths • Shorten the Optical Path of a System	• Heavy, Solid Glass Construction • Difficult, and more Expensive to Make in Large Sizes
Plate Beamsplitters	• Lightweight • Relatively Inexpensive • Easy to Manufacture in Larger Sizes	• Reflected and Transmitted Optical Paths are Different Lengths • Beam Shift of Transmitted Light (see Figure 2) • The 45° AOI may Require Additional Alignment Time

Types of Beamsplitters



Standard Beamsplitters are commonly used with unpolarized light sources, such as natural or polychromatic, in applications where polarization state is not important. They are designed to split unpolarized light at a specific Reflection/Transmission (R/T) ratio with unspecified polarization tendencies.

Polarizing beamsplitters are designed to split light into reflected S-polarized and transmitted P-polarized beams. They can be used to split unpolarized light at a 50/50 ratio, or for polarization separation applications such as optical isolation (Figure 3).

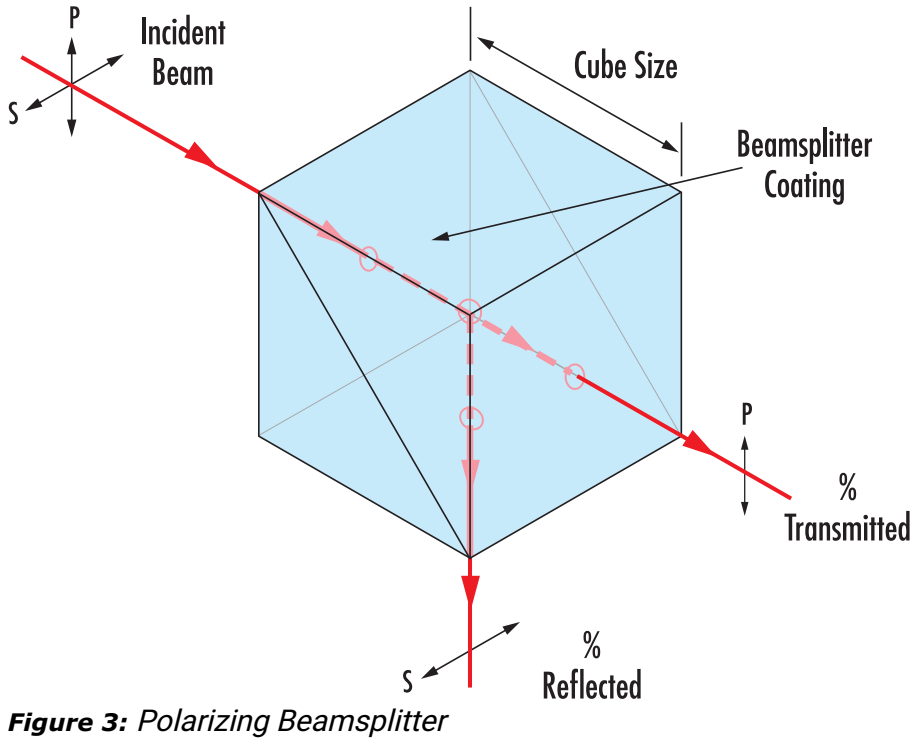


Figure 3: *Polarizing Beamsplitter*

Non-polarizing beamsplitters split light into a specific R/T ratio while maintaining the incident light's original polarization state. For example, in the case of a 50/50 non-polarizing beamsplitter, the transmitted P and S polarization states and the reflected P and S polarization states are split at the design ratio. These beamsplitters are ideal for maintaining polarization in applications utilizing polarized light (Figure 4).

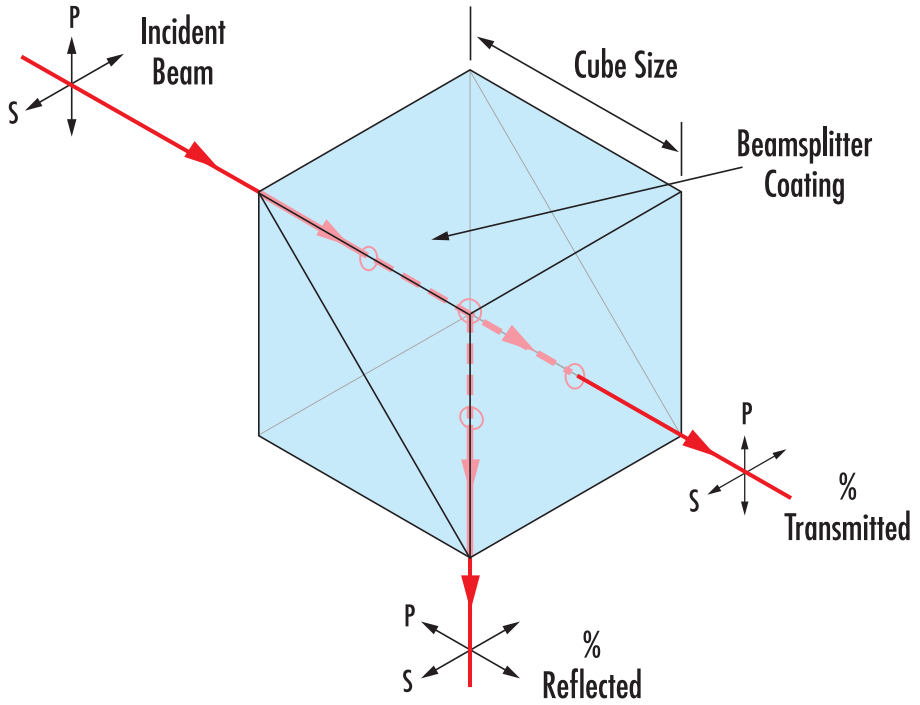


Figure 4: *Non-Polarizing Beamsplitter*

Dichroic Beamsplitters split light by wavelength. Options range from laser beam combiners designed for specific laser wavelengths to broadband hot and cold mirrors for splitting visible and infrared light. This type of beamsplitter is commonly used in fluorescence applications.