**Bending light by a prism**

**Objective**
To study refraction, Snell’s law, and total internal reflection.

**Experiments**

You will be using a helium-neon (HeNe) laser which produces a red laser beam of wavelength $\lambda = 632.8$nm, and a right-angle prism that is mounted on a rotation stage. This stage has 360° markings on it. The hypotenuse surface of the prism is aligned with the diameter of the circular stage, so that the input and output beam angles are determined by reading the markings on the scale that is directly under the beam path.

A. **Total Internal Reflection (TIR)**
- Place prism in the path of the laser beam. Rotate the stage that the incident beam passing through the iris reflects back.
- Align the prism to aim laser beam at the center of hypotenuse. Check 0° degree reading on the rotation stage.
- Observe where the output beam exits. Does this agree with the fact that the prism is a right-angle prism? (Note that the beam inside the prism is incident on the hypotenuse surface at 45°.)
- Is there another output beam exiting from the hypotenuse surface?

B. **Critical Angle ($\theta_c$)**

- Slowly increase the incident beam angle $\theta_i$. Note the output angle of any beam that may begin to emerge from the hypotenuse surface.
- If a beam emerges from the hypotenuse surface, the beam has exceeded the critical angle condition given by
  $$\sin(\theta_c) = \frac{n_1}{n_2}$$
  where $n_1$ is refractive index of the air ($n_1 = 1$) and $n_2$ is refractive index of the prism. Prism is made of a material called BK7 glass and has an index of 1.515 at $\lambda = 632.8$nm. Calculate critical angle $\theta_c$ for this wavelength.

- Using Snell's law, experimentally verify $\theta_c$ for red light. To do it, measure $\theta_i$ when the output beam just begins to emerge from the hypotenuse surface. Calculate $\theta_2$ and compare it with $\theta_c$. Figure below shows the angles that you will be measuring and calculating.

  **Note** that for the right-angle prism $\theta_2 = \theta_1 - 45°$. 

---

![Diagram of angles](https://via.placeholder.com/150)