11.1: Introduction to Interference

The most certain indication of a wave is interference. This wave characteristic is most prominent when the wave interacts with an object that is not large compared with the wavelength. Interference is observed for water waves, sound waves, light waves, and, in fact, all types of waves.

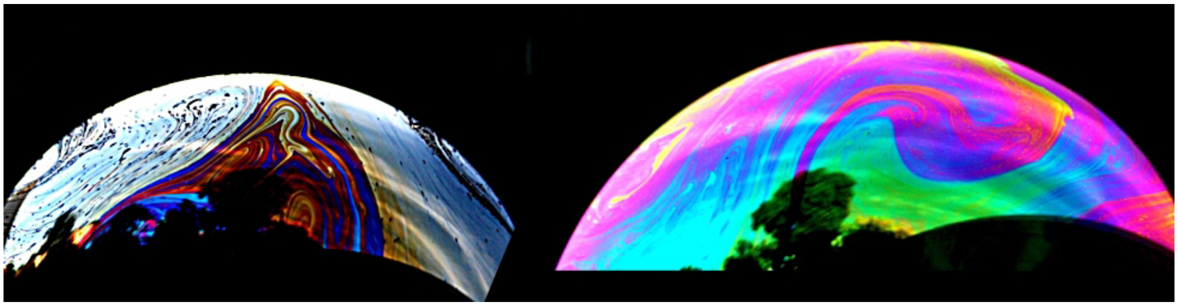

Figure 11.1.1: Soap bubbles are blown from clear fluid into very thin films. The colors we see are not due to any pigmentation but are the result of light interference, which enhances specific wavelengths for a given thickness of the film.

If you have ever looked at the reds, blues, and greens in a sunlit soap bubble and wondered how straw-colored soapy water could produce them, you have hit upon one of the many phenomena that can only be explained by the wave character of light (Figure $11.1.1$). The same is true for the colors seen in an oil slick or in the light reflected from a DVD disc. In these cases, light interacts with objects and exhibits wave characteristics.

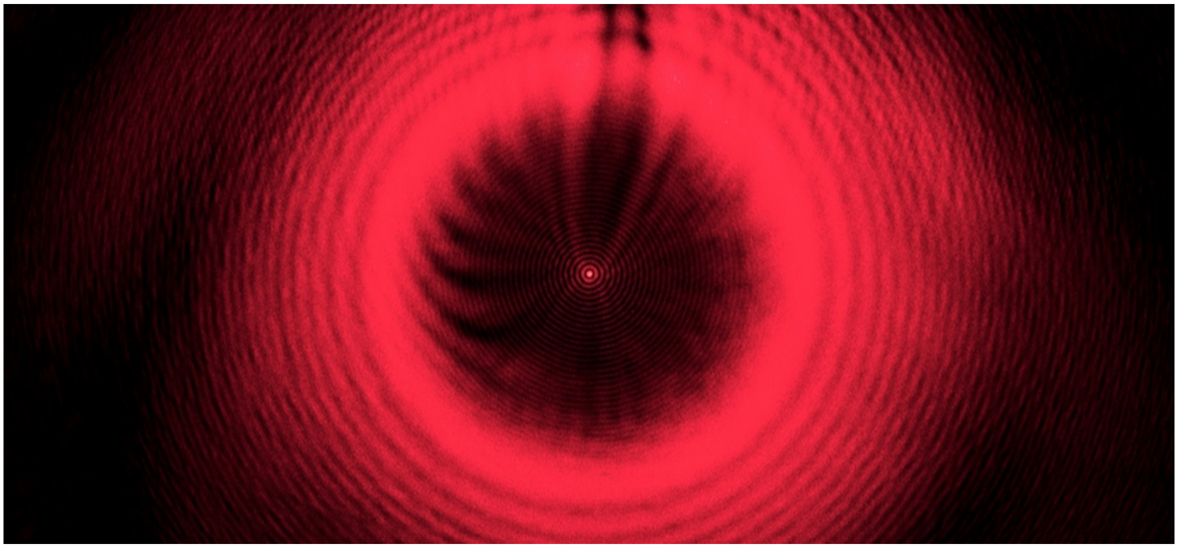

Figure 11.1.2: A steel ball bearing illuminated by a laser does not cast a sharp, circular shadow. Instead, a series of diffraction fringes and a central bright spot are observed. Known as Poisson's spot, the effect was first predicted by Augustin-Jean Fresnel (1788–1827) as a consequence of diffraction of light waves. Based on principles of ray optics, Siméon-Denis Poisson (1781–1840) argued against Fresnel's prediction. (credit: modification of work by Harvard Natural Science Lecture Demonstrations)

We will learn in this chapter that a wave can behave not as one wave but as an infinite number of point sources of waves. These waves can interfere with each other, resulting in interference patterns. Thus, a monochromatic light beam through a narrow opening —a slit just a little wider than the wavelength of the light would not cast a simple shadow of the slit on the screen, an interference pattern appears in what we will refer to as diffraction. An example of diffraction is what is depicted in Figure $11.1.2$ Diffraction plays a major role in the way we interpret the output of optical instruments and on the was we design instruments that are based on the use of light.

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