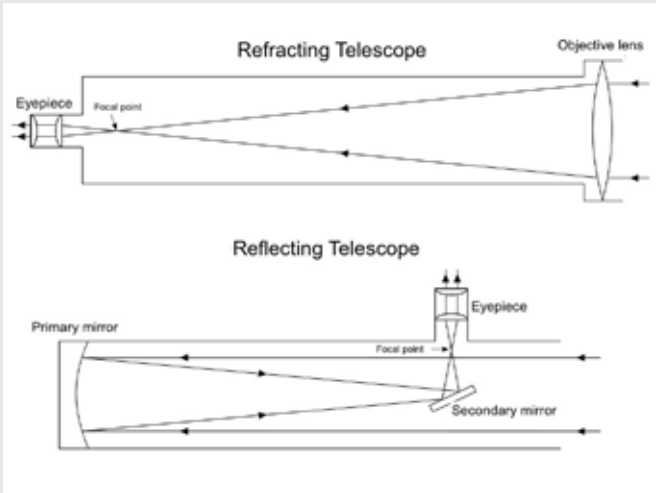
FIGURE 1-17[17]



A diagram of a refracting telescope and a reflecting telescope.

is necessary to collect enough light for proper viewing. Manufacturing the large lenses that would be necessary to construct a refracting telescope at this scale would be difficult and costly; large-diameter lenses are also heavy and prone to sagging. For these reasons, reflecting telescopes tend to be more useful for the purposes of astronomical research. The 10-m primary mirrors of the Keck Observatory telescopes could not rigidly hold their shape to a necessary precision if they were made of single pieces of glass. Instead, each mirror is made of an array of thirty-six hexagonal segments that work together as a single unit.

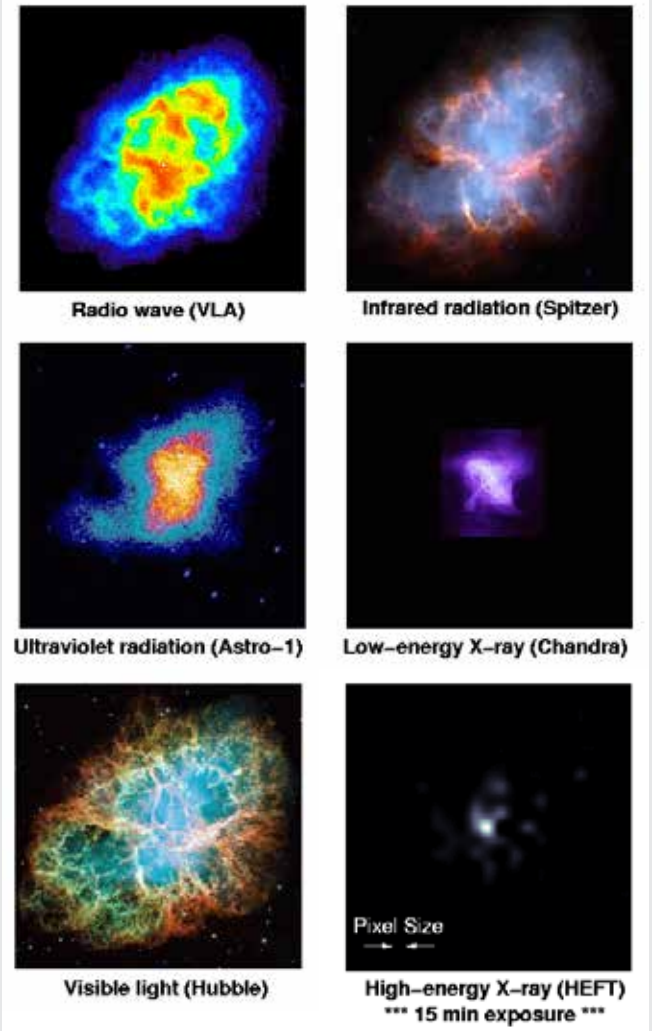
Radio Astronomy

Some astronomical objects emit most of their radiation outside the visible spectrum. We would not be able to make useful observations of such objects using optical telescopes. Radio astronomy originated in 1931 when U.S. engineer Karl G. Jansky discovered radio waves coming from the Milky Way. Since then, radio waves have been received from a variety of sources, including the Sun, other planets, cold interstellar gas, pulsars, distant galaxies, and quasars. Since Earth's atmosphere does not block or scatter radio waves, radio telescopes can be operated in cloudy weather or during the daytime. Radio telescopes consist of a curved "dish" antenna that acts like the curved mirror in a telescope. Because radio waves have wavelengths of many meters, the antennas must be correspondingly large in size.

Radio waves collected by a radio telescope cannot be seen, heard, or photographed directly. Rather, a receiver collects, amplifies, and records their "image" as an electronic signal. Computers may display radio images digitized, as a contour map that shows the strength of the radio source, or as a **radiograph**, which is a false color picture that shows how the radio source in space would "look" to a person with "radio vision." Figure 1-18 shows the same celestial object (the Crab Nebula) imaged with six different wavelengths, including radio waves.

FIGURE 1-18[18]

Crab Nebula: Remnant of an Exploded Star (Supernova)



Six images of the Crab Nebula, each captured using a different wavelength of electromagnetic waves.