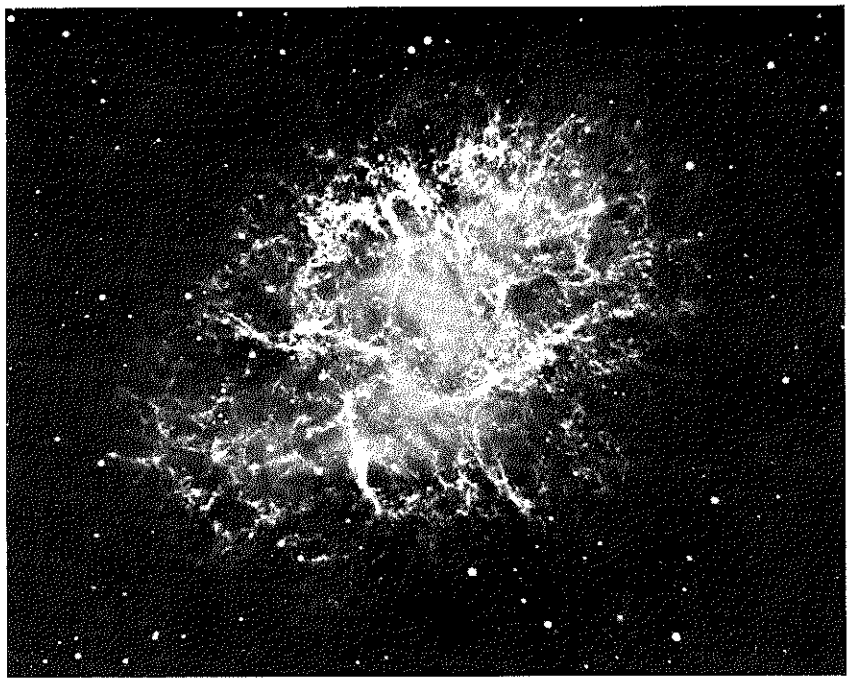
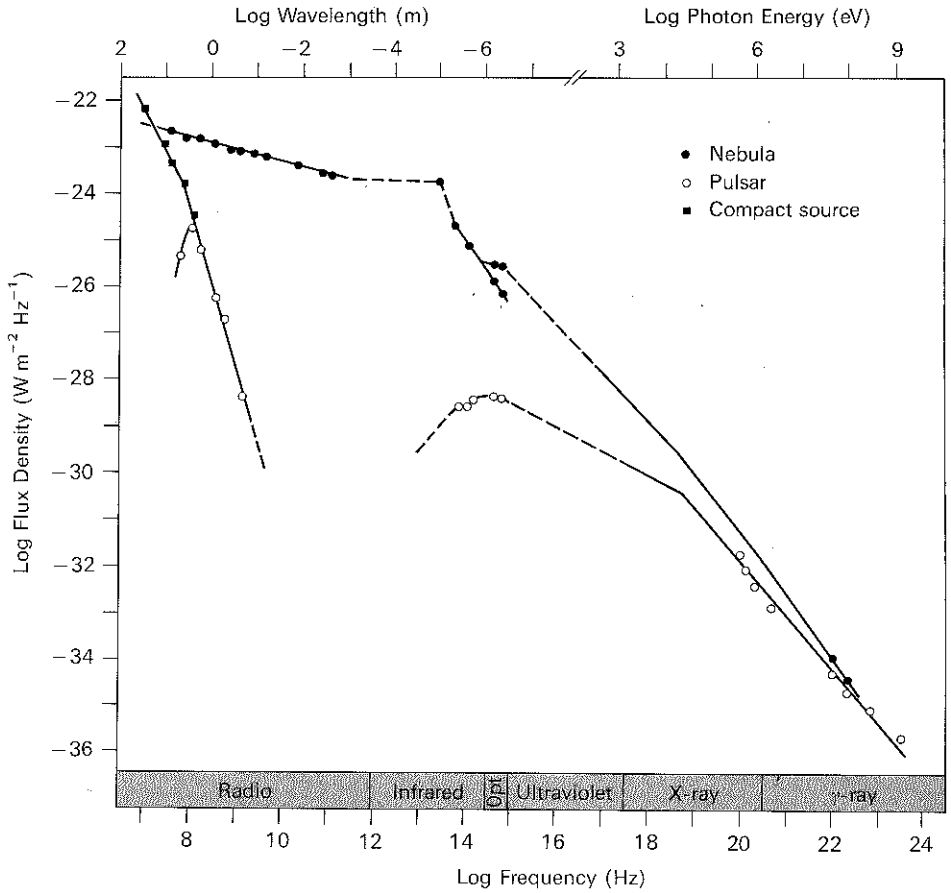


4-1 The Crab Nebula photographed in red light to show the line-emitting filaments. [Courtesy of the Lick Observatory.]

a pulsar was found in the nebula by Staelin and Reifenstein (1968). It has the shortest period of any known pulsar and has been shown to be ultimately responsible for most of the emission from the nebula, including the X-rays and the compact radio source. Because of this close association between the nebula and the pulsar, we begin this chapter with a description of the nebula itself.

The Nebular Emission

At radio and X-ray frequencies the Crab Nebula is one of the strongest sources in the sky, but at optical frequencies it is not so prominent. Its apparent visual magnitude is about 8.4 and, although its surface brightness is rather low, it can be seen with a small telescope. Continuum spectra from low radio frequencies to the γ-ray region for both the nebula and the pulsar are given in Figure 4-2. The nebular spectrum appears to be essentially continuous over this entire range, although observations are lacking



4-2 Spectra of the Crab Nebula and its pulsar over the range 10^7 to 10^{24} Hz. Two lines are drawn for the nebular spectrum in the optical region: the lower line is the observed spectrum and the upper line is corrected for interstellar extinction ($A_v = 1.6$ mag). The optical spectrum for the pulsar has also been corrected for $A_v = 1.6$ mag. Data from the following sources were used: Aitken and Polden, 1971; Andrew *et al.*, 1964; Becklin and Kleinmann, 1968; Becklin *et al.*, 1973; Bell and Hewish, 1967; Bridle, 1970; Clark *et al.*, 1973; Kellermann *et al.*, 1969; Kniffen *et al.*, 1974; Kurfess, 1971; Laros *et al.*, 1973; Manchester, 1971b; Matveyenko, 1971; Matveyenko and Meeks, 1972; McBreen *et al.*, 1973; O'Dell, 1962; Oke, 1969; Parker, 1968; Rankin *et al.*, 1970; Scargle, 1969; Thomas and Rothenflug, 1974; Vandenberg *et al.*, 1973; and Williams *et al.*, 1965.