

Pulsars

In the 1930s, Walter Baade and Fritz Zwicky suggested that neutron stars might perhaps exist as the stellar remnants of a supernova explosion. This far-sighted idea lay dormant until the early 1960s when it dramatically exploded on the scene with the 1967 discovery of pulsars. These, found by a team of astronomers from Cambridge University, England, appeared as radio sources which pulsated with very short periods, of the order of seconds or less, and they maintained these periods with extreme accuracy (Fig. 3.25). Neutron stars seemed to be the most likely explanation for the generation of such short pulses and the discovery, one year later, of the pulsar NP 0531, embedded deep in the heart of the Crab Nebula supernova remnant, both confirmed Baade and Zwicky's hypothesis and proved beyond doubt that pulsars were neutron stars. Neutron stars rotate rapidly, and, although the actual mechanism of the pulsations is still unclear, it certainly seems to involve

a strong magnetic field rigidly linked to the rotating surface. Somehow and somewhere close to the neutron star itself, energetic particles (probably electrons) interact with this rotating field to produce a narrow, lighthouse-like beam of radiation which we see as a pulse when it intercepts the Earth (Fig. 3.26). Pulsars have also been observed in the X-ray region as components of X-ray binary sources.

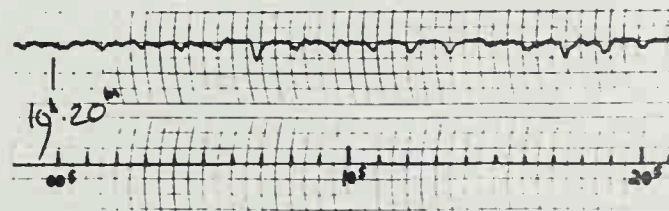


Fig. 3.25 Pulse trace (obtained on 1967 November 28) revealing the discovery of a hitherto unknown class of objects, now referred to as pulsars. The regular but variable radio emission from the first known pulsar CP 1919 is clearly visible in the upper trace. The lower trace is a timing marker. CP 1919 emits a radio pulse every 1.3373 s.

The Crab Nebula; a supernova explosion observed by Chinese astronomers in 1054 AD. The nebula is about 2 kpc distant and is observed to be expanding. One of the central stars, indicated by the arrow, is the Pulsar NP 0531, which is flashing like a lighthouse more than thirty times every second, as shown in sequence of television pictures at right.