customarily measured in ELECTRON VOLTS (eV), the energy gained by an electron moving through a POTENTIAL DIFFERENCE of 1 volt (V). Cosmic rays with energies higher than 10^8 eV can penetrate into the Solar System, and are detected by balloon-borne detectors, or more recently by satellites and deep-space probes. The number of cosmic rays drops off sharply with increasing energy, falling to an expected detection rate of less than 1 per m^2 per year for particles with energies higher than 10^{16} eV. Clearly, not many such particles can be picked up by the relatively small instruments carried by balloons, satellites and probes, but they are detectable indirectly from the ground. These very high energy cosmic rays produce a large 'shower' of elementary particles when they hit the top of the Earth's atmosphere, and this air shower can be picked up by particle detectors spread over several square kilometres on the Earth's surface. The most energetic cosmic rays known have energies of around 10^{20} eV – the energy of a tennis ball travelling at 100 km per h.

Although Solar-System-based experiments can only sample cosmic rays in a tiny portion of the Galaxy, the new science of γ-ray astronomy tells of their wider distribution. Cosmic rays colliding with hydrogen atoms in interstellar space can produce a shower of neutral PIONS, which quickly decay to γ-rays. The gamma ray satellites SAS-II and COS-B show enhanced emission from the central regions of the Galaxy, just where a higher density of gas and cosmic rays is expected. Unfortunately the generally low sensitivity and poor directional qualities of satellite-borne detectors means that very little detail can be distinguished in these all-sky surveys, and this is likely to remain the case until better detectors can be developed.

All except the highest energy cosmic rays (which may well be extragalactic) must be accelerated to their high speeds by energetic processes in our Galaxy. Supernova explosions are the most likely cause. Particles can either be accelerated by the neutron star relic (like those energized by the Crab pulsar, which make the Crab nebula shine), or by the shock wave of the exploded gas shell expanding out into the interstellar gas. These **supernova remnants** are generally faint optically because of their high temperatures (around 10^6 K), but this very hot gas makes them prominent X-ray sources. They also 'shine' at radio wavelengths by the synchrotron process, as particles accelerated at the SHOCK FRONT whirl around the lines of magnetic field in the expanding shell.

The interaction of the general cosmic ray background with the magnetic field of interstellar space also causes the whole of the Galaxy's disc to emit radio waves by the synchrotron process. The important particles here are the electrons, for although they are a rare component of cosmic rays, their small mass makes them very efficient synchrotron broadcasters. This radio background predominates at 1 cm wavelengths upwards, because of the preponderance of low energy cosmic rays. Since it arises in the interstellar region of the disc, the distribution roughly follows the path of the visible Milky Way across the sky, but without troublesome obscuration by the radio-transparent dust grains.