Synchrotrons Encyclopedia Article

Synchrotrons

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Synchrotrons

Synchrotrons are a class of particle **accelerators**. The highest **energy** accelerators in use today, such as the Tevatron at Fermilab and the large **electron positron** collider (LEP) at the European Organization for Nuclear Research (CERN). The synchrotron incorporates improvements over the simpler **cyclotron**, which allows it to be used with highly relativistic particles. Instead of one large magnet with a constant magnetic field as found in a cyclotron, the synchrotron has many smaller magnets placed around a ring. As the particles are accelerated, they become heavier according to special relativity. The path of the particles depends on their **mass** and the magnetic field acting on them; as the particles become more massive, the magnetic field must be turned up in order to keep them traveling around in a circle. Since there are many smaller magnets instead of one large magnet, they can be controlled individually to keep the particles traveling through the accelerator.

A special application is the **radiation** synchrotron. Unlike synchrotrons built to study high-energy physics, which are designed to minimize the amount of radiation produced, radiation synchrotrons are built specifically to produce high-energy **x rays** and gamma rays. They have the advantage of producing very narrow and very bright beams of radiation, which makes them ideal for studying condensed **matter** and biological systems.