



**Figure 26. Interior view of Fermilab's main ring. The lower magnets are superconducting magnets used to boost protons from about 400 GeV to almost 1 TeV.**

successful use of superconductivity on an industrial scale anywhere in the world. It has laid the foundations for the U.S. superconducting magnet industry, which promises to rival the size of the liquid nitrogen industry and have applications in diverse sectors of the economy. Superconducting magnets are already used, for example, in hundreds of whole-body MRI scanners in hospitals around the country. Applications of superconductors are being envisioned for power transmission and storage, high-speed rail transport, supercomputers, and even for metal and garbage separation.

Other state-of-the-art devices originally developed by high-energy physicists have been adopted for industrial purposes. High-power microwave technology, including klystrons like those originally designed for the SLAC accelerator, are the basis for this country's defense and air-traffic radar. An apparatus designed for the collection and concentration of extremely dim light emitted by particle detectors has been developed into a solar hot water heater. Its inventor, a theoretical particle

physicist, now pioneers the use of *non-imaging concentrators* for increasing the collection of the sun's radiation to generate electricity, produce high-temperature process heat, and provide high radiant flux for use in chemical processes.

No formal studies have attempted to evaluate the aggregate benefits to U.S. industry, but CERN commissioned such a study of European industry several years ago. The manufacturing firms involved in CERN contracts, it revealed, received three Swiss francs in additional sales revenues in related product lines for every Swiss franc in sales to high-energy physics. What's more, 75 percent of the total added value came in applications outside of high-energy physics—in areas as diverse as railways, shipbuilding, power generation and distribution, and automobile design.

High energy physics, its products, and the knowledge gained from this basic research program are used in medicine for diagnosis and treatment of illness, in the food industry for steriliza-