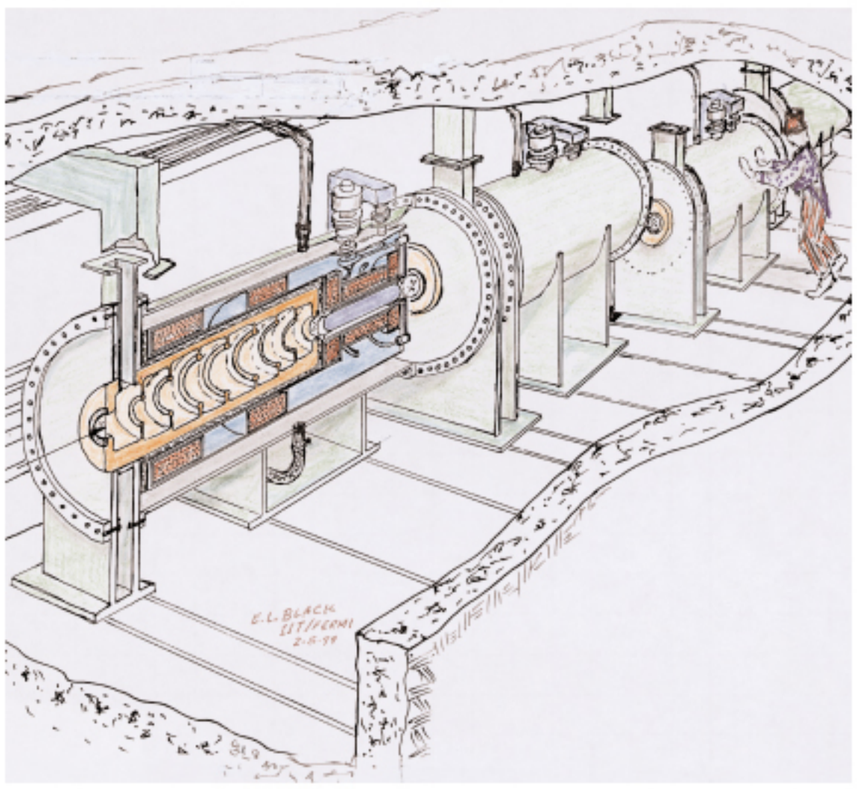
FERMILAB

A Department of Energy National Laboratory

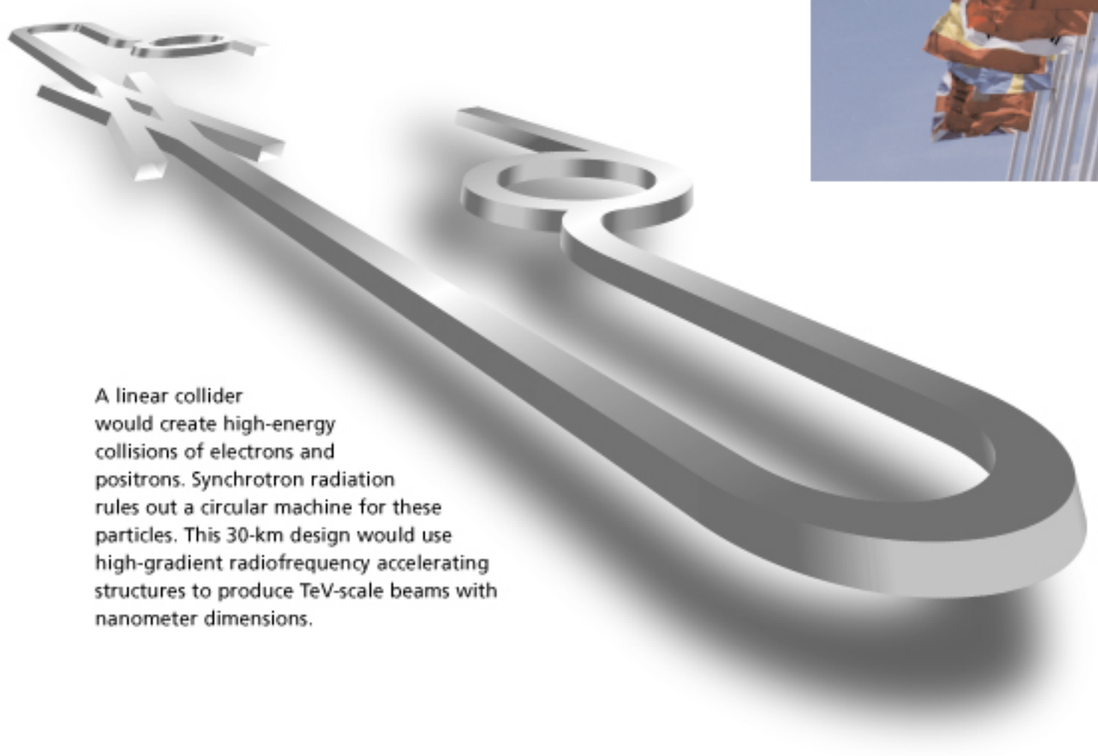
Paths to the Future Frontier

Linear Collider? Muon collider? Very Large Hadron Collider? Fermilab physicists are working other with scientists worldwide to define the technologies that will keep the U.S. among world leaders in particle physics.

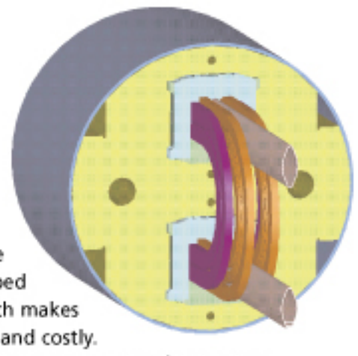
High-energy physics has long been a leader in international scientific collaboration. Future progress will require even greater international cooperation to build accelerators and detectors to reach new energy frontiers.



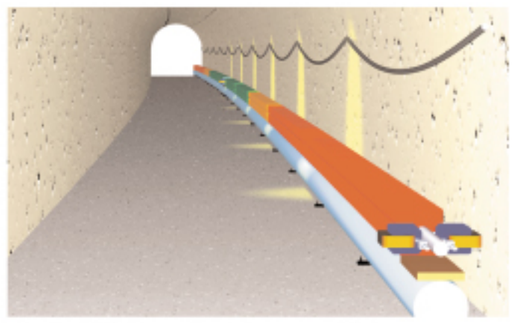
What will be the particle accelerators of the future? The sketch illustrates one idea: an accelerator with colliding beams of high-energy muons, the heavier cousins of the electron. Scientists say a muon collider is an intriguing idea, but they do not yet know if it will prove technically feasible.



A linear collider would create high-energy collisions of electrons and positrons. Synchrotron radiation rules out a circular machine for these particles. This 30-km design would use high-gradient radiofrequency accelerating structures to produce TeV-scale beams with nanometer dimensions.



A concept for a possible high-field two-in-one magnet for a Very Large Hadron Collider. This design reaches a field strength of 11T. Most high-field superconductors are brittle when reacted and must be shaped into coils prior to reaction, which makes insulation and support difficult and costly. The flat coil configuration of this magnet makes fabrication very simple compared to the usual saddle shape of high-field coils. Furthermore, the curvature of the coil ends is very gentle, allowing the use of pre-reacted superconductor, and simple insulation and support. These features are expected to result in significant cost reduction.



The low-field magnet design concept for a Very Large Hadron Collider relies on an extremely simple warm-iron superferric magnet built around a superconducting transmission line. The design eliminates quadrupoles and difficulties with synchrotron radiation, reduces parts cost and greatly simplifies magnet installation. To match the low cost of the magnet, the design anticipates a minimally-improved tunnel deep-bored in Illinois dolomite.