At the Frontier:
A Brief History of Fermilab . . .

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In 1965, the United States Joint Committee on Atomic Energy (JCAE) and the National Academy of Sciences (NAS) approved a frontier high energy physics project to develop a 200 giga electron volt (GeV) Accelerator. Although there were other regional and university accelerator laboratories working in high energy physics at this time the JCAE and NAS agreed to start a new laboratory that would address a broader range of investigation by a larger constituency of physicists from across the country and around the world. To manage this national project a new organization, the Universities Research Association, Inc. (URA) was formed that year.

By late 1966 Weston, Illinois had been selected as the site for the new National Accelerator Laboratory. Robert R. Wilson from Cornell University was appointed by URA in 1967 as the first Director of the National Accelerator Laboratory (NAL). The first offices were established in an Oak Brook office building while the site was prepared for the incoming physicists and engineers. Edwin Goldwasser from the University of Illinois became Wilson's Deputy Director. Harvard Professor Norman Ramsey, President of URA, provided strong support during the organization and design of the Laboratory.

The Village of Weston houses were converted to offices once the Laboratory moved west to develop the accelerator and the site. Groundbreaking for the first stage of acceleration, the Linear Accelerator, was held on December 1, 1968. The Main Ring accelerator was constructed from 1969 until 1971. The design energy of 200 GeV was reached in March 1972 and this success was celebrated by the entire NAL staff in the basement of Wilson Hall, then under construction. They had done the job faster and for less money than anyone had thought possible.

As the research areas developed, it was vital to preserve the aesthetics and natural beauty of the site. The Big Woods were carefully protected and an annual Arbor Day celebration was initiated to cultivate the green spaces of the Laboratory. Many of the original farmhouses dotting the landscape of the 6800 acre site were preserved and gathered adjacent to the Weston houses to provide housing for visiting scientists. A herd of North American Bison also came to reside at NAL in 1969. Restoration of the native prairie began in 1971.

During the early 1970's the three beamlines delivering protons from the accelerator to the Fixed Target Experimental Areas of the Laboratory—the Meson Area, Neutrino Area and Proton Area— were constructed while the research experiments for those areas were proposed to the administration. "Users" came to the NAL from many nations to explore the frontiers of physics at the highest energy accelerator in the world. Pushing even further into the frontier, the Main Ring attained 400 GeV in December, 1972 and then ran briefly at 500 GeV in May, 1976.

One of the aspects of the research program that Wilson hoped to nurture was the medical application of beam therapy in the treatment of cancer. Neutron beams from the Linac have been used for this purpose since 1976.

In May 1974 the Laboratory was dedicated and renamed Fermi National Accelerator Laboratory in honor of the internationally renowned Italian physicist Enrico Fermi who had achieved the first self-sustaining nuclear chain reaction at the University of Chicago during World War II. It is since this time that our identity has been "Fermilab." Mrs. Laura Fermi, widow of Enrico, participated in the Dedication Ceremony held on the footsteps of the newly constructed "High Rise"—now called Robert Rathbun Wilson Hall. The award-winning design of Wilson Hall, often compared with the cathedrals of France, was a collaborative effort with Wilson himself the leader of the architecture team.

The search for new particles using the accelerator at Fermilab produced a major discovery in the summer of 1977 when the first evidence for the bottom quark was observed. The experiment was conducted in the Proton Area by a collaborative team of 17 physicists from three institutions, led by Leon Lederman from Columbia University.

The need to reap the most significant physics results during the difficult economic times of the 1970's provided the foundation for Fermilab's next frontier, the Energy Doubler/Saver. Wilson had first proposed the idea of an Energy Doubler to the Joint Committee on Atomic Energy in 1971. Making use of the innovative and cost-saving technology of superconductivity, a ring of superconducting magnets added to the Main Ring was frequently proposed to double the energy of the complex of Fermilab's accelerators. Approval finally came in 1979.

Meanwhile, physicists and engineers were working to create and invent the necessary provisions for future expeditions into the unknown of high energy physics because neither the technology or materials existed anywhere at that time. The superconducting cable used in the Doubler magnets, as well as the process providing successful maintenance of superconducting temperatures allowing delivery of doubled energy through these magnets, were all invented at Fermilab. The superconducting magnets were installed below the Main Ring by March, 1983.

Robert Wilson resigned in February of 1978. In the fall Leon Lederman was appointed Director Designate by URA and in June he became Director. Lederman weighed the possibilities of the Laboratory's future in light of the research capabilities at other laboratories. He reaffirmed the central direction that the Laboratory had undertaken to complete the first superconducting accelerator and to transform that accelerator into a proton-antiproton collider. He decided to continue the pursuit of the high-energy frontier with the Energy Doubler/Saver knowing that, once completed, many opportunities for new explorations would become possible.

Indeed, a new scheme for colliding beams of protons and antiprotons had become an option in addition to the higher energy fixed target experiments for the Fermilab research program. Construction of an Antiproton Source was essential to produce the proton's opposite particle. These antiprotons could then be steered into collision with protons and observed in specially designed detectors. The energy of these collisions would be close to 2 TeV in the center of mass. This technically risky project, employing stochastic cooling techniques, was approved in 1982 and was led by John Peoples.

The superconducting Tevatron was the biggest innovation in international accelerator technology and by July 1983 the particle beam reached 512 GeV. That summer 10,000 neighbors attended an Open House at Fermilab to celebrate the milestone and learn more about our frontiers in science.

Pushing the frontiers of knowledge onward, Fermilab's particle theorists help intergrate the massive amounts of data produced by the experiments and provided direction for future experiments. Deep connections between the inner space of this experimental high-energy physics research and the outer space of our universe prompted Lederman to form a partnership with NASA in 1983. The Theoretical Astrophysics Group, the first such group formed at a national laboratory, links the data from the Tevatron's particle collisions with physical conditions not present since the beginning of the universe, the Big Bang.

Through the 1980s the computing technology and power of Fermilab experienced a revolution. Where once small independent consoles with oscilloscopes monitored the accelerator's beam and photographs from the bubble chamber were inspected for unusual occurances, a major effort was launched in this decade to put high performance computing to work to improve our methods of observation and understanding.

In 1985 the beam reached 800 GeV and the first collisions of protons and antiprotons (combined energy of 1.6 TeV) were observed at the Colliding Detector at Fermilab (CDF) in October. The energy rose to 900 GeV in 1986. The scientists who led the Tevatron project, Helen Edwards, Richard Lundy, J. Richie Orr, and Alvin Tollestrup were awarded the National Medal of Science in a ceremony at the White House in 1989.

Equipped with the highest energy, most powerful superconducting accelerator in the world the search began for the most exotic particle within reach: the top quark. Two specialized detectors were constructed by large teams of experimenters at CDF and at DZero. As plans progressed for the analysis of unprecedented kinds and amounts of data from the collisions it became apparent that greater computing strength was necessary to track the events and sort out the rare from the common. Another frontier was on the horizon.

As more information about the collisions became crucial, computers could be programmed to search for the new clues and track only the unique events desired. With the introduction of the Advanced Computer Project (ACP) and its ability to coordinate Fermilab's collision data with analysis by computers we entered a new domain of rapid data acquisition. During the observance of Fermilab's 20th anniversary in 1988 the Feynman Computing Center was dedicated.

Also in 1988 the careful treatment of our natural setting from the Laboratory's founding to the present brought distinction to Fermilab as a Department of Energy National Environmental Research Park. Our open grounds are home to many species of vegetation and wildlife and provide a favorable habitat for their propagation. As the prairie flourishes we are reminded of our legacy of the land.

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In 1989 Leon Lederman retired and John Peoples was appointed Director of Fermilab. In order to improve the performance of the Main Ring accelerator a new initiative, the Main Injector, was launched that year. When it begins to operate in 1999 it will provide the Tevatron with higher luminosity, increasing the number of particle collisions, and enhancing our ability to "see" them.

The science education programs, begun in the 1980's under the sponsorship of the Friends of Fermilab and the leadership of Lederman, were provided a permanent home when the Laboratory held a groundbreaking in 1989 for the Lederman Science Education Center.

Dedicated in 1992, the Center serves as a base for our expanding horizons, reaching out to bring science to the students and teachers of the nation.

As the Doubler and ACP were examples of physicists inventing their research tools to extend their frontiers, so the World Wide Web was invented in the early 1990's by international collaborations of high energy physisists to improve communications among themselves and their many essential partners.

From 1992 to 1993 the twenty-year old 200 MeV Linac received a boost of energy. This phase of Fermilab's initiatives to improve our apparatus for the 1990's brought the older Linac up to 400 MeV and increased the intensity of the beam in the Booster, and in turn that of the Tevatron. This improvement also enhances our collider luminosity, allowing us to make more collisions and discover rare events.

On March 22, 1993, a groundbreaking for the Main Injector, the centerpiece of these upgrades, was held. These improvements will enable us to launch a broader experimental research program with stronger capabilities. Adjacent to the Tevatron on our western border, the Main Injector will boost Fermilab's position for frontier research in the twenty-first century.

During the1990s the top quark search intensified and in 1994 evidence of its sighting was reported. By 1995 both teams of detector collaborations, CDF and DZero, closed in on their quarry and announced the top's discovery. The two discovering expeditions consisted of almost one thousand physicists from around the globe. An incredible amount of data had been mined in the search for these precious nuggets. Fermilab was the only place on earth where this search could occur.

As the program at Fermilab moves forward the particle physics field focuses inside the quark and beyond. Fixed-target and colliding-beams experiments continue their searches on the frontier. The KTeV experiment will probe uncharted regions to reveal new information about the differences in the laws of physics between matter and antimatter. The Main Injector will begin a search to investigate whether neutrinos do or do not have mass. Known as the NuMI Project, this research hopes to explain the existence of dark matter in the universe, yielding an explanation of how galaxies form. The Collider program will continue to probe for a deeper understanding of heavy quarks, the bottom and the top. The new Experimental Astrophysics Group will examine the heavens mapping the universe in a Digital Sky Survey.

Innovative technologies emerge from the research conducted at Fermilab. Eventually these contribute to improving our society and culture. The knowledge gained enriches our citizens, preparing them for their future.

Fermilab holds a leadership position at this fundamentalfrontier with the instruments and knowledge needed to explore the unknown. Discoveries lie ahead and beckon our inquiry.