Particle Physics: Benefits to Society

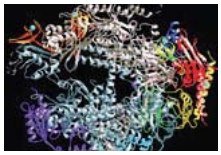
From the earliest days of high energy physics in the 1930s to the latest 21st century initiatives, the innovative ideas and technologies of particle physics have entered the mainstream of society to transform the way we live. Selected examples illustrate a long and growing list of beneficial practical applications with contributions from particle physics.

Medicine: cancer therapy
Every major medical center in the nation uses accelerators producing x-rays, protons, neutrons or heavy ions for the diagnosis and treatment of disease. It is estimated that there are over 7,000 operating medical linacs around the world that have treated over 30,000,000 patients. At Fermilab, the NIU Institute for Neutron Therapy uses a beam of neutrons to treat cancer patients.

Medicine: diagnostic instrumentation
Particle detectors first developed for particle physics are now ubiquitous in medical imaging. Positron emission tomography, the technology of PET scans, came directly from detectors initially designed for particle physics experiments sensing individual photons

Homeland security: monitoring nuclear waste nonproliferation
In nuclear reactors, the amount of plutonium builds up as the uranium fuel is used. Because plutonium and uranium emit different kinds of particles, a particle detector can be used to monitor and analyze the contents of the nuclear reactor core. A prototype detector, originally developed by physicists for experiments, has already demonstrated the potential use of this new monitoring technology.

Industry: power transmission
Cables made of superconducting material can carry far more electricity than conventional cables with minimal power losses. The construction of Fermilab's Tevatron accelerator started the superconducting wire industry. Research at particle physics laboratories will help advance this industry, offering an opportunity to meet continued power needs in densely populated areas where underground copper transmission lines are near their capacity.



Industry: biomedicine and drug development
Biomedical scientists use particle physics technologies to decipher the structure of proteins, information that is key to understanding biological processes and healing disease. A clearer understanding of protein structure allows for the development of more effective drugs, such as Kaletra, one of the world's most-prescribed drugs to fight AIDS.

Industry: understanding turbulence
From long distance oil pipelines to models for global weather prediction, turbulence determines the performance of virtually all fluid systems. Silicon strip detectors and low-noise amplifiers developed for particle physics are used to detect light scattered from microscopic particles in a turbulent fluid, permitting detailed studies of this challenging area.

Computing: the World Wide Web
Particle physicists developed the World Wide Web to share information quickly and effectively with colleagues around the world. Few other technological advances in history have more profoundly affected the global economy and societal interactions than the Web. In 1992, Fermilab launched the third Webserver in the United States. In 2001, revenues from the World Wide Web exceeded one trillion dollars, with exponential growth continuing.

Computing: the Grid
The Grid is the newest particle physics computing tool that allows physicists to manage and process unprecedented amounts of data across the globe by combining the strength of hundreds of thousands of individual computing farms. Industries such as medicine and finance are examples of other fields that also generate large amounts of data and benefit from advanced computing technology.

Sciences: synchrotron light sources
Researchers use the ultra-powerful X-ray beams of dedicated synchrotron light sources to create the brightest lights on earth. These luminous sources provide tools for such applications as protein structure analysis, pharmaceutical research, materials science and restoration of works of art.