



Ernest Courant

March 26, 1920 – April 21, 2020

The accelerator community mourns the passing of Ernest David Courant, who passed away peacefully and surrounded by family in Ann Arbor on April 21, 2020, at the age of 100. Courant was a seminal leader in large-scale particle accelerator design and a distinguished scientist emeritus at Brookhaven National Laboratory. He was awarded by the American Physical Society the first Robert R. Wilson Prize for Achievement in the Physics of Accelerators, was a member of the National Academy of Sciences and a recipient of the Enrico Fermi Award, awarded by the United States Government in recognition of a lifetime scientific achievement, as well as many other honors and awards for his scientific work. Ernest Courant was known as the “father of modern particle accelerators”. Essentially all high-energy accelerators in use today incorporate principles that he helped to develop. He spent most of his career at Brookhaven National Laboratory, interspersed with visiting appointments at Princeton University, the University of Cambridge, Yale University, the University of Michigan, Stony Brook University, and Fermilab, among other places. Ernest Courant was born in Göttingen, Germany, in 1920. His father, Richard Courant, was head of the Institute of Mathematical Sciences at the University of Göttingen, and his mother, Nina, was a musician. Ernest was the oldest of four children, all of whom are now deceased. In 1933 Richard Courant was removed from his position as a professor by the Nazi regime and in 1934 the family moved to New Rochelle, a suburb of New York. Richard became head of the math department at New York University, which became the Courant Institute of Mathematical Sciences. Ernest graduated from high school at the Fieldston School in the Bronx, received his undergraduate degree in physics from Swarthmore College at the age of 20, and completed his Ph.D. at the University of Rochester in 1943. He spent 1944 and 1945 working on nuclear physics at the Montreal Laboratory, which was part of the Manhattan Project that developed the atomic bomb. Montreal was also the home of Sara Paul, who worked as lab technician. She and Ernest were married in 1944. In 1948 Ernest moved to Brookhaven Lab, where he spent most of his life and did most of his work, designing and building particle accelerators.

Courant joined the newly formed Lab as a member of the team assembling Brookhaven’s first accelerator, a proton synchrotron called the Cosmotron, which was also the first synchrotron to accelerate beams to GeV energies. In 1952, the Cosmotron reached the world record of 1.3 GeV – almost five times more energy than had been previously achieved. The accelerator design appealed to European physicists, interested in building a similar, but larger, accelerator at Europe’s CERN laboratory and a study group was formed together with Brookhaven physicists.

In considering modifications to the Cosmotron's design for the accelerator at CERN, Ernest Courant, together with M. Stanley Livingston and Hartland Snyder, discovered the "alternating gradient", principle which revolutionized the design of all modern accelerators. They showed that with a magnetic lattice composed of alternating-gradient dipoles, the particle beams would remain confined and stable. This presented a breakthrough in accelerator design with regards to construction costs, by limiting both the overall size of the accelerator and the accelerator magnets, and in particular in enabling acceleration of beams to even higher energies. Courant, Livingston, and Snyder quickly published in 1952 a design for a 30 GeV accelerator, which became the basis for Brookhaven's Alternating Gradient Synchrotron (AGS) and CERN's Proton Synchrotron (PS). The alternating gradient principle provides the basis for all modern high energy particle accelerators including Brookhaven's Relativistic Heavy Ion Collider (RHIC), Fermilab's Main Injector (MI), Europe's Large Hadron Collider (LHC), SLAC's Linac Coherent Light Source (LCLS), and many other linacs and synchrotron light sources around the world including Brookhaven's original National Synchrotron Light Source (NSLS) and its successor NSLS-II.

In later years, Courant made many other important contributions including development of the foundations for analyzing beam dynamics and stability in strong focusing synchrotrons. The parameters used to characterize particle beams, commonly referred to as "Courant-Snyder" parameters, guided the design of many accelerators around the world. Courant also made major contributions to the field of polarized beam acceleration, which facilitated the development of polarization capabilities at many accelerators.

The impact of Ernest's work on modern science can hardly be overstated as particle accelerators have taken center stage in many disciplines.

Ernest "retired" in 1990 but continued to be scientifically active for more than twenty years, spending a day a week at Brookhaven even after he and Sara had moved to Manhattan. Ernest was an active hiker, skier, flute-player, photographer, bicycle-rider, opera buff, and concertgoer. He swam several days a week and frequently rode his bicycle around Central Park well into his eighties. Ernest and Sara moved to Ann Arbor from New York in 2013. Courant is survived by his wife of 75 years, who spent her career as a librarian and library director, and by his children, Paul, who is a professor at the University of Michigan, and Carl, who is a retired economist with the New York Power Authority, and by his daughter-in-law, Marta Manildi, an attorney. He is also survived by dozens of students and colleagues, three grandchildren, Ernest Mendel, Noah, and Sam, and three great-children, who provided him with limitless joy.

He will be sorely missed by his friends, colleagues and students at the APS Division of Physics of Beams.

Contributed by Paul Courant, Michiko Minty, Erika Peters and Thomas Roser