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Norman Foster Ramsey Jr

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Norman Foster Ramsey Jr, a towering figure of physics in the second half of the 20th century, died on 4 November 2011 at age 96. Ramsey was widely esteemed for his scientific contributions, his achievements as a statesman of science, and his teaching. He is best known for inventing the separated oscillatory field method and the hydrogen maser, for which he received the Nobel Prize in 1989, but those were just two of his many contributions. He helped to found Brookhaven National Laboratory and was instrumental in the creation of Fermilab. During his four-decade career at Harvard University, he supervised 84 PhD students. He continued to teach at Harvard and elsewhere long after his retirement in 1986.

Ramsey was born on 27 August 1915 in Washington, DC. He graduated from Columbia University in 1935 with a degree in mathematics, attended Cambridge University in the UK for two years, and returned to Columbia in 1937. He joined the molecular-beams group of I. I. Rabi despite Rabi's admonition that molecular-beam research was pretty well exhausted. A few months later Rabi's invention of molecular-beam magnetic resonance triggered a revolution in atomic physics. Ramsey's first research effort resulted in the discovery that the deuteron possesses an electric quadrupole moment and provided the first evidence for a noncentral nuclear force.

Upon leaving Columbia in 1939, Ramsey started work on proton scattering at the Carnegie Institution of Washington and then accepted a faculty position at the University of Illinois. When World War II broke out, he shelved his academic plans and joined the staff of the Radiation Laboratory at MIT. There he helped to develop 3-cm radar. In 1943 he went to Los Alamos and worked on the Manhattan Project until the end of the war. He then returned to Columbia and resumed molecular-beam research. With Rabi, Ramsey led in organizing a consortium that created Brookhaven. He became the first head of its physics department and had planned on splitting his time between there and Columbia, but the Long Island Rail Road frustrated his commuting plans. In 1947 he joined the faculty at Harvard.

Ramsey developed a program of theoretical and experimental research on magnetic interactions in molecules that he continued throughout his career. In a quest to improve the spectral resolution of molecular-beam magnetic resonance, he invented the separated oscillatory field method. That technique was quickly adopted by others and was important in the creation of atomic clocks. Today Ramsey's method is employed in wide areas of atomic and molecular research, including spectroscopy, metrology, ultracold atom studies, atom interferometry, and studies of atom entanglement and quantum information theory. Ramsey's molecular research had other consequences: It provided the underpinnings for the theory of chemical shifts that are fundamental to nuclear magnetic resonance spectroscopy and magnetic resonance imaging.

In the late 1950s, Ramsey proposed a new type of atomic clock—the hydrogen maser—with the goal of observing the effect of gravity on time. That observation was later made with the maser by Robert Vessot and his colleagues at the Harvard–Smithsonian Center for Astrophysics. Atomic-beam clocks and hydrogen masers now lie at the heart of the global positioning system. The hydrogen maser also serves the radio astronomy community, helping to make very long baseline interferometers possible.

Ramsey was the first to point out the possibility that nuclear interactions might violate parity. With his close friend Edward Purcell, he showed that this would permit the neutron to possess an electric dipole moment. They launched a search for the dipole moment that Ramsey continued for 39 years. The dipole moment has yet to be observed, but the successively smaller limits set on it have put to rest many theoretical conjectures. Ramsey sometimes expressed chagrin that he chose to search for parity violation in the strong interaction rather than in the weak interaction, where it is so large that it was discovered almost immediately after it was predicted.

Beginning in 1958 Ramsey took a leave of one and a half years from Harvard to serve as the first science adviser to the North Atlantic Treaty Organization. He initiated the NATO programs for advanced study institutes, fellowships, and research grants. Those programs helped to restore European physics, which was still recovering from the effects of war. Among the NATO institutes for which Ramsey secured funding was the summer school at Les Houches, France, which continues to be an energizing force in atomic physics and other areas of science.

As a scientific statesman, Ramsey is widely credited for his decisive role in the creation of Fermilab. In the early 1960s, proposals for a new accelerator were put forward by several laboratories that had conflicting visions. To deal with the controversy, 25 universities formed the Universities Research Association (URA), and Ramsey was selected to be its president. His unique background as an atomic physicist who was also conversant with particle physics (he had helped plan a cyclotron at Harvard and the Cambridge Electron Accelerator), his sterling reputation for fairness and accuracy, and his reputation for personal judgment uniquely qualified him for the job. In his new position, Ramsey quelled a simmering East Coast–West Coast scientific civil

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war, served as an effective spokesman to the US Congress, oversaw the entire creation of Fermilab, and personally selected Robert R. Wilson to be its first director. In gratitude, Fermilab named its auditorium in Ramsey's honor.

Ramsey made a strong impression on most everyone he met. A handsome, tall man with a broad smiling face and an open and friendly manner, he loved to tell stories with a booming voice that was legendary. Once, a visitor passing his office inquired about the noise. Told that it was Ramsey talking to someone in Chicago, he inquired, "Why doesn't Ramsey use a phone?"

To his students and colleagues, Ramsey was a role model for scientific integrity, which included a strict standard for scientific accuracy and an elevated standard for scientific behavior. For example, he and Clifford Shull of MIT once pushed the search for the neutron electric dipole moment using different methods with about the same sensitivity. In such a situation there is a natural wish to be the first to publish, but the scientific cost of premature publication can be high. The two physicists agreed that if either was ready to publish, he would notify the other and allow one week for the other to also submit a publication. Ramsey was also meticulous about allocating credit. Although he was occasionally described as the father of the atomic clock, he would scrupulously point out that the clock was originally proposed by Rabi, the first atomic frequency standard was developed by Louis Essen and Jack Parry in the UK, and the first practical atomic clock was created by Jerrold Zacharias at MIT.

During the McCarthy era, Ramsey spoke out to defend intellectual freedom. In 1953 Wendell Furry, a professor in the Harvard physics department, became the victim of a witch-hunting expedition by Senator Joseph McCarthy. Furry was indicted and several of the Harvard overseers called for his dismissal. Ramsey, along with Robert Pound, successfully defended Furry within the university, but the public charges by McCarthy were unrelenting. Ramsey responded to the charges on a national TV news program with a defense that was so persuasive that McCarthy offered him a job.

Although he was not often in the lab, Ramsey essentially never missed the weekly group meetings with his PhD students on Fridays, even if his attendance required breakneck travel arrangements. Aside from discussing research in progress, participants were likely to be provoked by toys Ramsey collected that appeared to defy parity conservation or other laws of physics and be entertained by anecdotes from Ramsey's endless collection. Ramsey taught a graduate course on molecular beams to several generations of physicists, and he was an enthusiastic undergraduate teacher. His 1956 monograph on molecular beams, based on his course, was a standard reference for decades. He continued to teach after retirement, serving as a visiting professor at the Universities of Virginia, Michigan, and Chicago and at Middlebury, Mount Holyoke, and Williams Colleges.

Among his many other activities, Ramsey served as president of the American Physical Society, chair of the governing board of the American Institute of Physics, and president of Phi Beta Kappa. To some of his colleagues, his schedule seemed to border on madness—he might fly from Cambridge, Massachusetts, to Washington, DC, for a morning meeting, exploit the time difference to get to Chicago for an afternoon URA meeting, return to Cambridge in the evening, and be up early next morning to teach.

Ramsey hiked enthusiastically and traveled extensively, usually with his family, his students, or his many friends around the world. At the age of 81 he walked across England. A few years later he was dissuaded from taking up bungee jumping, but only with effort. In his nineties he visited both the Antarctic and the Arctic, including a wilderness adventure in Alaska. He introduced many of his students to skiing and was enthusiastic about sailing, surfing, good music, good food, and good stories.

Even as Ramsey's health declined in his final years, his cheerful disposition and optimistic outlook never deserted him. As one of his students put it, Norman Ramsey was a role model for everything.

Daniel Kleppner
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