Ben Roy Mottelson

The American Danish theoretical physicist Ben Roy Mottelson, one of the pioneers of nuclear structure theory, left us on 13 May 2022. We lost one of the greatest minds and one of the finest people. Ben combined his passion for physics and his great and unusual gift for doing science with a warm, enthusiastic, and open-minded personality, leaving an indelible impact on colleagues and future generations of younger researchers alike.

Ben was born on 9 July 1926 in Chicago and grew up nearby in La Grange, Illinois. He was sent for officer training at Purdue University by the US Navy during World War II. After getting his BS at Purdue in 1947, he earned his PhD in nuclear physics from Harvard University in 1950; his doctoral adviser was Julian Schwinger. Ben became a professor at Nordita, the Nordic Institute for Theoretical Atomic Physics, in Copenhagen in 1957. In 1971 he obtained citizenship in Denmark.

The close scientific collaboration between Ben and Åge Bohr began in 1950 immediately after Ben arrived in Copenhagen to spend his graduate fellowship from Harvard at the Institute for Theoretical Physics (now the Niels Bohr Institute). Their unique collaboration continued until Bohr died in 2009. Their way of understanding physics can be seen in their seminal 1953 article "Collective and individual-particle aspects of nuclear structure." Seventy years after its publication, the paper continues to earn citations, and their work became known as the Bohr–Mottelson theory. They published the monograph *Nuclear Structure* in two volumes: *Single-Particle Motion* in 1969 and *Nuclear Deformations* in 1975. The books are not usual textbooks but more like enormous papers full of original ideas on nuclear structure and related research areas. Today they are among the most widely used monographs on the theory of many-particle quantum systems.

Ben Roy Mottelson

Ben was awarded the Nobel Prize in Physics in 1975 with Bohr and James Rainwater for finding the connection between collective and single-particle motions in atomic nuclei and developing the theory of the atomic-nucleus structure. Their work fundamentally changed the understanding of nuclear structure and set a landmark for the general theory of many-particle quantum systems. It also shows how fundamental theory needs to work hand in hand with experiment. During his Nobel banquet speech, Ben remarked that it is the combination of individual and collective processes that promotes science through the interplay of ideas—such an allusion to nuclear structure was characteristic of his humor.

From 1993 to 1997, Ben was the founding director of the European research institute ECT*. Typical of his later work, Ben brought concepts from one field of physics to another. For example, he applied the concept of supershell structure to electrons in metallic clusters.

Ben was among the first to realize that ultracold atomic quantum gases offer new and unprecedented prospects to study bosonic and fermionic many-body quantum systems, which he sometimes called "artificial nuclei." His 1999 work on the "yrast" physics of rotating Bose–Einstein condensates spurred a new field of research. Ben's work on pairing mechanisms in atomic Fermi gases demonstrated the universality of concepts earlier developed for the nucleus. Around 2000, Bohr invited Ben to join the work on genuine fortuitousness as the leading postulate in quantum theory.

Ben's playful and unbounded creativity provided an inspirational and enjoyable atmosphere to the people around him. In discussions and collaborations alike, it was clear that authority had no role to play, and physics always came first. Ben was remarkably gifted at motivating his students and colleagues alike—with him at the blackboard, new ideas often appeared crystal clear, but proving them right could take days and weeks of follow-up hard work and calculus. Ben's intuition was extraordinary, and he inspired many generations of researchers with his contagious joy of doing physics.

A marvelous example is Ben's lectures in the 1960s and 1970s at the Niels Bohr Institute, associated with Nordita, which one of us (Hamamoto) remembers as very special: Ben's deep thinking and remarkably clear teaching style left a great impression on his young students, who came from all over the world—some listening to a lecture in English for the first time. He inspired many to engage in research on nuclear structure. In his lectures, he also put great effort into teaching younger theoreticians the crucial importance of learning from experimental data and of communication between theory and experiment for making fundamental progress.

One gets an impression of Ben's forward spirit from an occasion when he joined the other of us (Reimann) and her family on their sailboat, which he did several times. As they headed across the strait of Øresund from Denmark to Sweden, the wind got strong, and it became advisable to reef the sails. But Ben strongly protested because he wanted all the fun: to go fast and get wet—at the age of 86.

To us, he was a close friend—we sorely miss him and are deeply thankful for the time shared. The science and joy that Ben shared with us about the "wonderful world of finite quantal systems," as he often called it, will always keep him entangled with our minds.

Stephanie M. Reimann
Ikuko Hamamoto
Lund University
Lund, Sweden