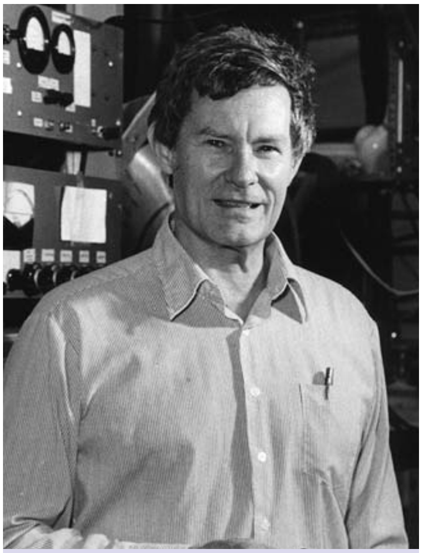
MASSACHUSETTS INSTITUTE OF TECHNOLOGY



John Gordon King

strates a principle of physics by driving fast in one of his meticulously restored Bugatti automobiles.

Traditional laboratory "cookbook" exercises, King believed, bored students and stifled creativity and ingenuity. To address that, and to help students understand fundamental science concepts in the real world and not just in the classroom, he introduced methods that emphasized hands-on learning and independent thinking. In 1966 he started Project Lab for undergraduates to design their own open-ended research. He advised his students, "The best way to understand your apparatus is to build it." In a 2009 oral history interview with the American Institute of Physics (http://www.aip.org/history/ohilist/33499.html), King remarked, "What people learned in Project Lab was that you could take any number of innocent situations and find complicated and interesting things that could be a life work." More than 1400 MIT students were a part of Project Lab.

King found that studying various disciplines simultaneously was disruptive for most students, so he advocated for full immersion into one topic at a time. He convinced other faculty members to join him in offering a sequenced version of the standard MIT undergraduate curriculum. The model has since been used at many schools in their intersemester immersion courses.

Among King's numerous publications is the upcoming book *Physics Project Labs* (Oxford University Press, December 2014), which he cowrote with Paul Gluck. His many honors and awards include a 1956 Alfred P. Sloan Award, the Danforth Foundation's 1971 E. Harris Harbison Award, and the American Association of Physics Teachers' 1965 Robert A. Millikan Medal and 2000 Oersted Medal, the organization's most prestigious award.

Perhaps his most endearing quality as a physicist, witnessed by his students and many of his colleagues, was King's unbridled enthusiasm for physics and new ideas. One could discuss a concept with him, and within minutes he would make drawings and estimates on the backs of envelopes and often invent an interesting and viable experiment on the spot. Ideas did not die when talking to King—rather, they flourished.

H. Frederick Dylla
American Institute of Physics
College Park, Maryland

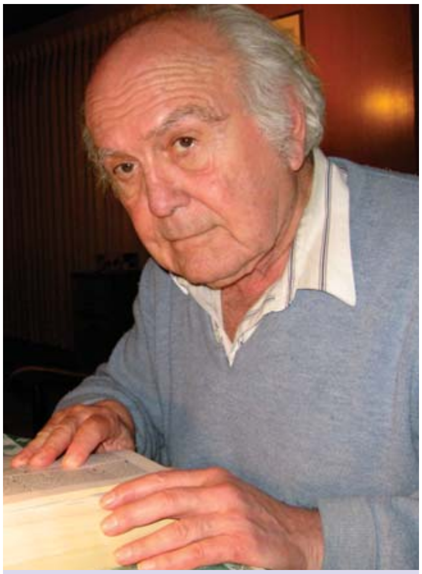
Rainer Weiss
Massachusetts Institute of Technology
Cambridge

Bruno Zumino

Bruno Zumino, codiscoverer of supersymmetric field theories in four dimensions with his lifelong friend Austrian physicist Julius Wess, died peacefully on 22 June 2014 in his home in Berkeley, California. He had been a distinguished professor at the University of California, Berkeley, and the Lawrence Berkeley Laboratory since 1982 and emeritus since 1994.

His main contributions to physics, for which Zumino received several major awards, were related to the introduction and applications of supersymmetry, an operation interchanging particles of different statistics. When applied to particle interactions, supersymmetry represents the main candidate idea underlying physics beyond the standard model. It predicts the existence of new particles, usually dubbed sparticles—spinless squarks and sleptons and several new fermion species, including the neutralino, a natural dark-matter candidate. Searches for such sparticles are a main target of the ongoing experimental programs at CERN's Large Hadron Collider in Geneva, Switzerland.

Zumino was born in Rome on 23 April 1923. He studied at the University of Rome, where he received his DSc degree working under the supervision of Bruno Ferretti, a distinguished young physicist. He made his first important contribution to physics, the proofs of the *CPT* and spin–statistics theorems, in the 1950s in Göttingen, Germany, with



Bruno Zumino

physicist Gerhart Lüders. (*CPT* denotes the combined operators for charge conjugation, parity, and time reversal.) Zumino moved to New York University in 1951, initially as a research associate and then as chairman of the physics department. He wrote many influential papers on algebras of fields with T. D. Lee and Steven Weinberg and on phenomenological Lagrangians and nonlinear realizations of symmetries with Curtis Callan, Sidney Coleman, and Wess.

During that time Zumino became an American citizen. I still recall my first impression of his strong Italian (actually Roman) accent, but curiously, despite a common mother tongue, our early collaborations took place almost exclusively in English.

In 1967 Zumino went to CERN as a visiting professor but soon joined its theory division. He became the division leader in 1970 and remained there until 1981. The years at CERN were the most significant ones for Zumino's scientific achievements and for his personal life, since it was there that he met his future wife and collaborator, Mary Gaillard, a prominent theoretical particle physicist.

Soon after Zumino moved to CERN, he and Wess wrote a fundamental paper on local gauge anomalies, in which the Wess–Zumino Lagrangian was introduced. After the discovery of four-dimensional supersymmetry in 1973, Zumino readily realized the importance and the possible implications of the emerging supersymmetric theories. In a number of different collaborations with Wess, Jean Iliopoulos, and me (at the time I was a CERN postdoctoral fellow), Zumino completed many pioneering works, including nonrenormalization theorems for the Wess–Zumino model, supersymmetric electrodynamics, and super Yang–Mills theories. The super Yang–Mills theories were introduced by Zumino and me and proved instrumental for the formulation of the minimal supersymmetric standard model and its extensions.

With Stanley Deser in 1976, Zumino also contributed to the foundation and development of supergravity, the supersymmetric extension of Einstein's theory of general relativity that had been formulated by Daniel Freedman, Peter van Nieuwenhuizen, and me.

Before they moved to Berkeley in 1981, Zumino and Gaillard wrote an important paper on electric–magnetic duality in field theory. Duality, the deep symmetry of supergravity and superstring theory, interchanges electric and magnetic charges and also relates weakly and strongly coupled descriptions of theories.

Zumino and Gaillard's work laid the foundation for intriguing advancements in the field: the development of supergravity theory and its dualities in higher dimensions by Eugène Cremmer, Joël Scherk, and Bernard Julia; later developments in superstring theory by Michael Green and John Schwarz; M theory created by Edward Witten; and most recently the anti–de Sitter/conformal field theory correspondence discovered by Juan Maldacena. Its lessons are still under scrutiny.

I again had the privilege to collaborate with Zumino when I visited Berkeley as a Miller Professor for a couple of months in 2008. We worked on issues connected to the physics of black holes in supergravity and superstring theory, along lines inspired by his earlier work with Gaillard.

Zumino traveled to Europe one last time in 2011 to attend a conference to honor French physicist Raymond Stora on his 80th birthday. It seemed that Zumino's health was already declining. Berkeley organized a conference in Zumino's honor on the occasion of his 90th birthday in 2013, but due to his health he could only participate in the opening reception.

With Zumino's death, a real master of theoretical physics is gone. I hope that present and future generations will not only learn about his work in textbooks but will also witness the discovery of some of his predictions.

Sergio Ferrara
CERN
Geneva, Switzerland ■