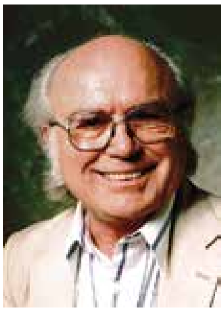
Bruno Zumino
(1923-2014)



Courtesy of Mary K.Gaillard

Bruno Zumino was awarded the "Enrico Fermi" Prize of the Italian Physical Society in 2005.

Bruno Zumino died in his home at Berkeley, California, on June, 22nd 2014, at the age of 91.

He was an Emeritus Professor at Berkeley University since 1994 and his name is mainly associated with the formulation of supersymmetry in our four-dimensional space- time. Supersymmetry is a highly non-trivial extension of the relativistic symmetry of elementary particle interactions, called Poincaré symmetry, which, among other things, leads to the conservation of energy and momentum. Supersymmetry transforms bosons into fermions and vice versa and it makes it possible by the introduction of extra "fermionic" anticommuting dimensions then extending ordinary relativistic Minkowski space-time to Superspace, a concept later introduced by the late Nobel Laureate Abdus Salam (Imperial College and ITCP) and James Strathdee (ICTP).

In his pioneering work with the Austrian physicist Julius Wess, done when he was a senior staff member at CERN (1968-1981), Bruno Zumino formulated the first four-dimensional quantum field theory, called the Wess-Zumino model, and proved his renormalizability. Infinities of perturbation theory were actually shown to be milder than in non-supersymmetric theories then giving rise to the so-called "non-renormalization theorems" whose original appearance was in papers written in the mid- seventies in several collaborations with Wess, Jean Iliopoulos (Ecole Normale Supérieure, Paris) and myself, at the time a CERN post-doctoral Fellow.

In a joint collaboration we solved the problems of combining supersymmetry with non-Abelian (Yang-Mills) gauge symmetry, then opening the way to apply supersymmetry to the fundamental non-gravitational forces, the electroweak and strong interactions.

The case of supersymmetry for our low-energy world was mostly advocated to solve the so-called naturalness and hierarchy problems, but other important areas where supersymmetry could play an important role is in the formulation of Grand Unified Theories and in providing some candidates for Dark Matter, a form of elusive matter not reactant to light which, together with dark energy, makes up 95% of the total mass-energy of the Universe.

Supersymmetry is a strong candidate for Physics beyond the Standard Model and even if today no particles predicted by this symmetry have been detected, there is still hope that they will show up in the TeV mass range, when the Large Hadron Collider (LHC) at CERN reaches the highest project energy (14 TeV).

Two years later, in 1976, supersymmetry was combined with the gravitational force, giving birth to supergravity and its stunning developments, including superstring theory and M-theory. The original formulation of supergravity, by Dan Freedman (MIT), Peter van Nieuwenhuizen (Stony Brook) and myself (at the time at INFN-LNF, Frascati and Ecole Normale Supérieure) was soon followed by an elegant formulation by Bruno Zumino and Stanley Deser (Brandeis) using the so-called first-order formalism.

In his last year at CERN Zumino, with Berkeley physicist Mary K. Gaillard, collaborated in a pioneering work on the application of duality to field theories. Duality, a generalization of "electric magnetic duality" which exchanges electric fields with magnetic fields, plays a fundamental role in connecting diverse formulations of string theory and in relating weakly-coupled theories in one formulation to strongly-coupled theories in other formulations.

Going back to Zumino's early life. He was born in Rome, Italy on 28th April 1923 and graduated in Physics at the University of Rome in 1945. In his early years, when in Göttingen, he wrote important papers, together with Gerhart Luders, on the consequences of the CPT theorem in relativistic quantum field theories. Then, in 1951, he moved to New York University where he remained until 1968 (also as Chair of the Physics Department) when he joined the Theory Division at CERN.

In those years he wrote important papers on "Field Algebras" with the Nobel Laureate T. D. Lee and on "phenomenological Lagrangians" with S. Coleman (Harward), J. Wess (Karlsruhe) and C. G. Callan (Princeton). When he moved to CERN he then wrote a fundamental paper with J. Wess on the treatment of local gauge anomalies and the introduction of the so-called Wess-Zumino Lagrangian.

As a final part of this tribute to Bruno Zumino I would like to make some personal recollections. I had the privilege of being his closest collaborator after J . Wess, with fourteen jointly published papers. This joint activity covered different epochs of my career, from the time of my Fellowships at CERN to the time of my senior and distinguished status (at CERN and UCLA). I was proud to share with him and Gabriele Veneziano (CERN and Collège de France) the 2005 Enrico Fermi Prize awarded by the Italian Physical Society. When I visited him in 2008, as a Miller visiting professor at Berkeley, we started again to collaborate on aspects of duality applied to Black Holes and in fact the last papers of his life were written together with me.

His last trip to Europe, to attend a conference as invited speaker, was in the summer of 2011, on the occasion of the celebration of the 80th birthday of Raymond Stora, his friend and collaborator. In the proceedings of that meeting, a joint study with Stora on the algebraic approach to anomalies was reported.

In May 2013, a conference in his honour, celebrating his 90th birthday, took place at Berkeley. Many distinguished physicists spoke on his behalf, including Fields Medalist E. Witten and Nobel Laureate S. Weinberg. Unfortunately he became ill just before the beginning of the meeting and he could only come to the inaugural banquet, where he sat near me. That was the last occasion I saw him.

Bruno Zumino won many other prestigious International Prizes, among them the Dirac Medal (1987), the APS Dannie Heineman Prize (1988), the 1989 Max Planck Medal, the 1992 Wigner Medal and the 1999 Giancarlo Wick Gold Medal.

He is survived by his wife Mary K. Gaillard and three stepchildren.

He leaves an enormous legacy and he will be remembered for his achievements by future generations. I sincerely hope that his predictions and discoveries will be proved by Nature.

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