Homage to Julius Wess

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Published online: 9 January 2009

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One of the fathers of supersymmetry, Julius Wess, unexpectedly passed away in August 2007. A few weeks before, he participated in the conference SUSY 07 in Karlsruhe, from which he returned very enthusiastically. He was impressed by the efforts of the community to detect supersymmetry at the LHC, and he looked forward to the coming years of exciting experimental data. At the same time, he always kept a natural skepticism about the realization of supersymmetry in nature and the prospects for actually detecting it during the next decade.

In fact, it was in Karlsruhe (and at CERN) that he, together with Bruno Zumino, invented and developed supersymmetry. In their seminal paper¹ they presented a four-dimensional renormalizable interacting quantum field theory with a Fermi–Bose symmetry, later called supersymmetry. At the beginning the mathematical existence of supersymmetry was the surprising feature, while the additional remarkable properties only gradually became apparent. For example, supersymmetric field theories are better behaved at high energies than their non-supersymmetric counterparts. This puts the Higgs sector of the standard model on theoretically firmer footing and renders it natural. One of the generic predictions of supersymmetry—a light Higgs boson—can already be inferred indirectly from the LEP data. These data also revealed that the unification of the gauge couplings fails in the standard model but instead holds in the supersymmetric standard model. Finally, the lightest supersymmetric particle is a perfect dark-matter candidate, whose existence can also be viewed as a prediction of supersymmetry.

Supersymmetry is a remarkable theoretical structure and is not only discussed as a possible extension of the standard model at high energies. In supersymmetric field theories the possible quantum fluctuations are more constrained and, as a consequence, the quantum theory in its strong-coupling regime is under better control. Exploiting this property, supersymmetry (often combined with string theory) has been

used as a tool to develop new methods for the treatment of strongly coupled non-supersymmetric quantum field theories like QCD.

Supersymmetry could be an essential building block in the construction of a quantum gravity. On the one hand, it is a necessary ingredient in all string theories. On the other hand, a particular supersymmetric field theory, $N = 8$ supergravity, has been discussed as a possible finite field theory which includes the gravitational interactions. The question of finiteness is not yet settled, but due to the much softer behavior of supersymmetric theories at short distances/high energies one is tempted to believe that in any case it will play an important role in quantum gravity.

Supersymmetry also had—and continues to have—a major impact on mathematics. Supersymmetric structures prominently entered developments in both geometry and algebra, and by now there is a whole new branch of mathematics called super-mathematics.

Julius Wess followed these developments and, to some extent, was fascinated by them. However, he understood early on that supersymmetry could only be an intermediate step in the development of a more fundamental theory of nature. During the last 15 years his attention focused on non-commutative structures which, at short distance, are supposed to replace the concept of a continuous space-time.

It is sad that he will not witness the results of the experimental and theoretical research of the coming years. Our community has lost one of its sharpest and most creative physicist. We have also lost a charming and entertaining friend and teacher.

¹J. Wess and B. Zumino, “Supergauge transformations in four-dimensions”, Nucl. Phys. B **70** (1974) 39.

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