History of Science

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The research mainly focused on the historical and foundational side of physics in the last century and it was also developed in collaboration with national and international research institutions (Dipartimento di Fisica, Roma La Sapienza, Dipartimento di Studi Filosofici e Antropologici, Bergamo, Max Planck Institut fuer Wissenschaftsgeschichte, Berlin, Seminario di Storia della Scienza Università di Bari, Centro Interuniversitari di Fondamenti e Filosofia della Fisica di Cesena). In particular, the research concerned the following subjects.

During the last century deep innovations in the representation of the physical world presented themselves, not only pertaining to material instruments as counters, bubble chambers, reactors, accelerators, and to conceptual ones as mathematical algorithms (as, for example, tensors, matrices, operators, wavefunctions) suitable to achieve such representation, but first of all to the conception of the foundamental properties attributed to physical objects. Of course, as A. Einstein and L. Infeld clarify in *The Evolution of Physics* (New York, Simon & Schuster, 1938) [1], such innovations in the representation of the physical world did not spring out of nothing, but presupposed some evidences in the history of physics previous to the XX century. Neverthless, such evidences could not be translated by themselves into new representations of things, in default of elements, essentially new ideas and new general principles, through which new solutions to the arising problems could succeed. So, even though electricity and light had already been conceived in the second half of the XIX century in terms of discrete corpuscules in some phenomena, these phenomena were not explained before a principle of quantization of energy in general was introduced, together with an irreducible casuality of energy exchanges, to explain several microphysical phenomena, even contrary to A. Einstein's opinion. Analogously, also Relativity theory presupposed many previous evidences which, to be explained, required its full enunciation in terms of principles of special and general relativity, even pertaining to the structure of space-time at large. But XX century physics was not only a physics of the enormously big and of the enormously small, and it was also applied to ordinary dimensions systems so contributing to the study of systems different from strictly physical ones, such as biological, chemical and endowed, as aggregate systems, with more or less high levels of complexity. Also here, of course, evidences in favour of a new physics, even in the framework of deterministic classical physics,were not missing, as in the study of thermodynamic systems, especially far from equilibrium, as in whirling and turbulence phenomena. In fact, some complexity degree had been singled out even in elementary (or considered such), strictly deterministic mechanical systems, as the famous three interacting bodies of Newtonian mechanics, by the great mathematician J.H. Poincaré. He in fact evidentiated complexity and relative unforeseeability of the evolution of such system in terms of non linearity and sensitive dependence on little variations of the initial conditions. Simulation through computers and mathematical modelling can then now contribute to study the evolution of complex systems in general, dealing with enormous quantities of data and calculations which cannot be considered exhaustive in front of systems of whatever complexity and nature, not only physical and in particular meteorological, but also chemical, biological and even economical, social and mental ones. Physical research, even still at technological and applicative levels, goes on exploiting ideas and principles, as the complexity, quantization and relativity principles, arisen at the turning points from XIX to XX century physics. Einstein's contribution to this evolution of physics has been undoubtedly incalculable, but also Italian physicists, particularly Fermi and his group, gave a considerable contribution to the rise of contemporary physics both at the tecnological-applicative and at the theoretical and foundational levels [2].

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