

## A Century Ago...EJTP “Year of Light” 2015

The “International Year of Light and Light-Based Technologies” (IYL 2015) is a global initiative, adopted by the United Nations to raise awareness about how optical technologies promote sustainable development and provide solutions to worldwide challenges in areas such as energy, education, communications, health, and sustainability. But for theoretical Physics there is the double anniversary of Special Relativity (SR) and General Relativity (GR); moreover the double wave/particle nature of light crosses entirely Physics from time of Newton and Huygens and arrives at the fundamental questions of Quantum Mechanics (QM).

In EJTP we have therefore decided to organize our special issue on the Year of Light (IYL), by calling the community of theoreticians for reflecting about the issues which could be at today the subject of the Einstein-Bohr contention: black holes, the structure of “empty space”, the nature of relativistic symmetries, and of course the entanglement and the non-locality. After the no-return point of the Aspect experiment, it has become clear that the non-local QM must be introduced “ab initio”, not as “unexpected guest”.

The recent work in quantum optics and quantum computing has also led to a full awareness about the fact that they are related but not identical properties, showing the rich structure of QM (see as example: “More nonlocality with less entanglement” by Thomas Vidick and Stephanie Wehner, Phys. Rev. A 83, 052310, 2011). The placed challenges beyond the Standard Model (SM) in the direction of Quantum Gravity (QG) put on a new basis the question of foundations.

It is no longer a philosophical habit, but the need to understand how QM works on enormously more “subtle” areas than molecular, atomic and nuclear ones, where Quantum Field Theory (QFT) has “seen the light” and has established, with its ripest fruit, the lighthouse which guided the exploration of these regions. An extraordinary new possibility consists in *Emerging Quantum Mechanics* (EQM), which requires radically new hypotheses about the nature of the physical world.

We are particularly grateful to Prof. G. 't Hooft, for allowing us to re-submit in the opening issue his work, which is already a milestone in theoretical physics, “The Fate of Quantum”. It retraces, with the usual conceptual density and formal elegance, the essential aspects of his proposal based on the non-locality as “equivalence class” of local states deterministically describable through “blocks” of information. The quantum level is therefore “compressed” between a local discrete determinism and a classic and continuous one.

This proposal is perhaps the most radical on a path running from the Einstein realism to the Turing theory of computation, receiving the notion of emergence from the physics of complex systems and thus re-defining our certainties on the classic/quantum border. Other proposals must also postulate, in addition to forms of fundamental discretization (theories of pre-quantization), more complex assumptions on the nature of space, time and dynamics, from the Euclidean non-temporal approaches to those of “superfluid” spacetime.

“Black Hole Wars” could not miss, a topic on which compare themselves today the first embryonic theories of quantum gravity, ideal laboratory of conceptual experiments, and the neutrino oscillations, particle which perhaps represents the ensign of awaiting physics beyond the standard model and that brings us back to the tutelary authority of this journal, Ettore Majorana, expecting us in 2016 for the anniversary of his birth and of course for the new round.

Volume Editors–The Einstein-Bohr Debate in the Year of Light 2015:  
Highlights in Quantum and Relativity

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