

***Quantum Information Processing
and Communication:
Quantum Information with Photons and Atoms***

Alain Aspect

**2013 Balzan Prize for Quantum Information Processing
and Communication**

Balzan GPC Adviser: Luciano Maiani

Project Directors and Main Researchers: Chris Westbrook (Research Coordinator);
David Clément, Marc Cheneau; Sébastien Tanzili (YQIS project)

Affiliated Institution: Institut d'Optique Graduate School (IOGS)

Period: 2014-

Website: <http://yqis15.sciencesconf.org/>

Alain Aspect is Professor at the Institut d'Optique Graduate School and the École Polytechnique in Palaiseau, and CNRS Distinguished Scientist Emeritus at the Laboratoire Charles Fabry at the Institut d'Optique. Aspect proposed two projects for the use of the second half of his Balzan Prize. The first was to promote a series of conferences, *Young Quantum Information Scientists (YQIS)*, based on the model of the Young Atom Opticians conference launched by Professor Aspect and Professor Mlynek twenty years ago to enable PhD students and postdoctoral scholars working in cold atoms to gain experience by organizing conferences and creating a European community. The first edition of YQIS, initiated by Alain Aspect together with Sébastien Tanzilli of the Laboratoire de Physique de la Matière Condensée at Nice (CNRS and Université Nice Sophia Antipolis), France, was held at the Institut d'Optique Graduate School in Palaiseau, France. As a conference “made by young researchers for young researchers (PhD students and postdoctoral fellows)”, YQIS makes it possible for young research fellows to communicate their research in the newly recognized field of Quantum Information, and to exchange ideas. An abstract of contributions can be downloaded at http://yqis15.sciencesconf.org/conference/yqis15/pages/BoA_YQIS2015_IOGS_2.pdf. This conference was a great success, and although it was held immediately after the terror attacks of November 2015 in

Paris, almost all of the eighty registered participants from many different countries showed up, and demonstrated their ability to form a genuine community.

The second proposal was to fund two young researchers, David Clément and Marc Cheneau, for projects of quantum simulators of quantum correlated matter. Quantum simulators are a variety of quantum computers proposed by Feynman in his milestone paper on quantum information. They consist of realizing systems to emulate quantum systems very difficult to study directly. Ultra cold atoms placed into optical potentials realized with laser beams are remarkable examples of such simulators, giving access to quantum properties of entangled many-body systems of condensed matter. Marc Cheneau's project concerns a cold atoms quantum simulator of supersolids, and he intends to measure directly spatial correlations with resolution enabling him to see each individual atom. Balzan funding has been used for the acquisition of a high performance camera and the high grade optical components necessary for this goal. David Clément's project concerns a quantum simulator of a strongly interacting quantum atomic gas, with the first goal to measure how quantum depletion depends on the strength of the interactions. Balzan funds have allowed him to buy a laser and to support a postdoctoral researcher for one year. Both projects have received adequate laboratory space. Marc Cheneau's experiment is still under development, while David Clément's experiment is already producing original results, which will be published in 2016 with acknowledgement of the Balzan Prize.