

## 2022 Nobel Prize in Physics

Alain Aspect, John Clauser and Anton Zeilinger receive Nobel Prize for experiments with entangled photons, establishing the violation of Bell inequalities and pioneering quantum information science.

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The 2022 **Nobel Prize in Physics** has been announced by the Royal Swedish Academy of Sciences, giving this prestigious award to three fathers of Quantum Physics, **Alain Aspect**, **John F. Clauser**, and **Anton Zeilinger** for "experiments with entangled photons, establishing the violation of Bell inequalities and pioneering quantum information science".

ICFOians full heartedly congratulate these friends and colleagues who have made landmark contributions to the field of quantum physics for which they are justly being recognized with this award. The major and unique contributions to the field these renowned scientists have made have helped usher the world into the Second Quantum Revolution, and are facilitating a tremendous scientific and technological transformation that will shape the future.

During the Nobel in Physics announcement, Anders Irbäck, Chair of the Nobel Committee for Physics highlighted this contribution, commenting "It has become increasingly clear that a

new kind of quantum technology is emerging.

The three laureates have been awarded for the following contributions to the field. **John Clauser** has been recognized for his contribution to John Bell's ideas, leading to a practical experiment. His experiments proved the validity of quantum mechanics by clearly violating a Bell inequality and thus showing that quantum mechanics cannot be replaced by any theory that uses hidden variables.

Clauser's experiment left some experimental loopholes open. **Alain Aspect** closed an important loophole by designing an experimental setup in which he was able to switch the measurement settings after an entangled pair had left its source, making it impossible for the setting that existed when they were emitted to affect the result.

**Anton Zeilinger** aimed at controlling entangled quantum states through a long series of experiments. His research group was able to demonstrate quantum teleportation, which means being able to replicate a quantum state from one particle to one at a distance. Zeilinger's experience in the field has positioned him as one of the precursors and drivers of the European Quantum Flagship initiative, that aims to overcome current limitations in the field and drive innovations that will bring breakthroughs in the development of quantum technology applications.

Several ICFO researchers, including **Morgan W. Mitchell**, **Valerio Pruneri**, **Soren Wengerowsky**, ICFO Alumni **Carlos Abellan** (CEO and co-founder of Qside), **Waldimar Amaya** (COO and also co-founder of Qside), **Timothy H. Taminiau**, **Fabien Steinlechner**, **Daniel Cavalcanti**, and **Stefano Pironio**, contributed to several different studies, including Zeilinger's loophole-free Bell test experiments in 2015. These studies have been included in the reference section of the Nobel press release, giving the scientific background information on this prize.

A longer list of ICFO members, in particular **Antonio Acin**, **Maciej Lewenstein**, and **Juan P. Torres** have had the honor of engaging with the laureates on a range of topics through the years, further emphasizing the tremendous scope of their influence. ICREA Prof at ICFO Dr Maciej Lewenstein who has ongoing collaborations with Aspect comments, "In addition to fundamental studies of nonlocality, Alain Aspect made seminal contributions to the physics of Bose-Einstein condensation and ultracold gases, condensation of metastable Helium, Anderson localization in ultracold atomic gases among many other areas. His enormous contribution across AMO physics cannot be overstated."

ICREA Prof at ICFO Dr Morgan W. Mitchell sums up his sentiments on hearing the news of this year's award as follows: "I was born in the Cold War, when physics was very useful, but thinking hard about what physics meant was considered a waste of time. David Mermin, one of the wittiest physicists of the era, called this the 'Shut up and calculate!' era. Today's Nobel Prize winners are physicists who refused to stop thinking about the question 'what does all this mean?', and found ways to do experiments at the border between physics and philosophy. They also refused to shut up. In fact, they wrote so eloquently

tly that the physics world eventually (after about 50 years) came to realize that it does it all mean it can be one of the most practical questions out there. All our efforts in quantum technologies are indebted to these pioneers

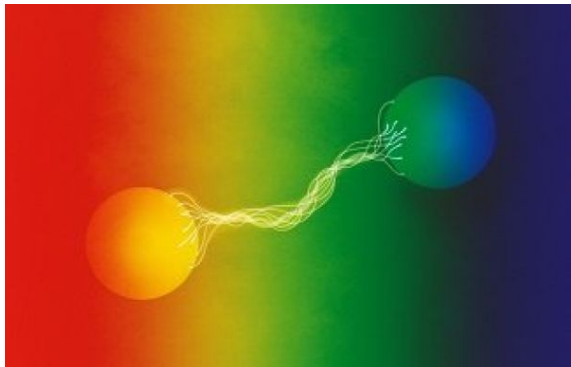


Illustration Entanglement | Johan Jarnestad / The Royal Swedish Academy of Sciences