



## Laudatio for the Award Ceremony of the Prix Schläfli Physics 2019 of the Swiss Academy of Sciences (SCNAT) for Dr Matteo Fadel

The Jury of the Prix Schläfli Physics 2019 of the Swiss Academy of Sciences (SCNAT), consisting of Professors Hans Peter Beck (Universities of Bern and Fribourg, President), Christoph Bruder (University of Basel), Ruth Durrer (University of Geneva), Anna Fontcuberta (EPFL), and Christian Rüegg (PSI), has after a careful evaluation decided to bestow the Prix Schläfli 2019 in Physics to Dr Matteo Fadel for his achievements in the field of fundamental quantum mechanics on the first demonstration of the EPR paradox and of Bell correlations in many-body systems with massive atomic ensembles.

The Jury decided unanimously to award the Prix Schläfli Physics 2019 to Dr Matteo Fadel for his state-of-the-art contributions to both experimental and theoretical physics, leading to major breakthroughs in the understanding of quantum-mechanical many-body systems. Matteo Fadel was first to demonstrate the Einstein-Podolsky-Rosen (EPR) paradox with an atomic ensemble. This paradox refers to a situation where measurement outcomes below the Heisenberg limit are predicted for a quantum system through measuring a different but with the former entangled quantum system. While the EPR paradox has previously been explored in optics and with single atoms, a demonstration with large ensembles of massive particles has not been reported previously. Moreover, this result opens up perspectives for applications in quantum metrology with enhanced measurement precision. Matteo Fadel was also first in observing Bell correlations in a many-body system. While Bell correlations of two particles have been observed in a variety of systems, a demonstration of Bell correlations in a true many-body system was unmatched before. This was possible in a new experiment measuring the correlated spin states of 480 Rb atoms in a Bose-Einstein condensate. This experiment was published in *Science* with Matteo as co-author [Schmied et al, *Science* 352, 441 (2016)]. A paper that received the 2017 Paul Ehrenfest Best Paper Award for Quantum Foundations, of the Institute for Quantum Optics and Quantum Information of the Austrian Academy of Sciences for the most significant publication in the foundations of quantum mechanics published in the five calendar years prior to the prize call.

Dr Matteo Fadel studied Physics at the University of Padova, Italy, where he received his BSc in 2011 with a thesis on 'The black hole information loss problem'. Fadel moved then to Zürich for his Master studies at ETHZ, which he concluded in 2013 with a thesis on the 'Cryogenic setup for fast manipulation of the quantum motional states of trapped ions' under the supervision of Prof. Jonathan Home. In 2014, Fadel moved to Basel to work on his PhD thesis on 'Many-particle entanglement, Einstein-Podolsky-Rosen steering and Bell correlations in Bose-Einstein condensates' under the supervision of Prof. Philipp Treutlein, which he concluded Summa cum Laude in 2018. Matteo Fadel is continuing his research in Basel as a Postdoctoral Research.

Prof. Hans Peter Beck, President of the Jury

Award Ceremony, 5 November 2019, University of Basel, with a presentation of the awarded work 'The Einstein-Podolsky-Rosen paradox in a many-body system' by Dr Matteo Fadel.

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