

PERSONAL INFORMATION

Stefano Olivares

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MAIN SCIENTIFIC RESULTS

Stefano Olivares is a **theoretician** and works in **quantum optics** and **quantum information** with emphasis on the optical implementation of quantum information processing. His main are in the fields of: i) **generation, characterization and application of quantum states**, ii) **quantum interferometry and quantum sensing**, iii) **dynamics of quantum properties in the presence of decoherence**, iv) **estimation of quantum states and operations** and v) **quantum communication**. He has a solid expertise in general quantum optics and a specific skill in the phase-space analysis of quantum states and operations with continuous variables. Though Stefano Olivares' activity is mainly theoretical, he is an active collaborator of four Italian **experimental groups** (INRiM, Torino; University of Insubria, Como; University of Naples Federico II; University of Milan). He also collaborates with several international theoretical groups.

i) Generation, characterization and application of quantum states. Stefano Olivares has studied a technique based on the subtraction of photons from optical states in order to improve the quantum properties such as entanglement and non-classicality. In particular, he showed that the proposed protocol is effective even in the presence of non-unit quantum efficiency (the first work, published in Phys. Rev. A in 2003, has received many citations). Moreover, Stefano Olivares and his co-workers have developed and demonstrated a new method that uses on/off detectors to reconstruct the statistics of optical signals. He has proposed a protocol for the complete reconstruction of the covariance matrix of two-mode optical Gaussian states which has been experimentally realized in collaboration with the University of Naples Federico II (the results were published in Phys. Rev. Lett. in 2009). Some of his results, obtained in collaboration with the experimental Quantum Optics group at the University of Insubria in Como, concern the use of photon number resolving detectors to manipulate, engineer and characterize optical quantum states (Phys. Rev. A and Opt. Express in 2012). He is currently collaborating to the design, implementation and characterization of a source of squeezed light at the Quantum Optics Laboratory of the Department of Physics at the University of Milan.

ii) Quantum interferometry and quantum sensing. Stefano Olivares' research has mainly developed in the continuous-variable regime focusing on the generation of entanglement from Gaussian states and operations (the results were published in Phys. Rev. Lett. in 2011) and the role of squeezing and correlations to improve the sensitivity of an optical interferometer. The results concerning the estimation of the optical phase in the presence of phase diffusion have been published in Phys. Rev. Lett. in 2011 and the experimental verification is appeared in Phys. Rev. A in 2012. Stefano Olivares has developed the theoretical basis that led to the first experimental verification of a quantum illumination protocol, developed in collaboration with the experimental group of Quantum Optics at INRiM in Turin (published in Phys. Rev. Lett. in 2013). The collaboration with the INRiM group also led to study the possibility of using continuous-variable entangled states of light to correlate two interferometers in order to verify the predictions of some theories of quantum gravity (Phys. Rev. Lett. in 2013 and Phys. Rev. A in 2015).

iii) Dynamics of quantum properties in the presence of decoherence. Stefano Olivares has carried out research on the dynamics of open quantum systems addressing both Markovian and non-Markovian environments, with particular emphasis on the quantum properties of the considered systems. The results showed that the non-Markovianity can be a resource to protect the entanglement (the papers published in Phys. Rev. A in 2007, 2009 and 2011 are among the most cited works) and can be exploited to improve the security of continuous-variable quantum cryptography by using a suitable protocol (Phys. Rev. A in 2011).

iv) Estimation of quantum states and operations. Stefano Olivares has studied the application of Bayesian methods to estimate single-qubit logic gates in the presence of phase noise. The protocol has been also experimentally verified (Phys. Rev. A in 2012) and successfully extended to the continuous-variable regime in the case of homodyne interferometry. In the field of estimation of

quantum states, he has also collaborated on the development of protocols based on maximum likelihood methods (MaxLik) for the reconstruction of quantum states.

v) Quantum communication. Stefano Olivares has studied the role of squeezing and entanglement in the discrimination of quantum states in the presence of dissipation. His most recent results concern the discrimination between continuous-variable optical states in the presence of phase diffusion. The theoretical investigation and the experimental verification of the previsions in the case of coherent states have been published as a Rapid Communication on Phys. Rev. A in 2013. Very recently, he proposed a hybrid quantum key distribution protocol based on coherent states, Gaussian modulation, and photon-number-resolving detectors. The method may enhance the secret key generation rate compared to homodyne-based schemes (Phys. Rev. A in 2018).

WORK EXPERIENCE

- | | |
|------------------------------------|---|
| 1 April 2019 - today | Associate Professor
Department of Physics, University of Milan, Italy |
| 1 April 2016 – 31 March 2019 | Assistant professor (art. 24 c. 3-b L. 240/10)
Department of Physics, University of Milan, Italy |
| 8 March 2015 – 7 March 2016 | Research fellow (art. 24 c. 3-a L. 240/10)
Department of Physics, University of Milan, Italy |
| 8 March 2012 – 7 March 2017 | Research fellow (art. 24 c. 3-a L. 240/10)
Department of Physics, University of Milan, Italy
<ul style="list-style-type: none"> ▪ National Coordinator of the national research project “<i>Light correlations for high-precision innovative sensing (LiCHIS)</i>” supported by MIUR (Italian Ministry of Education, Universities and Research) through the program “FIRB - Futuro in Ricerca 2010”, grant nr. RBFR10YQ3H. |
| 15 January 2011 – 7 March 2012 | Research fellow (art. 1 c. 14 L. 230/05)
Department of Physics, University of Trieste, Italy
<ul style="list-style-type: none"> ▪ <i>Coherent phenomena in many-body systems: correlations and entanglement.</i> |
| 1 January 2007 – 31 December 2009 | Research fellow
CNISM, Department of Physics, University of Milan, Italy
<ul style="list-style-type: none"> ▪ <i>Optical implementations of quantum technologies</i> |
| 1 November 2003 – 31 July 2007 | Research grant (Post doc)
Department of Physics, University of Milan, Italy
<ul style="list-style-type: none"> ▪ <i>Entanglement, decoherence and nonlocality in the processing of quantum information.</i> |
| 1 October 2007 – 30 September 2009 | Research fellow
CNISM, Department of Physics, University of Milan, Italy
<ul style="list-style-type: none"> ▪ <i>Optical implementations of quantum information protocols.</i> |
| 1 August 2007 – 30 September 2007 | CoCoCo
Department of Physics and Mathematics, University of Insubria, Como, Italy
<ul style="list-style-type: none"> ▪ <i>Realization of quantum teleportation and cloning effects through optical parametric processes.</i> |
| 1 November 2003 – 31 July 2007 | Research grant (Post doc)
Department of Physics, University of Milan, Italy
<ul style="list-style-type: none"> ▪ <i>Entanglement, decoherence and nonlocality in the processing of quantum information.</i> |

EDUCATION AND TRAINING

2 February 2004

PhD in Physics

University of Milan, Italy

- Thesis title: *Entanglement and Decoherence: Fundamental Aspects and Quantum Information Processing.*

23 March 2004

Degree in Physics

University of Milan, Italy

110/110
cum Laude

PERSONAL SKILLS

Mother tongue Italian

Other language(s)

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
English	C1	C1	C1	C1	C2

Levels: A1/A2: Basic user - B1/B2: Independent user - C1/C2 Proficient user
[Common European Framework of Reference for Languages](#)

Organizational / managerial skills

National Coordinator of the research MIUR FIRB project “Light correlations for high- precision innovative sensing (LiCHIS)” (8 March 2012 - 7 March 2015), the **three involved Research Units, one theoretical** (University of Milan) and two **experimental** (University of Insubria, Como, and INRiM, Turin).

Member of the **Scientific Committee** and **Organizer** of the conferences:

- “12th Italian Quantum Information Science Conference - IQIS 2019”, 9 - 12 September 2019, Milan (Italy).
- “6th Italian Quantum Information Science Conference - IQIS 2013”, 24 - 26 September 2013, Como (Italy).
- “Officina di didattica e divulgazione della Fisica - Aspetti Quantistici”, 27 September 2013, Como (Italy).

Scientific secretary of three international conferences:

- “Mysteries, Puzzles and Paradoxes in Quantum Mechanics”, 1 - 5 September 2003, Gargnano (Garda Lake, Italy).
- “Recoil Induced Effects in BEC”, 23 - 26 June 2002, Gargnano (Garda Lake, Italy).
- “Mysteries, Puzzles and Paradoxes in Quantum Mechanics”, 27 August - 1 September 2001, Gargnano (Garda Lake, Italy).

Scientific advisor del “Fall Workshop of the Quantum Technology Lab” (30 October - 18 December 2018, Department of Physics, University of Milan, Italy).

Member of the **Program Committee** dell’“International Wigner Workshop 2019” (19 - 20 May 2019, Evanston, Illinois, USA).

Job-related skill

- **Editorial Board Member** of Scientific Reports Nature Publishing Group.
- **Guest Editor** of the International Journal of Quantum Information (Volume 12, Number 2, March 2014).
- **President** of the “Outreach committee” at the Department of Physics, University of Milan (Italy).

WORK EXPERIENCE

Publications From 2000, **130 publications** (**118 papers in international peer-reviewed journals, 11 proceedings and 1 book**).

Citations His publications received about **2300 citations, H-index 28** (source Web of Science 2018).

ADDITIONAL INFORMATION

Presentations **38 oral contributions** to scientific conferences (**27 as invited talks**).

Honors and awards “Le Scienze” award for quantum optics and the medal awarded by the President of the Italian Republic, Carlo Azeglio Ciampi (2005).

- Projects and grants**
- Grant from the Department of Physics of the University of Milan, for the project “*Continuous-variable quantum optical simulator with integrated quantum photonics*” through the “Progetti Giovani” (Linea 2-A)” supported by UNIMI (2017).
 - Grant from the Department of Physics of the University of Milan, for the project “*Continuous-variable quantum optical simulator with integrated quantum photonics*” through the “Progetti “Giovani” (Linea 2-A)” supported by UNIMI (2017).
 - Grant from the Department of Physics of the University of Milan, for the project “*Continuous-variable quantum technology with integrated quantum photonics*” through the “Piano di Sostegno alla Ricerca” supported by UNIMI (2016).
 - Grant from the Department of Physics of the University of Milan, for the project “*Programmable optical devices for quantum transport*” through the “Piano di Sostegno alla Ricerca” supported by UNIMI (2015).
 - Grant from the Department of Physics of the University of Milan, for the project “*Generation, characterization and application of non-classical continuous- variable states for quantum information protocols*” through the “Sviluppo UniMi” supported by UNIMI (2014).
 - Three-year grant (8 March 2012 - 7 March 2015) for the national research project “*Light correlations for high-precision innovative sensing* (LiCHIS)” supported by MIUR (Italian Ministry of Education, Universities and Research) through the program “FIRB - Futuro in Ricerca 2010”, grant nr. RBF10YQ3H.
 - Grant from the University of Trieste, for the project “*Characterization and dynamics of correlations in optical systems for quantum technologies*” (2009).
 - Participant in the national scientific project co-funded by MURST “*Generation, manipulation and detection of entangled light for quantum communication*” (2005).

TEACHINGS

Graduation theses **Supervisor** of di 20 graduation theses in Physics (14 bachelor e 7 master) at the University of Milan (from 2013).

PhD theses **Co-Supervisor** of a PhD thesis in Physics

Post docs and fellows **Scientific supervisor** of 1 post doc and 1 fellow.

Lectures Lecturer at the PhD School in Physics, Astrophysics and Applied Physics and at the Master’s degree course in Physics at the university of Milan (UniMi) and University of Trieste (UniTs), as described in the following.

- 2017 – 2020**
- Ottica quantistica (Quantum optics)
 - Master’s degree in Physics, UniMi, 3 CFU per academic year.

- 2015 – 2020
- Teoria quantistica della computazione (Quantum computing)
– Master’s degree in Physics, UniMi, 6 CFU per academic year.
- 2016
- Advanced quantum optics - Quantum optics in the phase space: entanglement and quantum key distribution
– PhD School in Physics, Astrophysics and Applied Physics, UniMi, 8 hours.
- 2017 – 2020
- Ottica quantistica (Quantum optics)
– Master’s degree in Physics, UniMi, 3 CFU per academic year.
- 2012 – 2015
- Calcolatori quantistici (Quantum computers)
– Master’s degree in Physics, UniMi, 48 hours per academic year.
- 2015
- “Didattica e laboratorio della Fisica 1”, “Fisica moderna e tecnologie quantistiche” for high-school teachers (Tirocinio Formativo Attivo (TFA) 2° Ciclo – Classe A038) – UniMi (12 hours).
- 2014
- Quantum Optics in Phase Space and Introduction to Quantum Computing
– PhD School in Physics, Astrophysics and Applied Physics, UniMi, 8 hours.
- 2014
- “Didattica della Fisica 3: Fisica Moderna”, “Fisica moderna e tecnologie quantistiche” for high-school teachers (Percorsi Abilitanti Speciali (PAS) - Classe A038) – UniMi (24 hours).
- 2013
- Didattica della Fisica moderna e laboratorio”, “Dal concetto di fotone al teletrasporto quantistico” for high-school teachers (Tirocinio Formativo Attivo (TFA) 2° Ciclo – Classe A038) – UniMi (14 hours).
- 2012
- Advanced Quantum Optics - Gaussian States in Quantum Information
– PhD School in Physics, Astrophysics and Applied Physics, UniMi, 8 hours.
- 2011
- Introduction to Gaussian States in Quantum Information
– PhD School in Physics, UniMi.
- 2010
- Quantum information with continuous variable systems
– PhD School in Physics, Astrophysics and Applied Physics, UniMi.
- 2007
- “Informazione quantistica” for high-school teachers (course CS 38 A SILSIS) – UniMi.
- 2006 – 2007
- Tutor for the course “Istituzioni di Fisica Teorica”
– Master’s degree in Physics, UniMi.
- 2006 – 2007
- Tutor for the course “Istituzioni di Fisica Teorica”
– Master’s degree in Physics, UniMi.
- Advising*
- “Evaluator” of a PhD thesis in Physics at the Faculty of Mathematics and Natural Sciences, University of Turku, Finland (2012).
 - “Reviewer” of a PhD thesis in Physics and Astrophysics at the University of Insubria, Como, Italy (2017).
 - “Pre-examiner” of a PhD thesis in Physics at the Faculty of Mathematics and Natural Sciences, University of Turku, Finland (2019).
 - “External examiner” of a PhD thesis in Physics Queen’s University Belfast, Belfast UK (2019).

SCIENCE DIVULGATION

Seminars

Public seminars about quantum mechanics, quantum informations at schools, open days and libraries.

Pedagogical material

Co-author of the following book for high-school teacher and students:

- S. Olivares e L. Belloni, *Elementi di Informazione Quantistica*
Collana dei Materiali Didattici dell’Indirizzo FIM (n. 4)
(CUSL, Milano, 2008) ISBN: 97888-8132-488-0

Books Co-author of the following books for the series "Grandangolo scienza":

- L. Belloni and S. Olivares, *Fermi – L'energia atomica*
Grandangolo Scienza, Vol. 2 (Corriere della Sera, 2016)
ISBN: 9788861269705
- L. Belloni and S. Olivares, *Planck – La rivoluzione quantistica*
Grandangolo Scienza, Vol. 3 (Corriere della Sera, 2016)
ISBN: 9788861269712

Other activities
2017-2019

Scientific advisor for the book series "Le frontiere della scienza", National Geographic, RBA.

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Milano, 8 October 2019