CURRICULUM VITAE

ALESSANDRO RIDOLFO

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BASIC INFORMATION

Born	Messina, 15th January 1981
Title	Doctor Philosophiae
Languages	Italian (mother tongue), English (good level), German (basic), Spanish (basic)
Citizenship	Italian
Programming	Mathematica, Fortran 77, Fortran 90
Journals Referee	Physical Review, IOP Journals
Other Interests	Chess, Checkers, Mathematics

EDUCATION

University of Messina, Messina (Italy) *March 2011*

PhD in Physics (with excellence). Ph.D. Thesis: Quantum Optical Properties of Strongly Coupled Systems, Supervisor: Dr. Onofrio Maragò. Referees: Prof. Fausto Rossi and Dr. Iacopo Carusotto.

University of Messina, Messina (Italy) *February 2008*

Laurea Degree in Theoretical Physics with full marks and honours (110/110 cum laude). Thesis: Teorie e tecniche ab initio nel calcolo della struttura elettronica e transizioni di fase nei sistemi metallici (Ab initio theories and techniques in the electronic structures calculations and phase transitions in metallic systems), under the supervision of Prof. Ezio Bruno.

PROFESSIONAL ACTIVITIES

University of Messina January 2014 - Present
Research Fellow *Messina, Italy*

· Research activities in the group leaded by Prof. Salvatore Savasta. Research topics: Light-Matter interaction in the Ultra-Strong Coupling Regime, Superconducting Quantum Circuits, and Quantum Plasmonics.

University of Catania January 2015 - July 2015
Research Fellow *Messina, Italy*

· Research activities in the group of Prof. Giuseppe Falci. Research topics: Dynamics of Electrons strongly Interacting with Quantized Modes and their Applications to the Quantum Transport, Light Harvesting, Stimulated Raman Adiabatic Processes, Open Quantum Systems.

Technische Universität München June 2011 - December 2013
Postdoctoral Researcher *Garching, Germany*

· Research activities in the group directed by Dr. Michael Hartmann. Main research topics: Quantum Optics in the Ultra-Strong Coupling Regime, Nanomechanics, and Quantum Phase Transitions.

22/02/2016

University of Messina January 2009 - March 2011
PhD *Messina, Italy*

· During my PhD, I started a fruitful collaboration with Prof. Salvatore Savasta that lasts till nowadays. Main research topics: Quantum Plasmonics, and Quantum Optical Properties of Strongly Coupled Systems.

PRIZES AND AWARDS

University of Messina November 2011

· My PhD Thesis was awarded by the Accademia Peloritana dei Pericolanti as the best Physics PhD Thesis of the year 2011 in the University of Messina.

SCIENTIFIC OUTPUT

· I am author of 23 peer reviewed articles, most of them published in high impact factor journals (> 2.75), in particular: 5 papers in **Physical Review Letters** (4 as first author), 2 in **ACS Nano** (1 as first author), 1 in Optics Letter, 3 in Physical Review A, and 2 in Physical Review B (1 as first author).

· As of February 2016, I have over 550 citations according to Google Scholar with an h-index of 10, instead, 422 citations according to ISI Web of Knowledge, with an h-index of 9. Remark: the paper in Ref. [6] has scored in the month of February 2016 (3 years and 6 months later its publication), 75 citations according to Google Scholar.

DEVISED AND MANAGED RESEARCH PROJECTS

Up to now, my research interest is mainly focused in studying the quantum optical properties of strongly correlated systems. I can schematically list the most important achievements of my research projects as follow:

Quantum Plasmonics (*2009 - 2011*) - I developed, during my PhD, the quantum optical framework for the full quantum description of the interaction of a quantum emitter with localized surface plasmons. Specifically, I presented a groundbreaking result [1]: the calculation of the normalized second order correlation function for the photons scattered by a hybrid system constituted by a quantum dot interacting with a metal nanoparticle. Nowadays quantum plasmonics is a rapidly growing field (see e.g. Ref. [2]), but the above derivation represents the first full quantum result in quantum plasmonics. The main scientific output of this period [1, 3, 4] is intensively covered and cited. Worthy of notice, Ref. [1] represents a fundamental work in its field and it is also my most cited paper (to the present) with 81 citations (according to Google Scholar).

Fano-Doppler Laser Cooling (*2010 - 2011*) - Together with my PhD supervisor, I studied the laser cooling of hybrid nanostructures that exhibit Fano resonances [5]. Interestingly, I found that cooling occurs for red or blue detuning of the laser frequency from resonance depending on the Fano factor associated with the resonance. The combination of the Doppler effect with the radiation cross-section quenching typical of quantum interference yields temperatures below the conventional Doppler limit. Such a result opens perspectives for controlling the motion of mesoscopic systems as hybrid nanostructures at the quantum regime and the exploration of motional nonclassical states at the nanoscale.

Ultrastrong Light-Matter Interaction (*2011 - present*) - As Postdoctoral Researcher, I managed a joint research project between the University of Messina and the TU-München, that led to the publication of several papers on high impact factor reviews (> 7). The main research topics were focused on the ultrastrong light-matter interaction regime, i.e. when the coupling energy is comparable or larger than the bare frequency of the uncoupled light and matter excitations. In order to study such a fascinating and non-perturbative regime of interaction, I developed a master equation

22/02/2016

approach and a general photodetection formalism based on the input-output relations [6-8], that is valid for arbitrary coupling rate. The developed formalism enables the calculations of general normal-order correlation functions, the essential tool for quantifying photonics quantum correlations, in systems displaying ultrastrong coupling. This formalism paved the route to the theoretical investigation of a plenty of open quantum systems as in circuit-QED, cavity-QED, optomechanics and quantum plasmonics. Namely, as first example I shown how, under coherent excitation, the standard photon blockade scenario has completely different features in the ultrastrong coupling [6].

Transport Properties of Metallic Nanoparticles (*2014 - present*) - Recently, I was involved in an ambitious project at the University of Messina, for the drug-delivery by means of metallic nanoparticles. Such a research project aims to design and exploit the optical properties of metallic nanoparticles for biomedical applications. In particular, the research is devoted to develop a theoretical framework, that links the desired drugs diffusional properties in human body to the geometrical structures of nanoparticles that are driven by electromagnetic fields. The state-of-art of this project is still in progress.

Quantum Opto-Mechanics (*2014 - present*) - At the present, I am collaborating with the Prof. S. Savasta, at University of Messina, with a project on the interaction between light-field and mechanical system in the strong and ultrastrong regime of interaction. In particular, I am developing the description of such a coupled open quantum system, i.e. in interaction with a reservoir, describing the leakage of energy and quantum correlations. This project will pave the route for a correct description of the dynamics of interacting nonlinear system with quantized mechanical systems.

Excitations Transport in Quantum Networks (*2015 - present*) - As of January 2015 I was involved in the study of the dynamics of excitons strongly interacting with quantized vibrational modes, and their applications to the Quantum Transport in new materials (for instance in the case of light harvesting). This research project was mainly carried out at the University of Catania, in the research group of Prof. Giuseppe Falci, and in collaboration with Prof. Salvatore Savasta from University of Messina. In this research field, I was also studying the case of stimulated Raman adiabatic passage (STIRAP) in systems where artificial atoms are ultrastrongly coupled to a light cavity mode, in order to achieve deterministically Fock states of light.

CONFERENCES AND SEMINARS

CLEO/EUROPE - IQEC 2013 May 2013
oral contribution *München, Germany*

· Photon Blockade Effect in the Ultrastrong Coupling Regime

DPG - Spring Meeting March 2013
oral contribution *Hannover, Germany*

· Statistical Properties of Photons in the Ultrastrong Coupling Regime

19th Central European Workshop on Quantum Optics 2012 - CEWQO 2012 March 2012
oral contribution *Stuttgart, Germany*

· Entangling coupled nanomechanical oscillators at moderate temperatures

DPG - Spring Meeting July 2012
oral contribution *Sinaia, Romania*

· Output Photon Statistics for the Ultrastrong Coupling Regime

OECS 11 September 2009
poster *Madrid, Spain*

· Photoluminescence of Microcavities Strongly Coupled to Single Quantum Dots

22/02/2016

SELECTED LIST OF PUBLICATIONS

The list is sorted in anti-chronological order:

1. R. Stassi, **A. Ridolfo**, O. Di Stefano, M.J. Hartmann, and S. Savasta: *Spontaneous Conversion from Virtual to Real Photons in the Ultrastrong-Coupling Regime.*, Phys. Rev. Lett. **110**, 243601, (2013).
2. **A. Ridolfo**, S. Savasta, and M.J. Hartmann: *Nonclassical Radiation from Thermal Cavities in the Ultrastrong Coupling Regime.*, Phys. Rev. Lett. **110**, 163601, (2013).
3. **A. Ridolfo**, M. Leib, S. Savasta, and M.J. Hartmann: *Photon Blockade in the Ultrastrong Coupling Regime.*, Phys. Rev. Lett. **109**, 193602, (2012).
4. **A. Ridolfo**, R. Saija, S. Savasta, P.H. Jones, M.A. Iatì, and O.M. Maragò: *Fano-Doppler Laser Cooling of Hybrid Nanostructures.*, ACS Nano **5**, 7354-7361, (2011).
5. **A. Ridolfo**, R. Vilardi, O. Di Stefano, S. Portolan, and S. Savasta: *All Optical Switch of Vacuum Rabi Oscillations: The Ultrafast Quantum Eraser.*, Phys. Rev. Lett. **106**, 013601, (2011).
6. **A. Ridolfo**, O. Di Stefano, N. Fina, R. Saija, and S. Savasta: *Quantum Plasmonics with Quantum Dot-Metal Nanoparticle Molecules: Influence of the Fano Effect on Photon Statistics.*, Phys. Rev. Lett. **105**, 263601, (2010).
7. S. Savasta, R. Saija, **A. Ridolfo**, O. Di Stefano, P. Denti, and F. Borghese: *Nanopolaritons: Vacuum Rabi Splitting with a Single Quantum Dot in the Center of a Dimer Nanoantenna.*, ACS Nano **4**, 6369-6376, (2010).

Remark: my PhD supervisor is co-author of only one paper in the full list of my publications.

COLLABORATIONS

The scientific results mentioned above were obtained with the fruitful collaboration of: Prof. S. Savasta (University of Messina), Dr. Michael Hartmann (TU-München), Dr. Elena del Valle (UAM, Madrid), and Dr. Onofrio Maragò, (CNR-IPCF, Messina). From 2011 to 2013, I was the linking chain for a solid and productive collaboration between University of Messina and TU-München, achieving striking results. I was able to deepen my understanding of the subtle physics involved in the ultrastrong coupling and to fruitfully push forward my research interests. Further collaborations are still in progress with Prof. Eva Weig from University of Constance, about the physics of coupled nanomechanical systems, and with Dr. Francesco Piazza from TU-München, on the quantum phase transitions in the ultrastrong coupling regime. Recently, I have also been collaborating with Dr. Simone De Liberato (Southampton University) for a few months, on a different project dealing with cavity quantum electrodynamics.

SUPERVISION OF STUDENTS

As postdoctoral researcher (2011-2013), I supervised the Bachelor-thesis of Mr. Filippo Cosi (TU-München, 2012) and the Laurea-thesis of Mr. Luigi Garziano (University of Messina, 2012) regarding the technical part for the implementation of the numerical codes and the data presentation. I also trained and collaborated with Dr. Roberto Stassi (University of Messina, 2011- 2014) during his PhD. The achievements of this latter collaboration were published in Ref. [8]. Informally, I was also involved in the supervision and computational training of Mr. Robert Jirschik and Mr. Peter Degenfeld-Schonburg, both belonging to the Hartmann research group at TU-München.

22/02/2016

REFERENCES

1. **A. Ridolfo**, O. Di Stefano, N. Fina, *et al.*, Phys. Rev. Lett. **105**, 263601, (2010).
2. **A. Ridolfo**, R. Vilardi, O. Di Stefano, *et al.*, Phys. Rev. Lett. **106**, 013601, (2011).
3. S. Savasta, R. Saija, **A. Ridolfo**, *et al.*, ACS Nano **4**, 6369-6376, (2010).
4. **A. Ridolfo**, R. Saija, S. Savasta, *et al.*, ACS Nano **5**, 7354-7361, (2011).
5. **A. Ridolfo**, M. Leib, S. Savasta, and M.J. Hartmann, Phys. Rev. Lett. **109**, 193602, (2012).
6. **A. Ridolfo**, S. Savasta, and M.J. Hartmann, Phys. Rev. Lett. **110**, 163601, (2013).
7. R. Stassi, **A. Ridolfo**, O. Di Stefano, *et al.*, Phys. Rev. Lett. **110**, 243601, (2013).
8. L. Garziano, **A. Ridolfo**, R. Stassi, *et al.*, Phys. Rev. A **88**, 063829, (2013)
9. **A. Ridolfo**, E. del Valle, and M.J. Hartmann, Phys. Rev. A **88**, 063812, (2013)
10. **A. Ridolfo**, M. Leib, S. Savasta, and M.J. Hartmann, Phys. Scr. **T153**, 014053, (2012).

22/02/2016