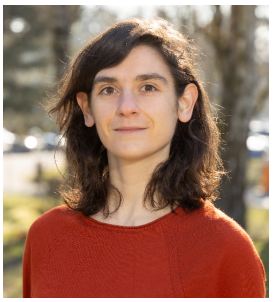
Ariane Soret



PhD, Research scientist
University of Luxembourg
Born 26 Oct 1991
Nationality: French
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Research experience

2022 - Research scientist, Department of Physics and Materials Science (DPhyMS), group of Massimiliano Esposito, University of Luxembourg

2020 - 2021 Postdoc, Department of Physics and Materials Science (DPhyMS), group of Massimiliano Esposito, University of Luxembourg

2019 - 2020 Postdoc, laboratoire Matériaux et Phénomènes Quantiques (MPQ), group of Cristiano Ciuti), University of Paris and CNRS

2016 - 2019 PhD in theoretical physics, "Forces induced by coherent effects", at Centre de Physique théorique (CPHT, École Polytechnique, France) and Technion (Israel), supervised by Karyn Le Hur (CPHT and CNRS) and Eric Akkermans (Technion and CNRS)

2014 - 2015 Pre-doctoral year of reasearch abroad (program ARPE of the École Normale Supérieure (ENS) Cachan), "Quantum dynamics for a fractal spectrum - Applications to simple processes in electrodynamics and quantum optics", Technion, Israel, supervised by Eric Akkermans

Scientific profile

Interests

Fields : quantum thermodynamics, stochastic thermodynamics, quantum optics, quantum mesoscopic physics, quantum electrodynamics, Casimir effect

Methods : counting statistics, master equations, quantum dynamical semigroups, Green's functions, diagrammatic approaches, larges deviations, path integrals

Programing : Python, Matlab, Mathematica

Main achievements

- Derivation, at the fluctuating level, of the statistics of the work performed by a coherent light mode on an atom in the strong coupling regime, and derivation of a fluctuation theorem for the work [3]
- Identification of necessary and sufficient conditions for a quantum master equation to be thermodynamically consistent, i.e., to preserve the laws of thermodynamics at the average and fluctuating level [4]
- Description of a new Casimir like force, induced by long range fluctuations of coherent light propagating through a weakly disordered scattering medium [7], and derivation of a thermodynamic uncertainty relation for this force [6]

Grants

2022- Recipient of the CORE Junior grant from the Luxembourg National Research Fund (FNR), as principal investigatior, duration 3 years, to develop my project "Thermodynamics of quantum optics", aiming at extending stochastic thermodynamics to quantum electrodynamics and quantum optics

Teaching and mentoring experience

2023 - 2024 Development and teaching of the course "Introduction to quantum thermodynamics" (25h) at the doctoral school of the University of Luxembourg

2022- Supervision of the research project of a PhD student at the University of Luxembourg

Dec. 2022 Lecturer and author [2] of the course "Introduction to quantum thermodynamics" (2h) at the winter school Post Modern Thermodynamics, University of Luxembourg, 5-7 dec 2022

2019-2020 Supervision of the research project of a PhD student at MPQ, Paris Diderot, France [5]

2018-2019 Teaching assistant for lab classes on superconductivity (64h), bachelor's level, at École Polytechnique, Palaiseau, France

2015-2016 Tutoring at Collège internat d'excellence in Cachan, France

Publications

[1] V. Cavina, K. Ptaszynski, A. Soret, and M. Esposito, "Decomposition of irreversible work", (draft in preparation) (2023).

[2] F. Avanzini et. al., "Methods and conversations in (post)modern thermodynamics", submitted to Sci Post, 10.48550/arXiv.2311.01250 (2023).

[3] A. Soret and M. Esposito, "Thermodynamics of atom-photons interactions near resonance", (draft in preparation) (2023).

[4] A. Soret, V. Cavina, and M. Esposito, "Thermodynamic consistency of quantum master equations", Phys. Rev. A **106**, 062209 (2022).

[5] Z. Li, A. Soret, and C. Ciuti, "Dissipation-induced antiferromagnetic like frustration in coupled photonic resonators", Phys. Rev. A **103**, 022616 (2021).

[6] A. Soret, O. Shpielberg, and E. Akkermans, "Uncertainty relations for mesoscopic coherent light", Journal of Statistical Mechanics: Theory and Experiment **2021**, 123302 (2021).

[7] A. Soret, K. Le Hur, and E. Akkermans, "Fluctuating forces induced by nonequilibrium and coherent light flow", Phys. Rev. Lett. **124**, 136803 (2020).

[8] A. Soret, "Forces induced by coherent effects", Université Paris-Saclay (2019).

[9] F. Yang, L. Henriet, A. Soret, and K. Le Hur, "Engineering quantum spin liquids and many-body majorana states with a driven superconducting box circuit", Phys. Rev. B **98**, 035431 (2018).

[10] K. Le Hur, A. Soret, and F. Yang, "Majorana spin liquids, topology, and superconductivity in ladders", Phys. Rev. B **96**, 205109 (2017).

[11] A. Soret, "Quantum dynamics for a fractal spectrum - applications to simple processes in electrodynamics and quantum optics", École Normale Supérieure de Cachan (2015).

Scientific communications

Invited talks

- "Thermodynamic consistency of driven quantum optical master equations", invited talk at the PhotonIcs & Electromagnetics Research Symposium (PIERS), 3-6 Jul 2023, Prague
- "Forces induced by a coherent light flow", invited talk at the WE-Heraeus-Seminar on "Fluctuation-induced forces", Physikzentrum Bad Honnef, 6-11 Sep 2020 (postponed to Feb 2022 due to covid)
- "Non equilibrium behavior of coherent light fluctuations", seminar at the Laboratoire Gulliver, invited by David Lacoste (CNRS), ESPCI Paris, 25 June 2020

Oral communications

- "Thermodynamics of atom-photons interactions near resonance", CMD30 - FisMat 2023, 4-8 Sep 2023, Milan, Italy
- "Thermodynamic consistency of driven quantum optical master equations", Quantum Thermodynamics Conference 2023 (QTD 2023), 17-21 Jul 2023, TU Wien, Vienna, Austria
- "Thermodynamic consistency of driven quantum optical master equations", XXVII Sitges Conference on Statistical Mechanics, 29 May - 2 Jun 2023, Sitges, Spain
- "Thermodynamic consistency of driven quantum optical master equations", Workshop on Stochastic Thermodynamics (WOST IV), online, organized by ICTP, Trieste, Italy
- "Thermodynamic consistency of quantum master equations", Quantum Thermodynamics Conference 2022 (QTD 2022), 27 Jun - 1 Jul 2022, online, host institution Quantum Technology group à Queen's University, Belfast, Ireland)
- "A Casimir Effect in Quantum Mesoscopic Physics", Israel Physics Society Annual Meeting (IPS), 17 Dec 2017, Technion, Haifa, Israel
- "Quantum dynamics of a wave packet for a Cantor spectrum", Israel Physics Society Annual Meeting (IPS), Ben Gurion University, 21 Dec 2014

Posters

- "Thermodynamic consistency of quantum master equations", (Post)Modern Thermodynamics workshop, 7-9 Dec 2022, University of Luxembourg
- "A Casimir Effect in Quantum Mesoscopic Physics", *Groupement de Recherche (GDR) Physique Quantique Mésoscopique*, Dec 2018, Aussois, France
- "Casimir Forces Induced by Non Equilibrium Light Flow", Canadian Institute for Advanced Research (CIFAR) Quantum Materials meeting, Jun 2018, Montreal, Canada
- "A Casimir Effect in Quantum Mesoscopic Physics", Frontiers of Quantum and Mesoscopic Thermodynamics Conference, 9-15 Jul 2017, Prague, Czech Republic
- "Majorana Spin Liquids, Topology and Superconductivity in Ladders", Canadian Institute for Advanced Research (CIFAR) Quantum Materials meeting, 5-7 Oct 2016, Collège de France, France

Contribution to the community

- Member of the Quantum Energy Initiative (QEI) since its creation in 2022; this community gathers scientists caring for the physical resource cost of emerging quantum technologies and willing to address the question in a scientific way.
- Member of the *Société Française de Physique* (SFP) since 2020, in particular of the commission Women in Science
- PhD students representative at the lab board at the Centre de Physique Théorique (CPHT) in 2018-2019 (during my PhD)

Education

2016 - 2019 PhD in theoretical physics, "Forces induced by coherent effects", at Centre de Physique théorique (CPHT, École Polytechnique, France) and Technion (Israel), supervised by Karyn Le Hur (CPHT and CNRS) and Eric Akkermans (Technion and CNRS).

2015 - 2016 Master's degree (M2) at the International Center for Fundamental Physics and Interfaces at the École Normale Supérieure (ENS-ICFP), ENS Paris, France

2014 - 2015 Pre-doctoral year of reasearch abroad (program ARPE of the École Normale Supérieure (ENS) Cachan), "Quantum dynamics for a fractal spectrum - Applications to simple processes in electrodynamics and quantum optics", Technion, Israel, supervised by Eric Akkermans

2013 -2014 First year of master's (M1) Fundamental Physics, Experimental Physics and Modelisation, at École Normale Supérieure de Cachan (ENS), Cachan, France

2012-2013 Bachelor's degree Fundamental Physics, Experimental Physics and Modelisation, at École Normale Supérieure de Cachan (ENS), Cachan, France

2012 Passed the entrance exam to the École Normale Supérieure (ENS) de Cachan

2009 - 2012 Preparatory class ("Classe préparatoire aux grandes écoles") at lycée Louis-le-Grand, Paris, France

Contacts

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Eric Akkermans
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Karyn Le Hur
CNRS senior scientist (DR1) and professor at École Polytechnique, France
karyn.le-hur [at] polytechnique.edu