Nathan Shammah

Date of Birth:	12 April 1987	Address:	Unitary Fund, Berkeley, USA
Place of Birth:	Milan, Italy		nathan@unitary.fund
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Nationality:	Italian		Applied Quantum Mechanics Group
			Department of Physics, University of Milan
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Research Interests

My research focus is on open quantum systems dynamics, and the interplay between cooperative effects and dissipative mechanisms in many-body quantum systems. In particular, I investigate how fingerprints of the ultrastrong coupling regime between light and matter can be addressed.

I have characterized novel light-matter physics phenomena for current devices, such as superconducting circuits and semiconductor quantum wells, for technology applications such quantum information processing and THz emission.

I develop open-source software for quantum physics research and quantum technology. I used it to study noisy quantum information processing and light-matter interaction in solid-state cavity quantum electrodynamics (QED).

Analytical Techniques: Dissipative master equations and their symmetries, fermionic and bosonic many-body systems in second quantization, input-output theory, mean-field theories, continuous-variable quantum mechanics.

Numerical Techniques: Superoperator formalism, symmetric methods in Liouvillian space, development of open-source libraries in Python, such as PIQS, QuTiP.

Work Experience

Mar 2020 – Now	*Chief Technology Officer* – Unitary Fund *Berkeley, USA* I lead the technical team performing in-house research projects and help support the open-source scientific ecosystem in quantum technology.
Jan 2019 – Now	*Visiting Scientist* – Dept. Physics, Università degli Studi, *Milano, Italy*
Aug 2016 – Mar 2020	*Postdoctoral Research Scientist* – RIKEN *Wako-shi, Japan* Theoretical Quantum Physics Lab
Jul 2017 – Now	*Co-founder* – Quantika, consulting hub quantika.co.

Education

Apr 2013 – Jul 2016	**PhD in Physics** University of Southampton, School of Physics and Astronomy *UK* Thesis: *Resonance Fluorescence and Superfluorescence of Intersubband Transitions*
Apr 2010 – Mar 2012	**MSc in Physics (Laurea Magistrale). Final Grade: 110/110 *cum laude*** Università degli Studi di Milano *Milan, Italy* Thesis: *Quantifying the nonlinearity of a quantum oscillator*
- Dec 11 – Apr 12	*MSc Erasmus Placement Student*, Controlled Quantum Dynamics Group Imperial College London *London, United Kingdom*
- Sep 10 – Apr 11	*MSc Erasmus Student* University of Copenhagen *Copenhagen, Denmark*
Oct 2006 – Apr 2010	**BSc in Physics (Laurea Triennale)** Università degli Studi di Milano *Milan, Italy* Thesis: *Diamagnetism and De Haas-van Alphen oscillations in the electronic gas*

Publications

8 published papers, 6 as first author, with a total of 114 citations since 2015, h-index: 5 (Google Scholar, 1/2020).

Submitted or in preparation:

[13] *Noisy quantum circuits and pulse-level control in QuTiP*
Boxi Li, Nathan Shammah, Shahnawaz Ahmed, Alex Pitchford, Neill Lambert, and Franco Nori

[12] *Probing quantum chaos with out-of-time-ordered-correlator quasiprobability in the kicked-top model*
Jose Raul Gonzalez Alonso, Nathan Shammah, Shahnawaz Ahmed, Arjendu Pattanayak, Franco Nori, and Justin Dressel

[11] *Observation of a quantum critical behavior in the thermodynamic limit using a driven hybrid quantum circuit*
Zhen Chen, Guo-Qiang Zhang, Nathan Shammah, Shuai-Peng Wang, Meiyong Liao, Xin-You Lu, Tie-Fu Li, Yi-Pu Wang, Franco Nori, and J. Q. You (*Submitted to Nature Communications*)

[10] *Quantum quenches and supercooling in the generalized Lipkin-Meshkov-Glick Model*
Matteo Wauters, Giulia Piccitto, Giuseppe Santoro, Franco Nori, and Nathan Shammah

[9] *Cooperative dynamics and dark states in artificial giant atoms*
Nathan Shammah, Franco Nori, and Anton Frisk Kockum

Preprints:

[8] *Mean-field validity in a dissipative critical system: Liouvillian gap, $\mathbb{PT}$-symmetric antigap, and permutational symmetry in the XYZ model*
Dolf Huybrechts, Fabrizio Minganti, Franco Nori, Michiel Wouters, and Nathan Shammah.
https://arxiv.org/abs/1912.07570

[7] *Dissipation-induced bistability in the two-photon Dicke model*
Louis Garbe, Peregrine Wade, Fabrizio Minganti, Nathan Shammah, Simone Felicetti, and Franco Nori.
https://arxiv.org/pdf/1911.11694.pdf

Peer-reviewed publications:

[6] *Multielectron Ground State Electroluminescence*
Mauro Cirio*, Nathan Shammah*, Neill Lambert, Simone De Liberato, and Franco Nori
Physical Review Letters, **122** 190403 (2019) Link arXiv. *equal contribution.

[5] *Open quantum systems with local and collective incoherent processes: Efficient numerical simulation using permutational invariance*
Nathan Shammah, Shahnawaz Ahmed, Neill Lambert, Simone De Liberato, and Franco Nori
Physical Review A **98**, 063815 (2018) Link arXiv

[4] *Superradiance with local phase-breaking effects*
Nathan Shammah, Neill Lambert, Franco Nori, and Simone De Liberato
Physical Review A **96**, 023863 (2017) Link arXiv

[3] *Theory of intersubband resonance fluorescence*
Nathan Shammah and Simone De Liberato
Physical Review B **92**, 201402 Rapid Comm. (2015) Link arXiv

[2] *Terahertz emission from ac Stark-split asymmetric intersubband transitions*
Nathan Shammah, Chris C. Phillips, and Simone De Liberato
Physical Review B **89**, 235309 (2014) Link arXiv

[1] *Quantifying the nonlinearity of a quantum oscillator*
Matteo G.A. Paris, Marco G. Genoni, Nathan Shammah, and Berihu Teklu
Physical Review A **90**, 012104 (2014) Link arXiv

Terahertz emission from asymmetric, doped quantum wells under resonant pumping
Nathan Shammah, Chris C. Phillips, and Simone De Liberato
Journal of Physics: Conf. Series **619**, 012021 (2015). Peer-reviewed proceeding.

Open Source Libraries:

- QuTiP, the Quantum Toolbox in Python, J. R. Johansson, P. Nation, A. Pitchford, N. Shammah, C. Granade, A. Grimsmo, S. Ahmed, Neill Lambert, E. Giguere, and F. Nori, http://qutip.org
- Permutational Invariant Quantum Solver (PIQS). Nathan Shammah and Shahnawaz Ahmed github.com/nathanshammah/piqs. Documentation: piqs.readthedocs.io
- *scikit-project*, https://github.com/nathanshammah/scikit-project
- Commits to: Qiskit, Cirq, Bokeh, Sphinx, Conda-Forge

Talks at International Meetings

2019 Dec 20th	Invited talk at the 4th AQM Meeting *Milan, Italy*
2019 Sep 11th	IQIS Conference *Milan, Italy*
2019 Sep 4th	EuroScipy 2019 *Bilbao, Spain*
2019 Jan 26th	Invited talk: RIKEN-Berkeley Quantum Information Science Workshop, *Berkeley, USA*
2018 Aug 31st	EuroScipy 2018 – 11th European Conference on Python in Science *Trento, Italy*
2018 Jul 16th	Current Trends in Open and Nonequilibrium Quantum Optical Systems, Max Planck Institute for the Science of Light *Erlangen, Germany*
2018 Jun 29th	ImPACT JST Quantum Simulation Meeting *Wako-shi, Japan*
2018 Apr 18th	C3QS – Coherent Control of Complex Quantum Systems, OIST *Okinawa, Japan*
2017 Feb 13th	VSI Workshops – Quantum Steering and Time Correlations Workshop *Tokyo, Japan*
2015 Jul 12th	PIERS Conference, Solid State Photonics Focus Session *Prague, Czech Republic*
2015 Mar 12th	Advanced Polaritonics Workshop (the British Council funded my participation) *Suzdal, Russia*
2014 Jul 31st	ICOOPMA14 – Intl. Conference on Optical, Optoelectronic and Photonic Materials *Leeds, UK*

Poster Presentations at International Meetings

2019	Coherent Network Computing Conference *Atsugi, Japan*
2018	JST Meeting on Quantum Computing (Cabinet of the Government of Japan)
2018	QFS 2018 – International Symposium on Quantum Fluids and Solids *Tokyo, Japan*
2018	C3QS – Coherent Control of Complex Quantum Systems, OIST *Okinawa, Japan*
2018	DAQS2018 – International Symposium on Dynamics in Artificial Quantum Systems *Tokyo, Japan*
2017	ISNTT 2017 – International School and Symposium on Nanoscale Transport and Photonics *Atsugi, Japan*
2017	QFML 2017 – Quantum Fluids of Light and Matter Conference *Cargèse, France*
2013	ISNP 2013 – International School of Nanophotonics and Photovoltaics *Maratea, Italy* **Best Poster Award**
2013	QUICC 2013 – International School on Quantum Information, Computing and Control *London, UK*
2013	International School of Photonics, Scuola Normale Superiore di Pisa e NEST *Cortona, Italy*

Talks at Research Centers

2019 Sep 25th	Seminar, Google Quantum A.I. Lab, Google. Host: Alan Ho. *Los Angeles, USA*
2019 Jul 1st-5th	6 Lectures on open quantum systems and open source, SISSA. Host: M. Dalmonte. *Trieste, Italy*
2019 Mar 25th	Seminar, Univ. of Antwerp. Host: M. Wouters. *Antwerp, Belgium*
2019 Mar 21st	Seminar, Vandersypen Lab, QuTech, TU Delft. Host: G. Zheng. *Delft, The Netherlands*
2019 Feb 1st	IQIM Seminar, Caltech. Host: V. Albert. *Pasadena, USA*
2019 Jan 29th	Seminar, Google Quantum A.I. Lab, Google. Host: H. Neven. *Los Angeles, USA*
2019 Jan 28th	Seminar, NASA, Ames Research Center and USRA. Host: D. Venturelli. *Mountain View, USA*
2019 Jan 23d	Special Seminar, Appl. Physics Dept., Stanford University. Host: P. McMahon. *Palo Alto, USA*
2018 July 16th	Seminar, Applied Quantum Mechanics Group, Univ. of Milan. Host: M. Genoni. *Milan, Italy*
2017 Aug 22nd	Qulink – National Institute of Informatics. Host: K. Nemoto. *Tokyo, Japan*
2017 May 15th	Laboratoire Pierre Aigrain – École Normale Supérieure Paris. Host: G. Hetet. *Paris, France*
2016 Oct 6th	RIKEN Quantum Condensed Matter Research Group Meeting *Tokyo, Japan*
2015 Jun 3rd	Bar-Ilan University. Host: E. Dalla Torre. *Tel Aviv, Israel*
2014 Jul 8th	The Racah Institute of Physics, Hebrew Univ. of Jerusalem. Host: A. Retzker. *Jerusalem, Israel*
2014 Sep 19th	Photonics Day, Zepler Institute and Optoelectronics Research Centre *Southampton, UK*
2012 Mar 21st	QOLS Group, Imperial College London *London, UK*
2012 Nov 6th	IQOQI. Host: A.V. Gorshkov. *Innsbruck, Austria*

Visits

Jul – Sep 2019	**University of Milan** *Applied Quantum Mechanics Group.* Host: Dr. Marco Genoni
Jun – Jul 2019	**International School for Advanced Studies (SISSA)** *Trieste, Italy.* Host: Dr. Marcello
Mar – Apr 2019	Dalmonte
Jul – Sep 2018	**University of Antwerp** *Antwerp, Belgium.* Host: Prof. M. Wouters
Jun – Jul 2015	**University of Milan** *Applied Quantum Mechanics Group.* Host: Dr. Marco Genoni
	RIKEN *Wako-shi, Japan, Summer Research Intern*, Quantum Condensed Matter Research Group

Workshop Organization

Feb 19-21 2019	**1st QuTiP Developers Workshop** *RIKEN, Wako, Japan.*

Awards

2016	**University of Southampton** *Vice-Chancellor's Awards (Runner-up)* Science Outreach
2015	**Embassy of Italy in the UK** *'Italy Made Me' Awards* Certificate of Excellence in Research
2013	**Best Poster Award** *Awarded by the EPL Journal* at the Intl. School of Nanophot. and Photovoltaics.

Funding

2019	**Google** Summer of Code Mentorship
2013 – 2016	**EPSRC** UK and University of Southampton *EPSRC DTA Studentship* (PhD Funding)
2015	**RIKEN** Intern at the Quantum Condensed Matter Research Group
2011 – 2012	**European Union** Placement at the Controlled Quantum Dynamics Group, Imperial College
2010 – 2011	**European Union** Erasmus Program at the Niels Bohr Institute, University of Copenhagen

Teaching and Mentoring

2018 - 2020	**Mentor** to two research interns, 4 PhD students, 2 MSc. students on my physics & code projects
2019	**Mentor** to Google Summer of Code 2019 students for the QuTiP project, NumFOCUS org.
2017 – 2018	**Mentor** to Shahnawaz Ahmed, MSc student in Eng. and Physics, intern at RIKEN from BITS Pilani Goa, India
2014 – 2015	**University of Southampton** *Southampton, United Kingdom* *Teaching Assistant*, School of Physics and Astronomy Computational Techniques in Physics (PHYS 3008) and Atomic Physics (PHYS 6017)

Languages and IT Skills

Fluent: Italian *(Native)*, English, French, Spanish. *Beginner*: Japanese.
Programming: Python, C/C++, Mathematica, MATLAB. Libraries: QuTiP, Matplotlib, Cython, Scipy, Jupyter.

Service and Outreach

Referee for: *Nature Scientific Reports (1), Optics Communications (1), Eur. Phys. Journal Plus (1), Phys Lett A (2), SciPost Physics (1)*

2017 July - Now	Writer, Newsletter on Quantum Technology medium.com/quantum-tech.
2019 Nov 7th	Talk at Machine Learning Tokyo Meetup *Tokyo, Japan*
2019 Oct 28th	Article for the online newspaper Linkiesta.
2019 Jan 11th	Article: *The rise of open source in quantum physics research*, Nature Blogs – with S. Ahmed
2018 Sep 29th	Talk 'Open-source for open science', European Research Day, Italian Institute of Culture *Tokyo*
2017 Jun 16th	Talk on Quantum Technologies at Nerd Nite Tokyo *Tokyo, Japan*
2017 May 27th	Talk at Falling Walls Lab, The National Museum of Emerging Science and Innovation *Tokyo*
2017 Mar 10th	Talk at the European Innovation Day by EURAXESS, Accenture Digital Hub *Tokyo, Japan*
Aug 2014 – 2016	*University Coordinator*, Pint of Science International Festival *Southampton, United Kingdom*
2016 May 16th	Talk at the Researchers' Café of the University of Southampton *Southampton, United Kingdom*
2016 May 26th	Article: *Que la lumière soit ! Mais une particule à la fois – The Conversation France*
2013 May 15th	Print and Online Article: *Five easy pieces on quantum information* – with S. De Liberato *IL magazine, Il Sole 24 Ore* (the Italian business and finance newspaper)

References

Prof. Franco Nori
Chief Scientist, RIKEN, Japan
Leader of the Theoretical Quantum Physics Laboratory, Cluster for Pioneering Research, http://dml.riken.jp/.
Also at the Physics Department, University of Michigan, Ann Arbor, MI 48109-1040, USA
E-mail: fnori@riken.jp

Prof. Simone De Liberato
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