

Interacting Photons, S. R. K. Rodriguez (2017-2022)

Biography



Said Rahimzadeh-Kalaleh Rodriguez leads the Interacting Photons group at NWO-Institute AMOLF, where he is tenured since 2022. The group investigates novel mechanisms through which nonlinearities, noise, memory, and dissipation, can synergistically enhance the transport of energy and information in light. Prior to starting his group, Said got a PhD in Physics at AMOLF and TU/Eindhoven. He worked on strong light-matter interactions in various nanophotonic systems, and pioneered studies of condensation in plasmonics systems. Said graduated Cum Laude (top 3-5%), received the 2015 FOM

thesis prize (best physics thesis in the Netherlands) and the Christiaan Huygens prize honourable mention (2nd best physics thesis in 2009-2014 in the Netherlands). Then, Said obtained a Marie Curie individual fellowship to investigate quantum and nonlinear optics of semiconductor cavities in France. There, he introduced methods for probing dissipative phase transitions of laser-driven systems. In 2017, Said received a NWO Veni grant to investigate noise-assisted optical functionalities, and started his group at AMOLF. With his group, he has opened several new frontiers of physics, including: i) scaling and universality in systems with memory, ii) optical sensors that benefit from noise or short measurement times, iii) broadband noise-assisted signal amplification, iv) cavity photon superfluidity, and v) stochastic thermodynamics of laser-driven resonators. In 2019, Said received an ERC Starting grant to investigate optoelectronic properties of polaritons, and in 2020 he received an Early Career Award from the Dutch Royal Academy.

Group output

Peer reviewed Publications 2017-2022

The group of Rodriguez started Nov. 2017. Only output to which he contributed as AMOLF PI is listed.

2019

1. S.R.K. Rodriguez, V. Goblot, N. Carlon Zambon, A. Amo and J. Bloch, *Nonreciprocity and zero reflection in nonlinear cavities with tailored loss*, Phys. Rev. A **99**, 013851, (2019). **Green OA**

2020

1. N. Carlon Zambon, S.R.K. Rodriguez, A. Lemaître, A. Harouri, L. Le Gratiet, I. Sagnes, P. St-Jean, S. Ravets, A. Amo and J. Bloch, *Parametric instability in coupled nonlinear microcavities*, Phys. Rev. A **102**, 023526: 1-8, (2020), **Green OA**.
2. K. Perrier, S. Greveling, H. Wouters, S.R.K. Rodriguez, G. Lehoucq, S. Combrie, A. De Rossi, S. Faez and A.P. Mosk, *Thermo-optical dynamics of a nonlinear GaInP photonic crystal nanocavity depend on the optical mode profile*, OSA Continuum **3**, 1879-1890, (2020), **Gold OA**.

3. Z. Geng, K.J.H. Peters, A.A.P. Trichet, K. Malmir, R. Kolkowski, J.M. Smith and S.R.K. Rodriguez, "Universal Scaling in the Dynamic Hysteresis, and Non-Markovian Dynamics, of a Tunable Optical Cavity", *Phys.Rev.Lett.* **124**, 153603: 1-7, (2020), **Hybrid OA**.
4. S.R.K. Rodriguez, "Enhancing the Speed and Sensitivity of a Nonlinear Optical Sensor with Noise", *Phys. Rev. Appl.* **13**, 024032: 1-11, (2020), **Hybrid OA**.

2021

1. K.J.H. Peters, Z. Geng, K. Malmir, J.M. Smith and S.R.K. Rodriguez, *Extremely Broadband Stochastic Resonance of Light and Enhanced Energy Harvesting Enabled by Memory Effects in the Nonlinear Response*, *Phys.Rev.Lett.* **126**, 213901: 1-7 (2021) **Green OA**
2. Z. Geng, J. Theenhaus, B.K. Patra, J.-Y. Zheng, J. Busink, E.C. Garnett and S.R.K. Rodriguez, *Fano Lineshapes and Rabi Splittings: Can They Be Artificially Generated or Obscured by the Numerical Aperture?*, *ACS Photonics* **8**, 1271-1276 (2021) **Hybrid OA**

2022

1. K.J.H. Peters and S.R.K. Rodriguez, *Exceptional precision of a nonlinear optical sensor at a square-root singularity*, *Phys.Rev.Lett.* **129**, 013901: 1-7 (2022) **Green OA**
2. B. Grabin, A. Giraldo, K.J.H. Peters, N.G.R. Broderick, A. Spakman, F. Raineri, A. Levenson, S.R.K. Rodriguez, B. Krauskopf and A.M. Yacomotti, *Spontaneous symmetry breaking in a coherently driven nanophotonic Bose-Hubbard dimer*, *Phys.Rev.Lett.* **128**, 053901: 1-6 (2022) **Green OA**
3. K.J.H. Peters and S.R.K. Rodriguez, *Limit cycles and chaos induced by a nonlinearity with memory*, *Eur. Phys. J. Spec. Top.* **231**, 247-254 (2022) **Green OA**

Contributions to scientific books (chapters or entire book) 2017-2022

N/A

PhD theses 2017-2022

2020

1. A. Berkhout, "Planar hybrid plasmonic-photonic resonators: an interferometric investigation", University of Amsterdam, 2020-11-13 OA (co-promotor)

2022

1. Z. Geng, *Strong light-matter interactions and nonlinear dynamics in coherently driven optical resonators*, University of Amsterdam, 2022-06-02 Open Access

Masters and Bachelors theses 2017-2022

2019

1. K. Peters, *Non-Markovian stochastic resonance in a tunable optical microcavity*, Utrecht University (master thesis) The Netherlands, 07/2019.
2. G. Keijsers, *Superfluidity of light in a tunable micro-cavity at room temperature*, Leiden University (master thesis) The Netherlands, 07/2019.

2020

1. F. Bijloo, *Optical Bistability in a plasmonic lattice*, Advanced Matter and Energy Physics, University of Amsterdam, The Netherlands, 03/2020.

2021

1. T. Ham, Superfluidity in a thermally nonlinear optical microcavity, Advanced Matter and Energy Physics, University of Amsterdam, The Netherlands, 09/2021.
2. P. Ackermans, Stochastic thermodynamics of an optical resonator, Advanced Matter and Energy Physics, University of Amsterdam, The Netherlands, 08/2021.
3. V. G. Ramesh, Arcsine Laws in a Driven-Dissipative Non-linear Optical Cavity, Advanced Matter and Energy Physics, University of Amsterdam, The Netherlands, 08/2021.
4. R. O. van der Steenhoven, Modifying electrical conductivity with optical cavities, Advanced Matter and Energy Physics, University of Amsterdam, The Netherlands, 08/2021.
5. J. Busink, Effective potentials as a paradigm-shift to understand optical non-linear oscillators, Advanced Matter and Energy Physics, University of Amsterdam, The Netherlands, 01/2021.

2022

1. B. Verdonschot, Spontaneous symmetry breaking in nonlinear optical cavities, master's thesis, Theoretical Physics Masters, University of Amsterdam, The Netherlands, 08/2022

Invited lectures at international conferences and meetings

2018

1. S.R.K. Rodriguez, *Probing a dissipative phase transition via dynamical optical hysteresis*, Dynamics Days, Latin America and the Caribbean Punta del Este, Uruguay (Nov. 26-30, 2018).
2. S.R.K. Rodriguez, *Critical phenomena with interacting photons in driven-dissipative systems*, XXV International Summer School 'Nicolas Cabrera' – Manipulating Light and Matter at the Nanoscale Madrid, Spain (Sept. 10-14, 2018).
3. S.R.K. Rodriguez, *Critical phenomena with interacting photons in driven-dissipative systems*, Applied Nanophotonics Retreat of the University of Twente Bad Bentheim, Germany (June 11-12, 2018).

2019

1. S.R.K. Rodriguez, *Phase transitions in driven-dissipative photonic systems*, HPM 2019 — Hybrid Photonics & Materials International Conference, Naxos, Greece, September 30- October 4, 2019.
2. S.R.K. Rodriguez, *Photonics analog simulators*, Workshop on Optical Microsources at CRHEA, Valbonne, France, November 29-29, 2019.
3. S.R.K. Rodriguez, *Noise-assisted optical sensing*, Dutch Photonics Event, Delft, the Netherlands, September 10, 2019.

2020

1. S.R.K. Rodriguez, EURAXESS (LAC). *Applying for an ERC Grant. Perspectives from Grantees and Evaluators*". 19 november 2020.
2. S.R.K. Rodriguez, *Advanced Computational and Experimental Techniques in Nonlinear Dynamics*, Mexico 26 oktober 2020
3. S.R.K. Rodriguez, Polariton Chemistry Webinar, San Diego, USA, 5 augustus, 2020
https://www.youtube.com/watch?v=Qv8_jw2rYy0

2022

1. S.R.K. Rodriguez, *Superfluid light in steady state and at room temperature*, Lorentz Center International Workshop — Condensates of Light, Leiden, the Netherlands, 04/04/2022.
2. S.R.K. Rodriguez, *Noise, nonlinearity, and loss: Limitations or resources for optical sensing?*, Tutorial at the Optica Advanced Photonics Congress, Maastricht, the Netherlands, 28/07/2022.

3. S.R.K. Rodriguez, *Noise, nonlinearity, and loss: Limitations or resources for optical sensing?*, International School of Modern Applications of Optics and Photonics, Yerevan, Armenia 29/08/2022.
4. S.R.K. Rodriguez, *Polarization switching and broken detailed balance in a multistable perovskite cavity*, 16th International Congress on Artificial Materials for Novel Wave Phenomena, Siena, Italy, 12/09/2022.
5. S.R.K. Rodriguez, *Emergent statistical structures in noisy light fields*, Hybrid Photonics & Materials International Conference, Hydra, Greece, 03/10/2022.

Academic teaching 2017-2022

2018

1. 2 Lectures + 2 exercise sessions (8 hours total) at the Nanophotonics Master's course of Femius Koenderink. University of Amsterdam.
2. 90 min lecture at the Bachelor's course on condensed matter of Sanli Faez. Utrecht University.

2019

1. 2 Lectures + 2 exercise sessions (8 hours total) at the Nanophotonics Master's course of Femius Koenderink, University of Amsterdam
2. 90 min lecture at the Bachelor's course on condensed matter of Sanli Faez, Utrecht University

2020

1. Two Lectures and two exercise sessions (8 hours total) at the Nanophotonics Master course of Femius Koenderink at the University of Amsterdam (Netherlands)

Selected awards & recognitions 2017-2022

2019

1. KNAW Early Career Award.
2. Invited as examiner for the PhD thesis of Henry Fernandez Pizarro, supervised by Prof. William Barnes at the University of Exeter.

2020

1. KNAW Early Career Award

2022

1. G. Keijsers, Best student presentation, *Superfluid Light through dissipation*, European Optical Society Annual Meeting 2022, Porto, Portugal, 12-16/09/2022.

Valorization 2017-2022

1. In contact with Eric van Genuchten (Sensing360) about optical sensing (2022)
2. In contact with Aimi Abass (OSRAM) about optical sensing (2022)
3. In contact with Giampiero Gerini (TNO) about nonlinear reconfigurable metasurfaces (2022)
4. S.R.K. Rodriguez lead the winning team at *Physics with Industry 2022*, organized by NWO. This week-long event brought together several companies with a physics problem/case whose solution requires innovative thinking. The problems are addressed by a team of ~10 PhD students and postdocs, and the winner is decided by an jury of academic and industry experts (2022).
5. S.R.K. Rodriguez is in the program committee of the Dutch Photonics Event, which brings together industry and academic experts on various areas of photonics (2022 – present).