

Cover Page



Universiteit Leiden



The handle <http://hdl.handle.net/1887/58471> holds various files of this Leiden University dissertation.

Author: Buters, F.M.

Title: Where photons meet phonons

Issue Date: 2017-12-21

Acknowledgment

I would like to take this opportunity to thank some people without whose help this work was not possible. I would like to thank my promotor Dirk Bouwmeester for providing me with the freedom, confidence and possibilities during my PhD.

The last four years I was part of a research team with scientists from Leiden and the University of California, Santa Barbara. From the Leiden team, I would like to thank Sven de Man for his help and guidance with the experiments, but also with the non-scientific challenges. The majority of the experiments presented in this thesis have been performed together with Hedwig Eerkens. It was nice to have someone to share the good and the bad times with. Four years I shared a desk with Kier Heeck, whose positive attitude and vast knowledge of almost all things technical were vital for this project. I would also sincerely like to thank Harmen van der Meer of the Fine Mechanics department. Whatever he fabricated, large or small, it was always perfect. Finally, before I started in Leiden, Petro Sonin and Evan Jeffrey have done a lot of the ground work for this project. I am grateful to both.

Across the ocean, my colleagues in Santa Barbara designed and fabricated the trampoline resonators. Early devices were fabricated by Brian Pepper, while Matthew Weaver and Fernando Luna have fabricated the majority of the devices used in this thesis. Your visits to Leiden were always fun and inspiring. Good luck to both of you with finishing your PhD.

I had the pleasure to work with several students during my PhD. I would like to thank Myles Huang in particular, who has spend almost two years in our group. I would also like to thank the Quantum Optics group members for the nice and interesting discussions during the coffee break and lunch. A special thanks to Wolfgang Löffler. His willingness to always help out in the lab, with proofreading articles, with referee replies or with science in general, is invaluable. I would like to thank Henriëtte van Leeuwen for the administrative support.

Finally I would like to thank my parents and brother for their love and support during my PhD.

Curriculum vitae

Frank Buters was born on the 20th of October 1989 in Velsbroek. He graduated cum laude from the Gymnasium Felisenum high school in 2008 with a specialization in natural sciences and went to study physics at the Vrije Universiteit Amsterdam. Frank obtained his BSc cum laude. His final research project involved photocatalysis of NaTaO_3 crystals in the group of Rinke Wijngaarden. He went on to do an MSc at the Vrije Universiteit Amsterdam with a focus on experimental condensed matter physics. In 2012 he was elected to attend the Lindau Nobel meetings. He performed his final research project on the optical properties of SiGe nanocrystals in the group of Tom Gregorkiewicz at the University of Amsterdam and obtained his MSc cum laude in 2013. He then moved to Leiden to work on the optomechanics experiment in the group of Dirk Bouwmeester. As of September 2017 Frank is working as a consultant at RiskQuest in Amsterdam.

List of publications

1. **F.M. Buters**, K. Heeck, F. Luna, M.J. Weaver, H. Eerkens, S. de Man and D. Bouwmeester, *Vibration free platform for cavity optomechanics*, in preparation (Chapter 10 of this thesis)
2. M.J. Weaver, **F.M. Buters**, J. Luna, H. Eerkens, K. Heeck, S. de Man and D. Bouwmeester, *Coherent optomechanical state transfer between dissimilar mechanical modes*, accepted for publication in Nature Communications (Chapter 11 of this thesis)
3. **F.M. Buters**, F. Luna, M. Weaver, H.J. Eerkens, K. Heeck, S. de Man, and D. Bouwmeester, *Optomechanically induced transparency with a trampoline resonator*, Optics Express 25, 12935 (2017) (Chapter 4 of this thesis)
4. **F.M. Buters**, K. Heeck, H. Eerkens, M. J. Weaver, F. Luna, S. de Man, and D. Bouwmeester, *High-nested resonator in an actively stabilized optomechanical cavity*, Appl. Phys. Lett. 110, 104104 (2017) (Chapter 9 of this thesis)
5. **F.M. Buters**, M.J. Weaver, H.J. Eerkens, K. Heeck, S. de Man, and D. Bouwmeester, *Optomechanics with a polarization non-degenerate cavity*, Phys. Rev. A 94, 063813 (2016) (Chapter 6 of this thesis)
6. M.J. Weaver, B. Pepper, F. Luna, **F.M. Buters**, H.J. Eerkens, G. Welker, B. Percock, K. Heeck, S. de Man, and D. Bouwmeester, *Nested trampoline resonators for optomechanics*, Appl. Phys. Lett. 108, 033501 (2016)
7. **F.M. Buters**, H. J. Eerkens, K. Heeck, M.J. Weaver, B. Pepper, S. de Man, and D. Bouwmeester, *Experimental exploration of the optomechanical attractor diagram and its dynamics*, Phys. Rev. A 92, 013811 (2015) (Chapter 3 of this thesis)
8. H. J. Eerkens, **F.M. Buters**, M.J. Weaver, B. Pepper, G. Welker, K. Heeck, P. Sonin, S. de Man, and D. Bouwmeester, *Optical side-band cooling of a low fre-*

- quency optomechanical system*, Optics Express 23, 8014 (2015) (Chapter 5 of this thesis)
9. **F.M. Buters**, H. J. Eerkens, K. Heeck, M.J. Weaver, B. Pepper, P. Sonin, S. de Man, and D. Bouwmeester, *Large parametric amplification in an optomechanical system*, Physica Scripta T165, 014003 (2015) (Chapter 3 of this thesis)
 10. S. Saeed, **F.M. Buters**, K. Dohnalova, L. Wosinski, and T. Gregorkiewicz, *Structural and optical characterization of self-assembled Ge nanocrystal layers grown by plasma-enhanced chemical vapor deposition*, Nanotechnology 25, 405705 (2014)