

## Matthew H. Matheny

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CITIZENSHIP	United States of America	
EDUCATION	<b>California Institute of Technology</b> , Pasadena, California, USA  Ph.D., Physics, February 2012 <ul style="list-style-type: none"><li>• Thesis Title: <i>Nonisochronous Oscillations in Piezoelectric Nanomechanical Resonators</i></li><li>• Adviser: Professor Michael Roukes</li><li>• Area of Study: Nanomechanics, Nonlinear Dynamics, Noise</li></ul> <b>University of Kansas</b> , Lawrence, Kansas, USA  B.Sc. in Mathematics , B. Sc. in Physics, August 2005	
ACADEMIC APPOINTMENTS	<b>Research Scientist</b> California Institute of Technology, Department of Physics - <i>Roukes Group</i>	July 2015 to present
	<b>Staff Scientist</b> California Institute of Technology, Department of Applied Physics - <i>Painter Group</i>	August 2013 - May 2015
	<b>Postdoctoral Scholar</b> California Institute of Technology, Department of Physics - <i>Roukes Group</i>	March 2012 - July 2013
REFEREED JOURNAL PUBLICATIONS	Karabalin, R.B., <b>Matheny, M.H.</b> , Feng, X.L., Defay, E., Le Rhun, G., Marcoux, C., Hentz, S., Andreucci, P., & Roukes, M.L. (2009) Piezoelectric nanoelectromechanical resonators based on aluminum nitride thin films, <i>Applied Physics Letters</i> , <i>95</i> (10), 103111.  Feng, X. L., <b>Matheny, M. H.</b> , Zorman, C. A., Mehregany, M., & Roukes, M. L. (2010). Low voltage nanoelectromechanical switches based on silicon carbide nanowires. <i>Nano Letters</i> , <i>10</i> (8), 2891-2896.  Villanueva, L. G., Karabalin, R. B., <b>Matheny, M. H.</b> , Kenig, E., Cross, M. C., & Roukes, M. L. (2011). A nanoscale parametric feedback oscillator. <i>Nano Letters</i> , <i>11</i> (11), 5054-5059.  Karabalin, R. B., Lifshitz, R., Cross, M. C., <b>Matheny, M. H.</b> , Masmanidis, S. C., & Roukes, M. L. (2011). Signal amplification by sensitive control of bifurcation topology. <i>Physical Review Letters</i> , <i>106</i> (9), 094102.  Ivaldi, P., Abergel, J., <b>Matheny, M. H.</b> , Villanueva, L. G., Karabalin, R. B., Roukes, M. L., ... & Defay, E. (2011). 50 nm thick AlN film-based piezoelectric cantilevers for gravimetric detection. <i>Journal of Micromechanics and Microengineering</i> , <i>21</i> (8), 085023.  Karabalin, R. B., Villanueva, L. G., <b>Matheny, M. H.</b> , Sader, J. E., & Roukes, M. L. (2012). Stress-induced variations in the stiffness of micro-and nanocantilever beams. <i>Physical Review Letters</i> , <i>108</i> (23), 236101.	

Kenig, E., Cross, M. C., Lifshitz, R., Karabalin, R. B., Villanueva, L. G., **Matheny, M. H.**, & Roukes, M. L. (2012). Passive phase noise cancellation scheme. *Physical Review Letters*, 108(26), 264102.

Kenig, E., Cross, M. C., Villanueva, L. G., Karabalin, R. B., **Matheny, M. H.**, Lifshitz, R., & Roukes, M. L. (2012). Optimal operating points of oscillators using nonlinear resonators. *Physical Review E*, 86(5), 056207.

Villanueva, L. G., Karabalin, R. B., **Matheny, M. H.**, Chi, D., Sader, J. E., & Roukes, M. L. (2013). Nonlinearity in nanomechanical cantilevers. *Physical Review B*, 87(2), 024304.

**Matheny, M. H.**, Villanueva, L. G., Karabalin, R. B., Sader, J. E., & Roukes, M. L. (2013). Nonlinear mode-coupling in nanomechanical systems. *Nano Letters*, 13(4), 1622-1626.

Villanueva, L. G., Kenig, E., Karabalin, R. B., **Matheny, M. H.**, Lifshitz, R., Cross, M. C., & Roukes, M. L. (2013). Surpassing fundamental limits of oscillators using nonlinear resonators. *Physical Review Letters*, 110(17), 177208.

**Matheny, M. H.**, Grau, M., Villanueva, L. G., Karabalin, R. B., Cross, M. C., & Roukes, M. L. (2014). Phase synchronization of two anharmonic nanomechanical oscillators. *Physical Review Letters*, 112(1), 014101.

Fang, K., **Matheny, M. H.**, Luan, X., & Painter, O. (2016). Optical transduction and routing of microwave phonons in cavity-optomechanical circuits. *Nature Photonics*, 10(7), 489.

Fang, K., Luo, J., Metelmann, A., **Matheny, M. H.**, Marquardt, F., Clerk, A. A., & Painter, O. (2017). Generalized non-reciprocity in an optomechanical circuit via synthetic magnetism and reservoir engineering. *Nature Physics*, 13(5), 465.

Fon, W., **Matheny, M. H.**, Li, J., Krayzman, L., Cross, M. C., D'Souza, R. M., Crutchfield, J.P., & Roukes, M. L. (2017). Complex dynamical networks constructed with fully controllable nonlinear nanomechanical oscillators. *Nano Letters*, 17(10), 5977-5983.

**Matheny, M. H.** (2018). Enhanced photon-phonon coupling via dimerization in one-dimensional optomechanical crystals. *Applied Physics Letters*, 112(25), 253104.

ACCEPTED  
PUBLICATIONS

**Matheny, M. H.**, Emenheiser, J., Fon, W., Chapman, A., Rohden, M., Salova, A., Li, J. de Badyn, M. H., Duenas-Osorio, L., Mesbahi, M. Crutchfield, J. P., Cross, M. C., D'Souza, R. M. & Roukes, M. L. (2019). Exotic states in a simple network of nanoelectromechanical oscillators *Science*.

CONFERENCE  
PRESENTATIONS

**Matheny, M. H.**, Villanueva, L. G., Karabalin, R. B., Sader, J. E., & Roukes, M. L. (2011). *Poster: Control of Nonlinearity in a Doubly-Clamped Nanomechanical Beams. IEEE International Frequency Control Symposium (IFCS)* (No. EPFL-POSTER-187869).

**Matheny, M. H.**, Redford, J. G., & Painter, O. (2014). *Poster: Towards Single-Photon Strong Coupling in Optomechanical Crystal Cavities Gordon Research Conference: Mechanical Systems in the Quantum Regime*.

**Matheny, M. H.**, Fon, W., Katti, R. & Roukes, M. L. (2016). *Contributed talk: Bit Storage via Buckled Nanomechanical Systems. Information Engines at the Frontiers of Nanoscale Thermodynamics*.

**Matheny, M. H.**, Fon, W., Emenheiser, J., Chapman, A., Li, J., Ansari, A., Mesbahi, M. Crutchfield, J. P., Cross, M. C., D'Souza, R. M. & Roukes, M. L. (2017). *Invited talk: Synchronization of Nanomechanical Oscillators via Electronic Coupling. Fourteenth International Workshop on Nanomechanical Sensors.*

**Matheny, M. H.**, Saira, O.P., Fon, W., Li, J. & Roukes, M. L. (2017). *Contributed talk: Towards Energetic Measurements of Mesoscopic Heat Baths Coupled to Strongly Nonlinear Nanoelectromechanical Systems. Information Engines at the Frontiers of Nanoscale Thermodynamics.*

**Matheny, M. H.**, Fon, W., Cross, M. C., & Roukes, M. L. (2018). *Contributed talk: Perturbation of Synchronized States via *in situ* Control of Individual Nodes and Edges. APS March Meeting.*

**Matheny, M. H.**, Fon, W., & Roukes, M. L. (2018). *Contributed talk: Information Measures in a Ring of Synchronized Oscillators. Information Engines at the Frontiers of Nanoscale Thermodynamics.*

CONFERENCE  
PUBLICATIONS

Feng, X. L., **Matheny, M. H.**, Karabalin, R. B., Zorman, C. A., Mehregany, M., & Roukes, M. L. (2009, June). Silicon carbide (SiC) top-down nanowire electromechanical resonators. *In IEEE Solid-State Sensors, Actuators and Microsystems Conference, 2009. TRANSDUCERS 2009.* International (pp. 2246-2249).

PATENTS

Feng, X. L., Matheny, M. H., Karabalin, R. B., Roukes, M. L., US Patent **U.S. 8115344**, "Very low voltage, ultrafast nanoelectromechanical switches and resonant switches"

Villanueva, L. G., Karabalin, R. B., Matheny, M., Kenig, E., Cross, M. C., Roukes, M.L. U.S. Patent **8378758**, "Parametric feedback oscillators"

Kenig, E., Cross, M. C., Lifshitz, R., Karabalin, R., Villanueva, L. G., Matheny, M., Roukes, M. L. (2016). U.S. Patent **9252731** "Passive phase noise cancellation element."

Matheny, M., Roukes, M. L., Cross, M. C., Villanueva, L. G., Karabalin, R. (2017). U.S. Patent **9660654**. "Synchronization of nanomechanical oscillators"

TEACHING  
EXPERIENCE

- Lecture - Math 002,101: Algebra - *University of Kansas, Department of Mathematics*
- Laboratory - Physics 5,6,7: Junior Physics Laboratory - *California Institute of Technology, Department of Physics*

SERVICE

Referee for peer-review journals:

- Physical Review Letters
- Applied Physics Letters
- Nano Letters
- Nature Communications
- Science Advances