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Research Interests

- Alkali metals and noble gases for precision measurements, biomagnetism, and navigation
- Stochastic differential equations and machine learning
- Real-time linear fitting routines with non-linear corrections

Positions

- Consultant, SRI International, Princeton, NJ; Apr. 2020-Present
  - DARPA Program Support, Clearance: S

- Physicist, Twinleaf LLC, Princeton, NJ; Jan. 2018-Present
  - DARPA AMBIIENT (Atomic Magnetometer for Biological Imaging In Earth's Native Terrain): first demo of unshielded magnetoencephalography using atomic sensors
  - Research small, low-power atomic magnetometers, develop table-top particle physics experiments, and hyperpolarized noble gases in miniature cells
  - DARPA QUIVER
  - DARPA SAVaNT (Science of Atomic Vapors for New Technologies)

- Postdoctoral Research Associate, Associate Research Scholar, Lecturer, Dept. Guest, Department of Physics, Princeton University, Princeton, NJ; Apr. 2014 –Dec. 2019. PI: Mike Romalis
  - DARPA C-SCAN (Chip-Scale Combinatorial Atomic Navigator): noble-gas comagnetometry for a miniature NMR gyro, first to develop mm-sized ^{3}He-^{129}Xe-^{87}Rb cells with long noble gas coherence times
  - Long-term fundamental efforts include spin-gravity searches under an NSF grant, first to detect *J*-coupling between noble gas nuclei
  - Lecturer for general physics using Investigative Science Learning Environment (ISLE)

- Teaching + Research Assistant, Ph.D. Student, and Postdoctoral Research Associate, Department of Physics and Astronomy, University of Utah, Salt Lake City, UT; 2005-2007, 2009-2014. Project PIs: Brian Saam, Christoph Boehme, Mikhail Raikh, J. Lupton
  - Researched gaseous, liquid, and solid noble-gas spin relaxation mechanisms
  - Studied organic semiconductors for spintronic devices
  - Mentored undergraduates and high-school students
  - TA and course marshal, maintained WebAssign/BlackBoard for entry-level courses

- Adjunct Professor, Life and Natural Sciences Department, Owens Community College, Toledo, OH; 2009
  - General astronomy class, calculus-based applied physics class

- Teaching Assistant and Ph.D. Student, Department of Mathematics and Statistics, Bowling Green State University, Bowling Green, OH; 2007-2009
  - Teaching assistant for business calculus classes
  - Runge-Kutta smoothing techniques

- Electrical Apprentice, L & B Electric, Grand Rapids, OH; 2006-2009
  - Assist the design and implementation of Rockwell Automation and other control systems

Education

- Ph.D., M.Sc., Physics – The University of Utah, 2005-2007;2009-2013, Salt Lake City, UT USA Dissertation Title: *^{129}Xe Relaxation and Rabi Oscillations*. Adviser: Brian Saam

- Ph.D. Program, Applied Mathematics – Bowling Green State University, 2007-2009, Bowling Green, OH USA. Adviser: Tong Sun (Masters All but thesis)

- B.Sc., Mathematics, Physics – Bowling Green State University, 2002-2005**,** Bowling Green, OH USA. Honors Title: *The Multi-Fractal Nature of Dynamical Systems*. Adviser: Haowen Xi

Publications

1. T. Wang, W. Lee, M. V. Romalis, M. E. Limes, E. L. Foley, T. W. Kornack, *Pulsed ^{87}Rb vector magnetometer using a fast rotating field. In preparation*

2. M. E. Limes, N. Dural , M. V. Romalis, E. L. Foley, T. W. Kornack, A. Nelson, L. R. Grisham, *Long spin-1/2 coherence times in mm-sized anodically bonded ^{3}He-^{129}Xe-^{87}Rb cells. In preparation*

3. V. G. Lucivero, W. Lee, T. W. Kornack, M. E. Limes, E. L. Foley, M. V. Romalis, *Femtotesla nearly quantum-noise-limited gradiometer at Earth-scale fields.* Phys. Rev. Applied *Letter* **18**, L021001 (2022)

4. W. Lee, V. G. Lucivero , M. V. Romalis, M. E. Limes, E. L. Foley, T. W. Kornack, *Heading errors in an all-optical pulsed-pump ^{87}Rb magnetometer in geomagnetic fields.* Phys. Rev. A **103**, 063103 (2021) *Editors' Suggestion*

5. A. Jaufenthaler , T. Kornack, V. Lebedev, M. E. Limes, R. Korber, M. Liebl, D. Baumgarten, *Pulsed optically pumped magnetometers: Addressing dead time and bandwidth for unshielded magnetorelaxometry of magnetic nanoparticles.* Sensors **21**(4), 1212 (2021)

6. M. E. Limes, E. L. Foley, T. W. Kornack, S. Caliga, S. McBride, A. Braun, W. Lee, V. G. Lucivero, M. V. Romalis, *Portable magnetometry for detection of biomagnetism in ambient environments.* Phys. Rev. Applied *Letter* **14**, 011002 (2020) *Editors' Suggestion Portable Sensor Detects Biomagnetic Signals in Noisy Outdoor Environments* by Ian Randall, Physics World

7. M. E. Limes, N. Dural, M. V. Romalis, E. L. Foley, T. W. Kornack, A. Nelson, L. R. Grisham, J. Vaara, *Dipolar and scalar ^{3}He-^{129}Xe frequency shifts in stemless cells*. Phys. Rev. A **100**, 010501 (R) (2019)

8. M. E. Limes, D. Sheng, and M. V. Romalis, *^{3}He-^{129}Xe comagnetometry with ^{87}Rb detection and decoupling*, Phys. Rev. Lett. **120**, 033401 (2018). *Editors' Suggestion, Featured in Physics, Viewpoint*: https://physics.aps.org/articles/v11/5

9. M. E. Limes, Z. L. Ma, E. G. Sorte, and B. Saam, *Robust solid ^{129}Xe longitudinal relaxation times*, Phys. Rev. B **94**, 094309 (2016).

10. D. P. Waters, G. Joshi, M. Kavand, M. E. Limes, H. Malissa, P. L. Burn, J. M. Lupton, and C. Boehme, *The spin-Dicke effect in OLED magnetoresistance*, Nature Physics **11**, 910-914 (2015).

11. K. J. van Schooten, D. L. Baird, M. E. Limes, J. M. Lupton, and C. Boehme, *Probing carrier-pair spin-spin interactions in a conjugated polymer by detuning of electrically detected spin-beating*, Nature Communications **6**, 6688 (2015).

12. E. F. Thenell, M. E. Limes, E. G. Sorte, Z. V. Vardeny, and B. Saam, *Nuclear relaxation measurements in organic semiconducting polymers for application to organic spintronics*, Phys. Rev. B **91**, 045205 (2015).

13. M. E. Limes, J. Wang, W. J. Baker, S.-Y. Lee, B. Saam, and C. Boehme, *Numerical study of spin-dependent transition rates within pairs of dipolar and exchange coupled spins with s=1/2 during magnetic resonant excitation*, Phys. Rev. B **87**, 165204 (2013).

14. R. Glenn, M. E. Limes, B. Saam, C. Boehme, and M. E. Raikh, *Analytical study of spin-dependent transition rates within pairs of dipolar and strongly exchange coupled spins with s=1/2 during magnetic resonant excitation*, Phys. Rev. B. **87**, 165205 (2013).

15. R. Glenn, M. E. Limes, B. Pankovich, B. Saam, and M. E. Raikh, *Magnetic resonance in slowly modulated longitudinal field: Modified shape of the Rabi oscillations*, Phys. Rev. B. **87**, 155128 (2013).

16. L. P. Fulcher, R. C. Scherer, A. Melnykov, V. Gateva, and M. E. Limes, *Negative Coulomb damping, limit cycles, and self-oscillation of the vocal folds*, Am. J. Phys. **74**, 386 (2006).

Selected Presentations

- M. E. Limes, E. L. Foley, T. W. Kornack, S. Caliga, S. McBride, A. Braun, W. Lee, V. G. Lucivero, M. V. Romalis, *A portable ^{87}Rb gradiometer operating in Earth's field*, Contributed Talk
  2020 APS DAMOP Meeting, 05/2020, Portland, OR (Online)

- A. Braun, S. McBride, S. Caliga, T. Kornack, E. Foley, M. E. Limes, V. G. Lucivero, W. Lee, M. V. Romalis, *Pulsed Intrinsic Gradiometer for Magnetometry in Earth's Native Terrain (PIGMENT)*
  2019 DARPA AMBIIENT Meeting, 01/2019, Anaheim, CA

- M. E. Limes, N. Dural, M. V. Romalis, E. L. Foley, T. W. Kornack, A. Nelson, L. R. Grisham *Dipolar and scalar ^{3}He and ^{129}Xe frequency shifts in mm-sized cells*, Contributed Talk
  2018 APS DAMOP meeting, 05/2018, Ft. Lauderdale, FL

- M. E. Limes, M. V. Romalis, *^{3}He-^{129}Xe Comagnetometery with ^{87}Rb Pulse-train Detection & Decoupling*, Contributed Talk
  2017 APS DAMOP meeting, 06/2017, Sacramento, CA

- M. E. Limes, *Optical Detection of a Nuclear-spin Gyro*, Colloquium
  Miami University, 02/2017, Oxford, OH

- M. E. Limes, D. Sheng, M. V. Romalis, *A ^{3}He-^{129}Xe co-magnetometer with ^{87}Rb magnetometry*, 2016 APS DAMOP meeting, 05/2016, Providence, RI

- M. E. Limes, D. Sheng, M. V. Romalis, *Progress on a ^{3}He-^{129}Xe co-magnetometer*, 2015 APS DAMOP meeting, 06/2015, Columbus, OH

- M. E. Limes, *^{129}Xe Relaxation and Rabi Oscillations*
  Pines Lab Seminar, 12/2013, UC Berkeley, CA

- M. E. Limes, J. Wang, W. J. Baker, S.-Y. Lee, B. Saam, and C. Boehme, *Numerical study of spin-dependent transition rates within pairs of dipolar and exchange coupled spins with s=1/2 during magnetic resonant excitation*, Contributed Talk
  2013 APS March Meeting, 03/2013, Baltimore, MD

- M. E. Limes, Z. L. Ma, and B. Saam, *Altered states of solid xenon*, Poster
  2012 DAMOP Meeting, 05/2012, Orange County, CA

- M. E. Limes and B. Saam, *Relaxation of low-field gas-phase ^{129}Xe*, Contributed Talk
  2010 APS/Four Corners Meeting, 10/2010, Ogden, UT

Honors/Academic Service

- James Robert and Gretchen Overman Undergraduate Physics Scholarship, 2004
- Phi Beta Kappa Society, Xi of Ohio, 2005
- Kappa Mu Epsilon National Mathematics Honors Society, Ohio Alpha, 2005
- Physics Graduate Student Advisory Council President, 2010
- J. Irvin and Norma K. Swigart Outstanding Graduate Student, 2013

- Referee: *Physical Review B, IEEE Photonics Technology Letters, Journal of Magnetic Resonance, IEEE Sensors, Physical Review Letters, Physical Review Applied, Physical Review A, Optics Express, Chinese Optics Letters, IEEE Transactions on Instrumentation and Measurement*