

# JEFFREY R. GUEST

Scientist, Experimental Physicist

Quantum and Energy Materials Group

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## Education

Ph.D. Applied Physics, University of Michigan

M.S. Applied Physics, University of Michigan

B.S.E. Mechanical Engineering / Engineering Physics, Princeton University

## Research interests

- Development of low temperature ultrahigh vacuum (UHV) scanning tunneling and atomic force microscopes (STMs/AFMs) combined with single 'particle' laser spectroscopy to correlate optical properties and photophysical processes with atomic scale structure
- Optical, photophysical, and quantum coherence properties of nanoscale structures, molecular self-assemblies, 2D materials and semiconductor defects (in addition to structural, electronic, and magnetic properties)
- Nanomechanical dynamics of self-assembled structures, nanofabricated systems, and individual nanoparticles; development of experimental techniques to measure and control nanomechanical motion

## Professional Experience

Argonne National Laboratory - Center for Nanoscale Materials (CNM)

Scientist

*2013-present*

Assistant Scientist

*2007-2013*

Argonne National Laboratory – Physics Division

*2004-2007*

Arthur Holly Compton Fellow

- Developed and demonstrated the first laser-cooling and laser-trap of radium (radium-225 and 226)
- Measured transition energies, lifetimes, hyperfine splittings, and isotope shifts in the radium atom
- Developed a next generation test for time-reversal asymmetry (or electric dipole moment (EDM) search) around laser-trapped radium-225 atoms

University of Michigan, Physics Department, Ann Arbor, MI

*2000-2004*

Postdoctoral Researcher

- Developed a superconducting atom and plasma laser trap for cold Rydberg atom gas and plasma studies at high magnetic fields (3-6 Tesla)
- Observed quantum chaos in laser-cooled strongly-magnetized Rydberg atoms; magnetically trapped Rydberg atoms; measured magnetic tunneling resonances and coherences in optical lattices
- Demonstrated coherent optical excitation of Rydberg states for quantum information processing

University of Michigan, Physics Department, Ann Arbor, MI

*1994-2000*

Research Assistant

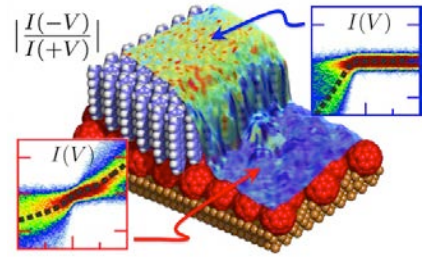
- Designed, built and demonstrated a scanning probe near-field optical microscope for linear and nonlinear optical spectroscopy of single quantum dots at low temperature (4K)
- Mapped local optical density of states of single quantum dots and the spatial wavefunction of a single quantum dot exciton
- Measured absorption and studied decoherence of excitons confined by a single quantum dot

## Selected Publications

Selected from 50+ publications:

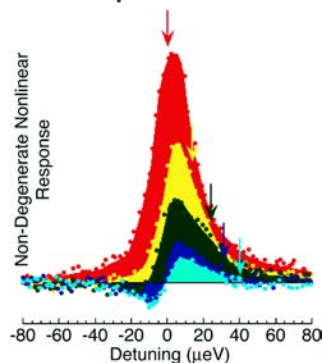
### Ultrahigh vacuum scanning tunneling microscopy/spectroscopy of 2D materials, molecular heterojunctions

1. J. A. Smerdon, P. Darancet, **J. R. Guest**, "Spatially-resolved, substrate-induced rectification in C<sub>60</sub> bilayers on copper," *J. Chem. Phys.* 164, 092328 (2017).
2. J. A. Smerdon, N. C. Giebink, N. P. Guisinger, P. Darancet, **J. R. Guest**, "Large spatially-resolved rectification in a donor-acceptor molecular heterojunction," *Nano Letters* 16, 2603 (2016).
2. L. Gao, P. P. Pal, T. Seideman, N. P. Guisinger, **J. R. Guest**, "Current-driven hydrogen desorption from graphene: experiment and theory," *J. Phys. Chem. Lett.* 7, 486 (2016).
3. A. J. Mannix, X.-F. Zhou, B. Kiraly, J. D. Wood, D. Alducin, B. Myers, X. Liu, B. L. Fisher, **J. R. Guest**, M. J. Yacaman, A. Ponce-Pedraza, A. R. Oganov, M. C. Hersam, N. P. Guisinger, "Synthesis of Borophene: An Anisotropic, Two-Dimensional Boron Allotrope," *Science* 350, 1513 (2015).
4. J. A. Smerdon, R. B. Rankin, J. P. Greeley, N. P. Guisinger, **J. R. Guest**, "Chiral 'pinwheel' heterojunctions self-assembled from C<sub>60</sub> and pentacene," *ACS Nano* 7, 3086 (2013).
5. J.-W. Cho, L. Gao, Ö. Süzer, **J. R. Guest**, and N. P. Guisinger, "Structural and Electronic Decoupling of C<sub>60</sub> from Epitaxial Graphene on SiC," *Nano Letters* 12, 3018 (2012).
6. A. E. DePrince III, M. Pelton, **J. R. Guest**, S. K. Gray, "Emergence of excited-state plasmon modes in linear hydrogen chains from time-dependent quantum mechanical methods," *Phys. Rev. Lett.* 107, 196806 (2011).
7. J. A. Smerdon, M. Bode, N. P. Guisinger, **J. R. Guest**, "Monolayer and bilayer pentacene on Cu(111)," *Phys. Rev. B* 84, 165436 (2011).
8. J.-W. Cho, L. Gao, J. Tian, H. Cao, Q. Yu, E. Yitamben, B. Fisher, **J. R. Guest**, Y. P. Chen, N. P. Guisinger, "Atomic-scale investigation of graphene grown on Cu foil and the effects of thermal annealing," *ACS Nano* 5, 3607 (2011).
9. L. Gao, **J. R. Guest**, N. P. Guisinger, "Graphene on Cu(111)," *Nano Letters* 10, 3512 (2010).
10. P. Sessi, **J. R. Guest**, M. Bode, N. P. Guisinger, "Patterning graphene at the nanometer scale via hydrogen desorption," *Nano Letters* 9, 4343 (2009).
11. P. Sessi, N. P. Guisinger, **J. R. Guest**, M. Bode, "Temperature and size dependence of anti-ferromagnetism in Mn nanostructures," *Phys. Rev. Lett.* 103, 167201 (2009).
12. N. P. Guisinger, T. S. Santos, **J. R. Guest**, A. Bhattacharya, J. W. Freeland, M. Bode, "Nanometer-scale striped surface terminations on fractured SrTiO<sub>3</sub> surfaces," *ACS Nano* 3, 4132 (2009).



### Low temperature near-field laser spectroscopy and microscopy of single quantum dots

13. **J. R. Guest**, T. H. Stievater, X. Li, J. Cheng, D. G. Steel, D. Gammon, D. S. Katzer, D. Park, C. Ell, A. Thranhardt, G. Khitrova, H. M. Gibbs, "Measurement of optical absorption by a single quantum dot exciton," *Phys. Rev. B* 65, 241310R (2002).
14. T. H. Stievater, X. Li, **J. R. Guest**, D. G. Steel, D. Gammon, D. S. Katzer, D. Park, "Wavelength modulation spectroscopy of single quantum dots," *Appl. Phys. Lett.* 80, 1876 (2002).
15. **J. R. Guest**, T. H. Stievater, G. Chen, E. A. Tabak, B. G. Orr, D. G. Steel, D. Gammon, D. S. Katzer, "Near-field coherent spectroscopy and microscopy of a quantum dot system," *Science* 293, 2224 (2001).



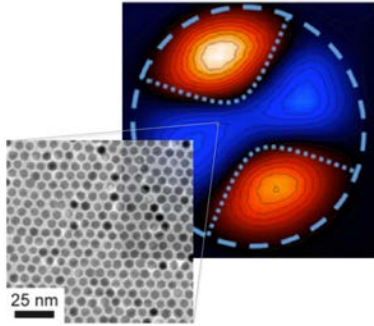
### Ultrahigh vacuum atomic force microscopy

16. Q. Chen, **J. R. Guest**, E. Thimsen, "Visualizing current flow at the mesoscale in assemblies of touching semiconductor nanocrystals," *J. Phys. Chem. C* 121, 15619 (2017).
17. W. Wu, Y. Horibe, N. Lee, S.-W. Cheong, **J. R. Guest**, "Conduction of topologically-protected charged ferroelectric domain walls," *Phys. Rev. Lett.* 108, 077203 (2012).

# JEFFREY R. GUEST

18. W. Wu, **J. R. Guest**, Y. Horibe, S. Park, T. Choi, S. B. Kim, S.-W. Cheong, M. Bode, "Polarization-modulated rectification at ferroelectric surfaces," *Phys. Rev. Lett.* 104, 217601 (2010).

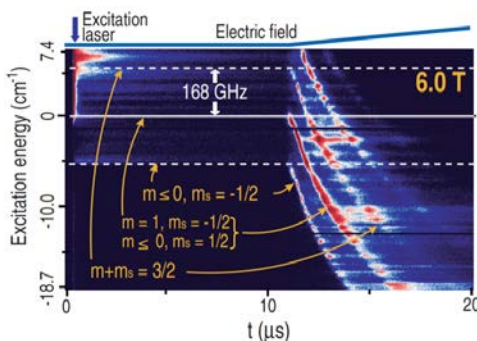
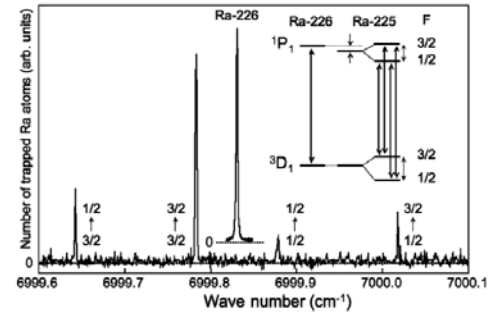
## Nanomechanics



19. A. Ahmed, M. Pelton, **J. R. Guest**, "Understanding how acoustic vibrations modulate the optical response of plasmonic metal nanoparticles," *ACS Nano* 11, 9360 (2017).
20. C. Chen, D. H. Zanette, **J. R. Guest**, D. A. Czaplewski, D. Lopez, "Self-sustained micromechanical oscillator with linear feedback," *Phys. Rev. Lett.*, 117, 017203 (2016).
21. D. Antonio, D. A. Czaplewski, **J. R. Guest**, D. Lopez, S. I. Arroyo, D. H. Zanette, "Nonlinearity-induced synchronization enhancement in micromechanical oscillators," *Phys. Rev. Lett.* 114, 034103 (2015).
22. P. Kanjanaboos, X.-M. Lin, J. E. Sader, S. M. Rupich, H. M. Jaeger, **J. R. Guest**, "Self-assembled nanoparticle drumhead resonators," *Nano Letters* 13, 2158 (2013).

## Atomic physics: laser-cooling radioactive isotopes, precision measurement, Rydberg atom spectroscopy

23. **J. R. Guest**, N. D. Scielzo, I. Ahmad, K. Bailey, J. P. Greene, R. J. Holt, Z.-T. Lu, T. P. O'Connor, D. H. Potterveld, "Laser trapping of  $^{225}\text{Ra}$  and  $^{226}\text{Ra}$  with repumping by room-temperature blackbody radiation," *Phys. Rev. Lett.* 98, 093001 (2007).
24. N. D. Scielzo, **J. R. Guest**, E. C. Schulte, I. Ahmad, K. Bailey, D. L. Bowers, R. J. Holt, Z.-T. Lu, T. P. O'Connor, D. H. Potterveld, "Measurements of the lifetime of the lowest  $^3P_1$  state in neutral Ba and Ra," *Phys. Rev. A* 73, 010501(R) (2006).
25. J.-H Choi, **J. R. Guest**, E. Hansis, A. P. Povilus, G. Raithel, "Landau quantization in the ionization of cold, magnetized Rydberg atoms" *Phys. Rev. Lett.* 95, 253005 (2005).
26. J.-H Choi, **J. R. Guest**, E. Hansis, A. P. Povilus, G. Raithel, "Magnetic trapping of long-lived Rydberg atoms," *Phys. Rev. Lett.* 95, 243001 (2005).
27. T. Cubel, B. K. Teo, V. Malinovsky, **J. R. Guest**, A. W. Reinhard, B. Knuffman, P. R. Berman, G. Raithel, "Coherent population transfer of ground state atoms into Rydberg states," *Phys. Rev. A* 72, 023405 (2005).
28. **J. R. Guest**, J.-H Choi, E. Hansis, A. P. Povilus, G. Raithel, "Laser cooling and magnetic trapping at several Tesla," *Phys. Rev. Lett.* 94, 073003 (2005).
29. B. K. Teo, D. Feldbaum, T. Cubel, **J. R. Guest**, P. R. Berman, G. Raithel, "Autler-Townes spectroscopy of the  $5S_{1/2} - 5P_{3/2} - 4D$  cascade of cold  $^{85}\text{Rb}$  atoms," *Phys. Rev. A* 68, 053407 (2003).
30. **J. R. Guest**, G. Raithel, "High- $|m|$  Rydberg states in strong magnetic fields," *Phys. Rev. A* 68, 052502 (2003).
31. **J. R. Guest**, J.-H. Choi, G. Raithel, "Decay rates of high- $|m|$  Rydberg states in strong magnetic fields," *Phys. Rev. A* 68, 022509 (2003).



32. **J. R. Guest**, B. K. Teo, N. V. Morrow, G. Raithel, "Magnetic behavior of atoms in gray optical lattices," *J. Opt. Soc. Am. B* 20, 942 (2003).
33. B. K. Teo, **J. R. Guest**, G. Raithel, "Tunneling resonances and coherence in an optical lattice," *Phys. Rev. Lett.* 88, 173001 (2002).
34. S. K. Dutta, **J. R. Guest**, D. Feldbaum, A. Walz-Flannigan, G. Raithel, "Ponderomotive optical lattice for Rydberg atoms," *Phys. Rev. Lett.* 85, 5551 (2000).