

Berea College
Physics Program
CPO 2191
Berea, KY 40404

t: 859.985.3326
c: 318.828.5487
e: troy_messina@bereda.edu
physics.bereda.edu/messinat.php

EDUCATION

University of Texas at Austin, Ph.D., Condensed Matter Physics, December 2002
University of Texas at Austin, M.A., Condensed Matter Physics, December 1999
University of Texas at Austin, B.S., Physics, May 1996

EXPERIENCE

Associate Professor of Physics

August 2014 – present

Berea College

Berea, KY

I am an associate professor at a liberal arts college dedicated to educating students of high academic promise and low financial means, with a special dedication to students from the Appalachian region. The Berea experience nurtures intellectual, physical, aesthetic, emotional, and spiritual potentials and with those the power to make meaningful commitments and translate them into action. I mentor undergraduate research projects in protein dynamics, materials science, and engineering technology. For more details see <http://physics.bereda.edu>.

Associate Professor of Physics and Biophysics

Gus S. Wortham Chair of Engineering

August 2007 – August 2014

Centenary College of Louisiana

Shreveport, LA

I earned tenure and promotion to associate professor, was department chair, and chair of the 3-2 engineering program at a liberal arts college in Shreveport, LA. The college maintains a high level of research involving undergraduates in addition to traditional liberal arts education, with a student to teacher ratio of twelve across the college. Our department develops pedagogical techniques, e.g., inquiry-, experience- and service-based learning. Centenary College also has the first biophysics degree program introduced at an undergraduate or liberal arts institution. I oversaw undergraduate research projects in protein dynamics related to structure, function, and folding. For more details see <http://www.centenary.edu/physics/tmessina>.

NIH NRSA Post-Doctoral Research Fellow

September 2003 – August 2007

Rutgers, the State University of New Jersey

Piscataway, NJ

My primary interest was to understand how the diversity of conformation and structure in complex molecules and materials contribute to and modify their function. Single molecule spectroscopy, and specifically, time-correlated single photon counting (TCSPC) with femto- and picosecond pulsed lasers allow me to observe these molecules as they thermally fluctuate through their conformational states. Both bulk and single molecule fluorescence, rotational anisotropy, and Stokes shift provide detail about molecular motions due to solvation, ligand-binding, and protein folding/fluctuations. These experiments make use of thoughtful fluorescent labeling schemes and micro- and nanofluidics for confinement of molecules to the microscope confocal volume without hindering natural behavior. I have made the first implementation of hidden Markov model (HMM) analysis on photon streams to maximize use of the information provided. Computational molecular dynamics served to model experiments. See <http://talaga.name>.

Post-Doctoral Research Associate

February 2003 – September 2003

Princeton University

Princeton, NJ

I developed electronic sensing techniques for biological discrimination without the need for chemical or physical sample alteration. Microfluidic tectonics was used to create novel parallel-plate devices for dielectric spectroscopy of biological materials (e.g., DNA, proteins, and E. coli cells) over the range 0.05-40 GHz. Other research was aimed at multi-analyte detection for binding assays of molecular and cellular biological materials using the Coulter resistive pulse technique. See <http://www.me.berkeley.edu/srl/>.

Graduate Research Assistant

January 1997 – January 2003

The University of Texas at Austin

Austin, TX

Yttrium and lanthanum were discovered in 1996 to transition from a metallic mirror to a transparent insulator upon hydrogenation to the trihydride phase (YH₃ and LaH₃). I have looked into steric effects upon this transition by substituting isoelectronic scandium for yttrium. Scandium maximally forms dihydride (ScH₂), and therefore, does not

exhibit this transition. My experience includes ultra-high vacuum (UHV), electron beam, thermal, and sputtering film deposition, optical spectroscopy, SQUID magnetometry, electronic transport measurements, NMR, AFM, SEM, x-ray diffraction, iodometric titration, solid-state reaction, and thermal gravimetric analysis (TGA). A pdf of my dissertation, “Steric Effects in the Metallic-Mirror to Transparent Insulator Transition of YH_x ” can be downloaded at <http://www.themessinas.net/dissertation.pdf>.

Semiconductor Industry Intern

June 1997 – April 2002

I conducted research as an intern for the International 300mm Initiative (I300I) and International Sematech (ISMT) in parallel with my dissertation studies. These companies are consortia from the semiconductor industry to eliminate cost-bearing and technological obstacles within the industry. Research included analysis of production capability of 300 mm silicon wafers and metrology tools as compared to state-of-the-art 200 mm technology, developing mathematical models for the International Technology Roadmap for Semiconductors (ITRS) Starting Materials division, and thermal stability and wet etch capability of high- κ dielectric materials (ZrO_2 and HfO_2) to replace SiO_x . Wet etch studies enabled ISMT to file for a patent on the film removal process. The techniques used include FTIR, ellipsometry, ion implantation, and surface particle and flatness scanners. See <http://www.semtech.org>.

Contract Engineer

July 2000 – December 2001

Designed, constructed, and used a chemical vapor deposition (CVD) system for growth of carbon nanotubes (CNTs). CNTs were grown using a precursor catalyst method, and analyzed with scanning electron microscopy (SEM). Growth conditions were tailored to obtain single, straight CNT on an ultrasensitive crystal silicon cantilever for scanning force microscopy. See <http://www.xidex.com>.

International Sematech/I300I

Austin, TX

Xidex Corporation

Austin, TX

TEACHING

- *All undergraduate physics courses*, Berea College, 2014–present
- *Intro. Physics, Modern Physics, Thermal Physics, Biophysics, Physics Research*, Centenary College, 2007–2014
- *Experience-Based Education Mentor*, Rutgers University 2004–06
- *Research In Science and Engineering (R.I.S.E.) Mentor*, Rutgers University 2005
- *Physics I & II Laboratory, Physics for Poets, Pseudoscience*, University of Texas, 1997–2001
- *Mathematics Grader, Calculus I – II*, University of Texas, 1995–96

HONORS/AWARDS/POSITIONS

- Sustainability Committee, Berea College, 2015-present
- Pacesetter Award for outstanding teaching voted by the student body, Centenary College, 2013
- Physics Department Chair, 2013–2014
- Faculty Personnel Council, 2013–2014
- Trek Committee: oversee requirements for Career, Culture and Community, 2011–2013
- Nicaragua Module: Annual intercultural trip to Nicaragua with students study tropical biology and develop energy solutions for a rural farm, 2011–present
- Faculty Development Committee Chair, 2008–2011
- Gus S. Wortham Chair of Engineering, 2008–present
- Zeta Tau Alpha Sorority’s Professor of the Month, February 2008
- Broyle’s Inaugural Year Research Chair, 2007–08
- NIH Ruth L. Kirschstein NRSA Post-Doctoral Fellowship, 2004–07
- Rutgers Molecular Biophysics Minisymposium Poster Prize, 2007
- Rutgers Molecular Biophysics Minisymposium Poster Prize, 2006
- Best Student Paper Award, SPIE 2001: MEMS Components and Applications to Industry, 2001

FUNDING

- Jonathan F. Reichert, ALPhA Immersion Support Grant, “Single Photon Quantum Optics,” \$5075, 2015–16.
- Kentucky Academy of Science, “Building a Low-Cost Atomic Force Microscope for Use in Undergraduate Physics Labs and Research at Berea College,” \$500, 2015.

- NASA Kentucky Space Grant Consortium, “Redesign of Berea College’s Advanced Physics Laboratory for Improved Skill Building,” \$3000, 2015.
- Louisiana Board of Regents, “Making Computer Science Tangible Through Physical and Mobile Devices,” \$21,918, 2012.
- Northwest Louisiana Master Gardeners, “Centenary College Community Gardens,” \$3200, Fall 2011.
- Louisiana Board of Regents, “Centenary College LabVIEW Electronics and Instrumentation Design Curricular Enhancement,” \$19,308, 2009

SKILLS

- *Biology* Molecular Cloning, PCR, Fluorescent Labeling, FPLC, HPLC, Gel Electrophoresis
- *Programming Languages*: C, C++, Python, R, Igor Pro, IDL, Basic, HTML, CSS
- *Tools*: Ultra-High Vacuum, Thin Film Deposition (sputtering, e-beam, thermal, CVD), AFM, SEM, Ellipsometry, SQUID Magnetometry, Time-Correlated Single Photon Counting (TCSPC), Confocal Microscopy, FTIR, Electronic Transport
- *Operating Systems*: MacOS X, Linux, Windows
- *Software*: Plug-ins and scripting for Igor Pro, NAMD, IMPACT, Arduino

EXTRAMURAL

- Semi-professional Drummer, 1991 – present
- Triathlons, Running, Swimming, Cycling, 1994 – present
- Organic Gardening, 1997 – present
- Centenary College Community Garden leader, 2010 – 2014

PUBLICATIONS

1. T. C. Messina, “*in-silico* methods of mutagenesis analysis,” *In Vitro Mutagenesis: Methods and Protocols*, Springer Publishing, Ed. Andrew Reeves, pp. 199–226 (2017).
2. B. Spitznagel, P. Pritchett, T. C. Messina, M. Goadrich, and J. Rodriguez, “An undergraduate laboratory activity on molecular dynamics simulations,” *Biochemistry and Molecular Biology Education* **44**, 130-139 (2016).
3. G. Q. Butcher, J. Rodriguez, S. Chirhart, and T. C. Messina, “Modeling Diffusion Using Coin Flips to Predict the Outcome of an Experimental Activity,” *BioScene* **42**, 3-7 (2016).
4. H. Chiang, L. C. Robinson, C. J. Brame, and T. C. Messina, “Molecular Mechanics and Dynamics Characterization of an *In Silico* Mutated Protein: A Stand-Alone Lab Module or Support Activity for *In Vivo* and *In Vitro* Analyses of Targeted Proteins,” *Biochemistry and Molecular Biology Education* **41**, 402-8 (2013).
5. A. Otto, G. Q. Butcher, and T. C. Messina, “Design plans for an inexpensive tail flick analgesia meter,” *Journal of Undergraduate Neuroscience Education* **10**, A80-A84 (2011).
6. C. W. Miller, M. D. Chabot, and T. C. Messina, “A Student’s Guide to Searching the Literature Using Online Databases,” *Am. J. Phys.* **77** (2009).
7. T. C. Messina and D. S. Talaga, “Protein free energy landscapes remodeled by ligand binding,” *Biophys. J.* **93**, 579-585 (2007).
8. T. C. Messina, C. W. Miller, and J. T. Markert, “Steric quenching of the switchable mirror effect,” *Phys. Rev. B* **75**, 104109 (2007).
9. T. C. Messina, H. Kim, J. T. Giurleo, and D. S. Talaga, “Hidden Markov Model Analysis of Multichromophore Photobleaching,” *J. Phys. Chem. B* **110**, 16366-16376 (2006).
10. J.-H. Choi, T. C. Messina, J. Yan, G. I. Drandova, and J. T. Markert, “Thermal Conductivity and ^{89}Y NMR of $\text{Ca}_{2+x}\text{Y}_{2-x}\text{Cu}_5\text{O}_{10}$,” *J. of Magn. Mag. Mat.* **272**, 970-971 (2004).
11. T. C. Messina, L. N. Dunkleberger, G. A. Mensing, A. S. Kalmbach, R. Weiss, D. Beebe, and L. L. Sohn, “A Novel High-Frequency Sensor for Biological Discrimination,” in the International Conference on Miniaturized Chemical and Biochemical Analysis Systems 2003, Kluwer Academic Publishers (2003).

12. C. W. Miller, U. Mirsaidov, T. C. Messina, J. T. Markert, "External Field Effects on Characteristics of Magnetically-Capped Oscillators for Magnetic Resonance Force Microscopy," *J. App. Phy.* **93**, 6572 (2003).
13. T. C. Messina, C. W. Miller, J. T. Markert, "Steric Effects in the Metal-Insulator (Mirror-Transparent) Transition in YHx," *J. Alloys and Compounds* **356-357**, 181 (2003).
14. J. T. Markert, T. C. Messina, B. Dam, J. Huijbregste, J. H. Rector, and R. Griessen, "Infinite-Layer Copper-Oxide Laser-Ablated Thin Films: Substrate, Buffer-Layer, and Processing Effects," *IEEE Transactions on Applied Superconductivity*, **13**, 2684 (2003).
15. G. I. Drandova, T. C. Messina, J. T. Markert, "NMR of ^{89}Y in the Copper-Oxide Spin-Chain Compound $\text{Ca}_{2+x}\text{Y}_{2-x}\text{Cu}_5\text{O}_{10}$," *J. Low Temperature Physics* **131**, 305 (2003).
16. K. Mochizuki, J.-H. Choi, T. C. Messina, Y. Ando, K. Nakamura, J. T. Markert, "Extreme Smallness of the Transverse Force on Moving Vortices," *Physica C* **388-389**, 705 (2003).
17. J. Barnett, D. Riley, T. Messina, P. Lysaght, "Wet Etch Enhancement of HfO_2 Films by Implant Processing," *Solid State Phenomena* **92**, 11 (2003).
18. P. S. Lysaght, P. J. Chen, R. Bergmann, T. Messina, R. W. Murto and H. R. Huff, "Experimental Observations of the Thermal Stability of High- κ Gate Dielectric Materials on Silicon," *Journal of Non-Crystalline Solids* **303**, 54 (2002).
19. M. D. Chabot, T. C. Messina, V. Manicevski, C. W. Miller, J. T. Markert, "Single-Crystal Silicon Triple-Torsional Micro-Oscillators for Use in Magnetic Resonance Force Microscopy," *SPIE-Int. Soc. Opt. Eng. Proceedings of Spie - the International Society for Optical Engineering* **4559**, 24 (2001).
20. J. T. Markert, T. C. Messina, B. Dam, J. Huijbregste, J. Rector, R. Griessen, "Observation of Step-Flow Growth in Laser-Ablated thin films of the T'-Phase compound Pr_2CuO_4 ," *Physica C* **341-348**, 2355-56 (2000).
21. J. T. Markert, T. C. Messina, B. Dam, J. Huijbregste, J. H. Rector, R. Griessen, "Laser-Ablated Thin Films of Infinite-Layer Compounds and Related Materials," *Proceedings of SPIE* **4058**, 141 (2000).
22. T. Ono, G. A. Rozgonyi, C. Au, T. C. Messina, R. Goodall, H. R. Huff, "Oxygen Precipitation Behavior in 300mm Polished Czochralski Silicon Wafers," *J. Electrochem. Soc.* **146**, 3807 (1999).
23. H. R. Huff, D. McCormack Jr., C. Au, T. C. Messina, K. Chan, R. Goodall, "Current Status of 200mm and 300mm Silicon Wafers," *Proceedings of the Intl. Solid State Devices and Materials (ISSDM '97)*, Japan, p. 456 and Conference Abstracts p.575, (1997) also published in *Jpn J. Appl Phys* **37**, (1998) Pt.1, No.3B.
24. C. Au, T. C. Messina, R. Goodall, H. R. Huff, "Characterization of 300mm Polished Silicon Wafers," *Proceedings of the 8th International Symposium on Silicon Materials and Technology* **1**, p.641, (1998).
25. T. C. Messina, C. Au, S. Shih, Z. Yang, R. Goodall, H. R. Huff, "Current Status of 300mm Wafer Characterization," *Proceedings of the International Mechanical Engineering Conference and Exposition (IMECE '98)*, p.825, (1998).
26. S. Shih, C. Au, Z. Yang, T. C. Messina, R. Goodall, H. R. Huff, "Characterization of 300mm Silicon-Polished and Epi Wafers," *Microelectronic Engineering* **45**, 169 (1999).
27. J. T. Markert, K. Mochizuki, T. C. Messina, B. C. Dunn, A. V. Elliott, "Studies of Infinite-Layer, T'-Phase, and 1-D Ladder Copper-Oxide Compounds," *Physics and Materials Science of High Temperature Superconductor, IV. Proceedings of the NATO Advanced Research Workshop*, Kluwer Academic Publishers. 1997, pp.151.

INVITED TALKS

1. "Biophysics Investigations into Protein Structure and Function," Department of Physics Colloquium, Berry College, Rome, GA, February 6, 2014.
2. "Biophysics Investigations into Protein Structure and Function," Department of Physics Colloquium, Centre College, Danville, KY, December 5, 2013.
3. "Structure-Function Relationships in Proteins Observed Through Fluorescence and Computational Molecular Dynamics," American Chemical Society, Northwest Louisiana Section Local Meeting, Shreveport, LA, February 26, 2008.

4. "Relationships Between Protein Structure, Function, Folding, and Aggregation," Department of Chemistry Colloquium, University of Arkansas - Fayetteville, Fayetteville, AR, January 23, 2007.
5. "Relationships Between Protein Function, Structure, (Mis)Folding, and Aggregation," Department of Physics Colloquium, University of Alabama - Birmingham, Birmingham, AL, January 18, 2007.
6. "From functional, shallow conformational equilibria to dysfunctional, irreversible misfolding on protein free energy landscapes," Department of Physics Colloquium, University of Texas at Brownsville, Brownsville, TX, January 16, 2007.
7. "Structural roles in protein function, folding, misfolding, and aggregation," Centenary College Special Colloquium, Shreveport, LA, December 7, 2006.
8. "Structural roles in protein function, folding, misfolding, and aggregation," Special Colloquium, Department of Physics, University of Kansas, Lawrence, KS, November 30, 2006.
9. "Structural roles in protein function, folding, misfolding, and aggregation," University of Tennessee Space Institute Special Colloquium, Tullahoma, TN, November 27, 2006.
10. "Magnet-on-Oscillator Characterization for Nuclear Magnetic Resonance Force Microscopy," Rutgers, the State University of New Jersey, August 2003.
11. "Steric Effects on the Metallic-Mirror to Transparent-Insulator Transition in YH_x ," Special Colloquium, Department of Physics, University of Pennsylvania August 2003.
12. "Steric Effects on the Metallic-Mirror to Transparent-Insulator Transition in YH_x ," Special Colloquium, Department of Physics, University of Montana December 20, 2002.
13. "Steric Effects on the Metallic-Mirror to Transparent-Insulator Transition in YH_x ," Special Colloquium, Department of Physics, Princeton University, December 12, 2002.
14. "Electronic and Magnetic Transport Experiments in Condensed Matter," Special Colloquium, Department of Physics, University of California at Berkeley, October 2002.

CONTRIBUTED TALKS

1. "Redesign of Introductory Physics Labs Using Arduinos," American Association of Physics Teachers, Cincinnati, OH, July 23, 2017.
2. "Molecular dynamics laboratory module designed to support a molecular genetics research project," American Chemical Society National Meeting, New Orleans, LA, April 9, 2013.
3. "Solvent Dependent Characterization of the Fluorescent Glucose Analog 2-(N-(7-nitrobenz-2-oxa-1,3-diazol-4-yl)amino)-2-deoxyglucose (2-NBDG)," presented by student James Nolan, Society of Physics Students Zone 10 Meeting, Rhodes College, Memphis, TN, February 2008.
4. "Ligand-Modulated Free Energy Landscapes of Glucose/Galactose Binding Protein," American Physical Society March Meeting, New Orleans, March 9-14, 2008.
5. "Shallow free energy landscapes remodeled by ligand binding," American Physical Society March Meeting, Denver, CO, March 5-9, 2007.
6. "Conformational Dynamics of the Receptor Protein Galactose/Glucose Binding Protein," American Physical Society March Meeting, Baltimore, MD, March 13-17, 2006.
7. "Tracking Amyloid Formation by Single Molecule Spectroscopy," American Chemical Society Mid-Atlantic Regional Meeting (ACS-MARM), Piscataway, NJ, May 22-25, 2005.
8. "Identifying the Mechanism for Amyloid Formation Using Single-Molecule Spectroscopy," American Physical Society March Meeting, Los Angeles, CA, March 21-25, 2005.
9. "Identifying the Mechanism for Amyloid Formation Using Single-Molecule Spectroscopy," 229th American Chemical Society National Meeting and Exposition, San Diego, CA, March 13-17, 2005.
10. "Steric Effects on the Metallic-Mirror to Transparent-Insulator Transition in Yttrium-Scandium-Hydride," American Physical Society March Meeting, Austin, TX, March 3-7, 2003.

11. "Steric Effects on the Metal-Insulator (Mirror-Transparent) Transition in YH_x ," Eighth International Symposium on Metal-Hydrogen Systems, Fundamentals and Applications (MH2002), September 2-6, 2002, Annecy, France.
12. "Optical Switching, Structure, and Transport in Y-Sc Hydride Thin Films," American Physical Society March Meeting, Indianapolis, IN, March 18-22, 2002.
13. "Magnet-on-Oscillator Characterization for Nuclear Magnetic Resonance Force Microscopy," American Physical Society March Meeting, Seattle, WA, March 12-16, 2002.

POSTER PRESENTATIONS

1. "Thermo-Magnetic Properties of High Entropy Alloys," presented by student Tanner Thompson (1st place winner), Kentucky Academy of Science, Louisville, KY, November 5, 2016.
2. "Thermo-Magnetic Properties of High-Entropy Alloys (HEAs)," presented by student Robert Barnes, Kentucky Academy of Science, Louisville, KY November 5, 2016.
3. "Developing High Entropy Alloys and the Impact of Annealing on the Crystalline Structures," presented by student Nathanael Bodine, PhysCon - Quadrennial Physics Conference, Silicon Valley, CA, November 4, 2016
4. "Building a Low-Cost Atomic Force Microscope for Use in Undergraduate Physics Labs and Research at Berea College," presented by student Nathanael Bodine (2nd place winner), Kentucky Academy of Science, Florence, KY November 6, 2015.
5. "Molecular modeling of casein kinase-1 to determine relevance of conserved potential phosphorylation sites," presented by student Paige R. Pritchett, American Chemical Society National Meeting, New Orleans, LA, April 8, 2013
6. "Amyloidogenesis Rate of Alpha-Lactalbumin III in the Presence of Hydrophobic and Hydrophilic Interfaces," presented by student Francis J. Petitto (granted the Young-Investigator Award by the Protein Society), the Protein Society, Stockholm, Sweden, May 2011.
7. "Molecular Modeling of Casein Kinase-1," presented by student Matthew N. Blam, American Chemical Society National Meeting, Anaheim, CA, March 2011.
8. "*In-vitro* Amyloid Kinetics Driven by Hydrophobic Interfaces," presented by student Frank Petitto, American Chemical Society National Meeting, Anaheim, CA, March 2011.
9. "A student's guide to searching the literature," American Chemical Society National Meeting, San Francisco, CA, March 2010.
10. "Structural Characterization of Ligand-Bound Glucose/Galactose Binding Protein," presented by student Jessica L. Garza, American Chemical Society National Meeting, Salt Lake City, UT, March 2009
11. "Design and Construction of an Automated Community Bicycle Loan/Return System," presented by students Richard Lopez and Kenneth Roland Womack, Society of Physics Students Zone 10 Meeting, Rhodes College, Memphis, TN, February 2008.
12. "Protein free energy landscapes remodeled by ligand binding," 19th Annual Molecular Biophysics Minisymposium, Piscataway, NJ, May 4, 2007.
13. "Conformational sampling of the receptor protein glucose/galactose binding protein," 18th Annual Molecular Biophysics Minisymposium, Piscataway, NJ, May 5, 2006.
14. "Photobleaching: An Innovative Approach to Investigate Protein Self-Assembly," DIMACS Workshop on Computational/Experimental Approaches to Protein Defects in Human Disease, Piscataway, NJ, April 20-21, 2006.
15. "Optimized fluorophore counting on multiple-labeled dextran and aggregating single-labeled protein using Hidden Markov Models," 228th American Chemical Society National Meeting and Exposition, Philadelphia, PA, August 22-26, 2004.