

Jeffrey R. Vieregg

Senior Research Scientist
Institute for Molecular Engineering
University of Chicago, Jones 222
5757 South Ellis Avenue
Chicago, IL 60637 USA

Phone: (773) 702-2556
Mobile: (312) 401-3121
jvieregg@uchicago.edu

home.uchicago.edu/~jvieregg

RESEARCH INTERESTS Nucleic acid biophysics: RNA folding, RNA-protein interactions
Measurement and control of gene expression
Rational design of nucleic acid nanodevices
Nucleic acid therapeutics

EDUCATION Ph.D. (Physics), University of California, Berkeley, 2007
 Advisors: Ignacio Tinoco, Jr., Carlos Bustamante
 Thesis: "Single molecule RNA folding studied with optical trapping"
 M.A. (Physics), University of California, Berkeley, 2003
 S.B. (2: Physics with Electrical Engineering, Humanities and Science), Massachusetts
 Institute of Technology, 2001
 Minor in Chemistry
 Advisors: Richard Temkin, Ken Kreischer
 Thesis: "A CW gyrotron oscillator for use in dynamic nuclear polarization NMR"

CURRENT RESEARCH **Senior Research Scientist, University of Chicago, 2013-present**
Institute for Molecular Engineering

- Developing improved techniques to capture long non-coding RNA molecules from cells to determine their structure, function, and interactions (with the Ruthenburg lab, Molecular Genetics and Cell Biology Department)
- Optimizing self-assembled artificial micelles for efficient, selective delivery of therapeutic nucleic acids into cells (with the Tirrell Lab, Institute for Molecular Engineering)

FELLOWSHIPS AND AWARDS UCBREP Graduate Research and Education in Adaptive Biotechnology
 Training Grant, 2004-06
National Science Foundation Graduate Fellowship, 2001-2003
Phi Beta Kappa, 2001
SPS Physics Honor Society, 2001
MIT Burchard Scholar (Humanities and Science honors program), 2000-2001
MIT I. Austin Kelly Essay Prize, 2001

PREVIOUS
RESEARCH

Postdoctoral Scholar, California Institute of Technology, 2008-2013

Nucleic acid devices for measurement and control of gene expression.

Advisor: Niles Pierce

- Developed Shielded Covalent Probes, a new type of conformation-switching nucleic acid probe that forms (optionally reversible) covalent bonds to RNA and DNA targets with near-quantitative yield and exquisite specificity. Applications include quantitative measurement of gene expression, RNA & RNP isolation, enzyme-free gene silencing, and nucleic acid nanotechnology.
- Led collaborations with synthetic organic chemists for probe development and with academic and industry biologists exploring applications.
- Member of Caltech Center of Excellence in Genomic Science collaboration developing methodologies for quantitative *in toto* analysis of vertebrate gene expression; measured expression profiles in whole-mount zebrafish embryos and cultured human cell lines.
- Mentored students in biophysical and biochemical techniques and assay development.

Graduate Student Researcher, Department of Physics, UC Berkeley, 2003-2007

Single-molecule studies of RNA folding using optical tweezers.

Advisors: Ignacio Tinoco, Jr. (Chemistry), Carlos Bustamante (Physics).

- Studied thermodynamics and kinetics of RNA secondary structure folding using single-molecule optical trapping techniques. Verified nearest-neighbor thermodynamic model for large hairpins and measured effects of salt and temperature on stability and dynamics.
- Applied recent non-equilibrium statistical physics results (Crooks Fluctuation Theorem) to extract reversible work and equilibrium thermodynamics from folding trajectories.
- Computational modeling of the effect of mechanical force on RNA folding dynamics.
- Designed and executed rebuild and major upgrade of optical tweezers instrument to improve stability, precision, and force control performance.

Graduate Student Researcher, Department of Physics, UC Berkeley & Lawrence Berkeley National Laboratory, 2001-2003

Low-energy tests of fundamental symmetries by measuring β -decay kinematics of optically-trapped nuclei. Advisor: Stuart Freedman

- Developed metastable atom production and optical trapping techniques for ^{19}Ne atoms.
- Member of group measuring β -decay kinematics of trapped ^{21}Na atoms at 88-inch cyclotron.

Undergraduate Researcher, MIT-Bates Linear Accelerator Center, 2000-2001

Member of group working to integrate, test, and calibrate hardware for BLAST (Bates Large Acceptance Spectrometer Toroid) detector. Helped design and implement detector trigger system and wrote control software. Advisor: Tim Smith

Undergraduate Researcher, MIT Plasma Science and Fusion Center, 1998-2000

Designed and built instrumentation and control system for high-frequency CW

microwave source used in dynamic nuclear polarization nuclear magnetic resonance. Measurements of radiation pattern and integration with NMR spectrometer. Advisors: Richard Temkin and Ken Kreisler

Summer Student, Argonne National Laboratory, 1997

Assisted in development of new electron cyclotron resonance ion source for ATLAS heavy-ion accelerator; built emittance measurement system and accompanying control software.

Publications and Patents

J.R. Vieregg, H.M. Nelson, B.M. Stoltz, and N.A. Pierce, Selective nucleic acid capture with shielded covalent probes.

J. Am. Chem Soc. **135**, 9691-9699 (2013).

J.R. Vieregg, Nucleic acid structural energetics.

Encyc. Anal. Chem. (2010).

P.T.X. Li, J.R. Vieregg, I. Tinoco, Jr., How RNA unfolds and refolds.

Ann. Rev. Biochem. **77**, 77-100 (2008).

J.R. Vieregg, W. Cheng, C. Bustamante, I. Tinoco, Jr. Measurement of the effect of monovalent cations on RNA hairpin stability.

J. Am. Chem. Soc. **129**, 14966-73 (2007).

J. R. Vieregg, I. Tinoco, Jr. Modelling RNA folding under mechanical tension.

Mol. Phys. **104**, 1343-52 (2006).

N.D. Scielzo, et al. Detecting shake-off electron-ion coincidences to measure β -decay correlations in laser trapped ^{21}Na .

Nucl. Phys. A **746**, 677-680 (2004).

V.S. Bajaj et al. Dynamic nuclear polarization at 9 T using a novel 250 GHz gyrotron microwave source.

J. Mag. Res. **160**, 85-90 (2003).

V.S. Morozov et al. Spin-flipping polarized electrons.

Phys. Rev. ST Accel Beams **4**, 104002 (2001).

M. Schlapp et al. A new 14 GHz electron-cyclotron-resonance ion source for the heavy ion accelerator facility ATLAS.

Rev. Sci. Inst. **69**, 631 (1998).

PATENTS

US Patent # 8,658,780: Triggered Covalent Probes for Imaging and Silencing Gene Expression

CONFERENCE PRESENTATIONS Post-Transcriptional Gene Regulation Gordon Conference, 2014 (poster)

American Chemical Society Spring Meeting, 2013 (talk)

Biophysical Society Annual Meeting, 2013 (poster)

Oligonucleotide Therapeutic Society Annual Meeting, 2012 (poster)

Molecular Programming Project Retreat, 2012 (talk)

RNA 2012 (poster)

Biophysical Society Annual Meeting, 2012 (talk)

Aspen Center for Physics Single Molecule Biophysics Workshop, 2007 (talk)

Biophysical Society Annual Meeting, 2007 (poster)

UCBREP GREAT Retreat, 2006 (talk)

4th International Student Seminar, Kyoto University Graduate School of Biostudies and Department of Virology, 2006 (talk and poster - best poster award)

Biophysical Society Annual Meeting, 2006 (poster)

TEACHING

Direct Student Research Supervision

Victoria Hsiao, Caltech graduate student (Bioengineering), Fall rotation, 2011
Shielded covalent probe optimization, probe design for RNA pulldown assays with SC probes.

Yue (Dorothy) Yang, UC Berkeley undergraduate (Chem. Eng.), 2007
Soft lithography for optical trapping microfluidics.

Teaching Assistantships

Introductory Physics: Electromagnetism, Optics, Modern Physics: UC Berkeley
Advanced Atomic, Molecular, and Optical Physics, UC Berkeley

Pedagogy Training

Physics 300: Supervised Teaching of Physics, UC Berkeley, 2003
Readings and discussion on STEM teaching, practice teaching
Caltech Project for Effective Teaching Pedagogy Certificate, 2012
Workshop series with journaling and discussion.

OUTREACH
AND SERVICE

Pasadena Public Schools Science Fair Program, Pasadena, CA: 2011-2012

- Discussed science fair projects with 6th-8th graders in Pasadena Public Schools
- Science fair judge: Sierra Madre Middle School, McKinley School, District-wide fairs

Molecular Programming Project / Pierce Lab Visiting Days: 2009, 2011

- Helped lead tours of Caltech research labs
- Discussed STEM careers and college options with local high school students

Caltech Postdoctoral Association Career Committee: 2011-2012

Caltech Sustainability Committee, Waste Subcommittee: 2009-2010