William M. Jacobs

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Present Position

Assistant Professor of Chemistry, Princeton University 2019–present
Associated Faculty, Department of Chemical and Biological Engineering

Education

University of Cambridge 2010–2014
Ph.D. in Theoretical Chemistry

University of Virginia 2006–2010
B.S. with Highest Distinction
Majors: Physics and Engineering Science; Minor: Applied Mathematics

Training

Postdoctoral Fellow 2014–2019
Department of Chemistry and Chemical Biology, Harvard University
Adviser: Eugene Shakhnovich

Ph.D. Candidate 2010–2014
Department of Chemistry, University of Cambridge
Adviser: Daan Frenkel

Undergraduate Researcher 2009–2010
Computational Materials Group, University of Virginia
Adviser: Leonid Zhigilei

Visiting Researcher 2009
Aerodynamics Group, Technical University of Munich
Adviser: Christian Stemmer

Undergraduate Researcher 2007–2009
Center for Electrochemical Science and Engineering, University of Virginia
Adviser: Robert Kelly

Selected Honors

Princeton Engineering Commendation for Outstanding Teaching 2023
NSF CAREER Award 2022–2027
NIH National Research Service Award (F32) Postdoctoral Fellow 2016–2018
Gates Cambridge Scholar 2010–2014
NSF Graduate Research Fellow 2010–2014
Edgar F. Shannon Award, University of Virginia 2010
Outstanding Physics Student Award, University of Virginia 2010
Barry M. Goldwater Scholar 2009–2010
Jefferson Scholar, University of Virginia 2006–2010
Rodman Scholar, University of Virginia 2006–2010
Micron Science and Technology Scholar 2006–2010

Preprints

W.M. Jacobs* and W.B. Rogers*, "Assembly of complex colloidal systems using DNA," *submitted.*
(*Co-corresponding authors)

S. Chatterjee and W.M. Jacobs, "Multi-objective optimization for targeted self-assembly among competing polymorphs," *arXiv 2401.11234.*

T. Li and W.M. Jacobs, "Predicting the morphology of multiphase biomolecular condensates from protein interaction networks," *arXiv 2312.02806.*

F. Chen and W.M. Jacobs, "Emergence of multiphase condensates from a limited set of chemical building blocks," *arXiv 2311.18142.*

Publications

A.R. Strom, J.M. Eeftens, Y. Polyachenko, C. Weaver, H. Watanabe, D. Bracha, N. Orlovsky, C. Jumper, W.M. Jacobs, and C.P. Brangwynne, "Interplay of condensation and chromatin binding underlies BRD4 targeting," ***Mol. Biol. Cell*** *in press; bioRxiv 2024.02.07.579384.*

O. Hegde, T. Li, A. Sharma, M. Borja, W.M. Jacobs*, and W.B. Rogers*, "Competition between self-assembly and phase separation governs high-temperature condensation of a DNA liquid," ***Phys. Rev. Lett.*** *in press; arXiv 2301.06134.*
(*Co-corresponding authors)

Y. An, M.A. Webb*, and W.M. Jacobs*, "Active learning of the thermodynamics–dynamics tradeoff in protein condensates," ***Sci. Adv.*** **10**, adj2448 (2024).
(*Co-corresponding authors)

A. Bitran, W.M. Jacobs, and E.I. Shakhnovich, "The critical role of co-translational folding: An evolutionary and biophysical perspective," ***Curr. Opin. Systems Biol.*** **37**, 100485 (2024).

T. Li, W.B. Rogers, and W.M. Jacobs, "Interplay between self-assembly and phase separation in a polymer-complex model," ***Phys. Rev. E*** **108**, 064501 (2023).

Y. Cho and W.M. Jacobs, "Nonequilibrium interfacial properties in chemically driven fluids," ***J. Chem. Phys.*** **159**, 154101 (2023).

A. Hensley, T.E. Videbæk, H. Seyforth, W.M. Jacobs*, and W.B. Rogers*, "Macroscopic photonic single crystals via seeded growth of DNA-coated colloids," ***Nat. Commun.*** **14**, 4237 (2023).
(*Co-corresponding authors)
[U.S. Provisional Patent Application No.: 63/380,258 (October 2022)]

W.M. Jacobs, "Theory and simulation of multiphase coexistence in biomolecular mixtures," ***J. Chem. Theory Comput.*** **19**, 3429–3445 (2023).

F. Chen and W.M. Jacobs, "Programmable phase behavior in fluids with designable interactions," ***J. Chem. Phys.*** **158**, 214118 (2023).
†Selected as a *JCP* Editors' Pick.

Y. Cho and W.M. Jacobs, "Tuning nucleation kinetics via nonequilibrium chemical reactions," ***Phys. Rev. Lett.*** **130**, 128203 (2023).

A. Hensley, W.M. Jacobs*, and W.B. Rogers*, "Self-assembly of photonic crystals by controlling the nucleation and growth of DNA-coated colloids," ***Proc. Natl. Acad. Sci. U.S.A.*** **119**, e2114050118 (2022).
(*Co-corresponding authors)

W.M. Jacobs, "Self-assembly of biomolecular condensates with shared components," ***Phys. Rev. Lett.* 126**, 258101 (2021).
†Selected as a *PRL* Editors' Suggestion and highlighted in *APS Physics*.

D.W. Sanders, ..., W.M. Jacobs, P. Ivanov, and C.P. Brangwynne, "Competing protein–RNA interaction networks control multiphase intracellular organization," ***Cell* 181**, 306–324 (2020).

A. Bitran, W.M. Jacobs, E.I. Shakhnovich, "Validation of DBFOLD: An efficient algorithm for computing folding pathways of complex proteins," ***PLoS Comp. Biol.* 16**, e1008323 (2020).

V. Zhao, W.M. Jacobs, E.I. Shakhnovich, "Effect of protein structure on evolution of cotranslational folding," ***Biophys. J.* 119**, 1123–1134 (2020).
†Selected by the editor for *Biophys. J.* New & Notable.

A. Bitran, W.M. Jacobs, X. Zhai, and E.I. Shakhnovich, "Co-translational folding allows misfolding-prone proteins to circumvent deep kinetic traps," ***Proc. Natl. Acad. Sci. U.S.A.* 117**, 1485–1495 (2020).

W.M. Jacobs and E.I. Shakhnovich, "Accurate protein-folding transition-path statistics from a simple free-energy landscape," ***J. Phys. Chem. B* 122**, 11126–11136 (2018).

M. Sajfutdinow, W.M. Jacobs, A. Reinhardt, C. Schneider, and D. Smith, "Direct observation and rational design of nucleation behavior in addressable self-assembly," ***Proc. Natl. Acad. Sci. U.S.A.* 115**, E5877–E5886 (2018).

S. Bhattacharyya*, W.M. Jacobs*, B.V. Adkar, J. Yan, W. Zhang and E.I. Shakhnovich, "Accessibility of the Shine–Dalgarno sequence dictates N-terminal codon bias in *E. coli*," ***Mol. Cell* 70**, 894–905 (2018).
(*Equal contribution)

W.M. Jacobs and E.I. Shakhnovich, "Evidence of evolutionary selection for co-translational folding," ***Proc. Natl. Acad. Sci. U.S.A.* 114**, 11434–11439 (2017).

W.M. Jacobs and D. Frenkel, "Phase transitions in biological systems with many components," ***Biophys. J.* 112**, 683–691 (2017).
†Selected by the editor for *Biophys. J.* News & Views.

W.M. Jacobs and E.I. Shakhnovich, "Structure-based prediction of protein-folding transition paths," ***Biophys. J.* 111**, 925–936 (2016).
†Selected by the editor for *Biophys. J.* News & Views.

W.M. Jacobs and D. Frenkel, "Self-assembly of structures with addressable complexity," ***J. Am. Chem. Soc.* 138**, 2457–2467 (2016).

W.M. Jacobs, T.P.J. Knowles, and D. Frenkel, "Oligomers of heat-shock proteins: Structures that don't imply function," ***PLoS Comp. Biol.* 12**, e1004756 (2016).

W.M. Jacobs and D. Frenkel, "Self-assembly protocol design for periodic multicomponent structures," ***Soft Matter* 11**, 8930–8938 (2015).

W.M. Jacobs, A. Reinhardt, and D. Frenkel, "Rational design of self-assembly pathways for complex multicomponent structures," ***Proc. Natl. Acad. Sci. U.S.A.* 112**, 6313–6318 (2015).

W.M. Jacobs, A. Reinhardt, and D. Frenkel, "Theoretical prediction of free-energy landscapes for complex self-assembly," ***J. Chem. Phys.* 142**, 021101 (2015).

W.M. Jacobs, D.W. Oxtoby, and D. Frenkel, "Phase separation in solutions with specific and nonspecific interactions," ***J. Chem. Phys.* 140**, 204109 (2014).
†Selected as a *JCP* Editors' Pick.

W.M. Jacobs and D. Frenkel, "Predicting phase behavior in multicomponent mixtures," ***J. Chem. Phys.*** **139**, 024108 (2013).

W.M. Jacobs, D.A. Nicholson, H. Zemer, A.N. Volkov, and L.V. Zhigilei, "Acoustic energy dissipation and thermalization in carbon nanotubes: Atomistic modeling and mesoscopic description," ***Phys. Rev. B*** **86**, 165414 (2012).

Invited Book Chapters

W.M. Jacobs, "Self-assembly of finite-sized structures," *The Art of Molecular Programming* (forthcoming).

Invited and Contributed Talks

- ◇ Edwards Symposium, Cambridge University, Cambridge, United Kingdom (*Invited–upcoming*, September 2024)
- ◇ Chemistry Department Seminar, University of Virginia, Charlottesville, VA (*Invited–upcoming*, September 2024)
- ◇ SIAM conference on Mathematical Aspects of Materials Science, Pittsburgh, PA (*Invited–upcoming*, May 2024)
- ◇ EMBL Symposium: Cellular Mechanisms Driven by Phase Separation, Heidelberg, Germany (*Upcoming*, May 2024)
- ◇ APS March Meeting, Minneapolis, MN (*Invited*, March 2024)
- ◇ Berkeley Stat Mech Meeting, University of California, Berkeley, CA (*Invited*, January 2024)
- ◇ Physics Colloquium, New York University, New York, NY (*Invited*, December 2023)
- ◇ Condensate Colloquium Series, Virtual (*Invited*, October 2023)
- ◇ CECAM workshop "Challenges and opportunities in non-equilibrium soft matter," Manresa, Spain (*Invited*, September 2023)
- ◇ Seminar on Living Matter Physics, Max Planck Institute for Dynamics and Self-Organization, Göttingen, Germany (*Invited*, September 2023)
- ◇ STATPHYS28 Meeting, Tokyo, Japan (August 2023)
- ◇ Lennard–Jones Seminar Series, Cambridge University, Cambridge, United Kingdom (*Invited*, June 2022)
- ◇ IDP Seminar Series, Virtual (*Invited*, February 2022)
- ◇ APS March Meeting, Virtual (*Invited*, March 2021)
- ◇ BPS Annual Meeting, San Diego, CA (February 2020)
- ◇ Applied Math Seminar, Courant Institute, New York University, NY (*Invited*, December 2019)
- ◇ American Association of Crystal Growth and Epitaxy (Western Section) Conference, Fallen Leaf Lake, CA (*Invited*, June 2018)
- ◇ CECAM Workshop "Liquid–liquid Phase Separation in Cells," Lausanne, Switzerland (*Invited*, May 2018)
- ◇ Center for the Study of Complex Systems Seminar, University of Michigan, Ann Arbor, MI (January 2018)
- ◇ Chemistry Department Seminar, Princeton University, Princeton, NJ (January 2018)
- ◇ MRSEC Seminar, Brandeis University, Waltham, MA (April 2017)
- ◇ Center for Biological Physics Seminar, University of California, Los Angeles, CA (*Invited*, April 2017)
- ◇ Workshop "Self-assembly: From Atoms to Life," Tuxtla Gutierrez, Mexico (*Invited*, October 2016)
- ◇ James Franck Institute Seminar, University of Chicago, Chicago, IL (*Invited*, May 2016)
- ◇ Foundations of Nanoscience Conference, Salt Lake City, UT (*Invited keynote speaker*, April 2016)
- ◇ Gordon Research Conference on Protein-folding Dynamics, Galveston, TX (*Poster-prize speaker*, January 2016)

- ◇ Laboratory of Chemical Physics Seminar, National Institutes of Health, Bethesda, MD (April 2014)
- ◇ Chemistry Department Seminar, University of California, Berkeley, CA (April 2014)
- ◇ Physics Department Seminar, Brandeis University, Waltham, MA (April 2014)
- ◇ STATPHYS25 Meeting, Seoul, South Korea (March 2013)
- ◇ APS March Meeting, Boston, MA (March 2012)

Teaching

Princeton University:

- ◇ `CHM 215:` Honors General Chemistry (undergraduate) 2023,2024
- ◇ `CHM 509:` Topics in Physical Chemistry: Coarse-graining and Nonequilibrium Statistical Mechanics (graduate) 2023
- ◇ `MSE 512:` Phase Transformations in Materials: Theory and Simulation (graduate) 2020,2022,2024
- ◇ `CHM 406:` Advanced Physical Chemistry: Chemical Dynamics and Thermodynamics (undergraduate) 2020,2021,2022
- ◇ `CHM 509:` Topics in Physical Chemistry: Fluids In and Out of Equilibrium (graduate) 2021
- ◇ `CBE 543:` Structures and Properties of Complex Fluids (graduate, *contributing lecturer*) 2021
- ◇ `CHM 515:` Biophysical Chemistry I (graduate, *contributing lecturer*) 2019

As a contributing lecturer:

- ◇ Boulder Summer School for Condensed Matter and Materials Physics 2024
- ◇ Physics of Life Summer School (Princeton/CUNY Center for the Physics of Biological Function) 2023

University of Cambridge:

- ◇ Computational Methods in Theoretical Chemistry (graduate supervisions) 2013–2014
- ◇ Statistical Mechanics (undergraduate supervisions) 2011–2014
- ◇ Physical Chemistry, including quantum mechanics, molecular symmetry, thermodynamics and solid-state electronic structure (undergraduate supervisions) 2011–2013