

Biographical Sketch: Michael F. Hagan

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(i) Professional Preparation

University of Connecticut, Storrs	Chemical Engineering	B.S.E. (summa cum laude), 1998.
University of California, Berkeley	Chemical Engineering	Ph. D., 2003 Advisor: Arup K. Chakraborty
University of California, Berkeley	Chemistry	Postdoctoral, 2003-2006 Advisor: David Chandler

(ii) Appointments

Chair, Biological Physics Program	Brandeis University	7/2013 - present
Associate Professor	Brandeis University	1/2013 - present
Assistant Professor	Brandeis University	1/2007-12/2012
NIH Ruth L. Kirchstein Postdoctoral Fellow	University of California, Berkeley	2004-2006
Postdoctoral Researcher	University of California, Berkeley	2003

(iii) Teaching

- Numerical Modeling Methods in Biology (QB110A): Spring 2013, Spring 2009, Spring 2008, Spring 2007

This is a new course that I designed for undergraduate and graduate students from physics, chemistry, biochemistry, and biology. Applies modern computational techniques to interesting and important problems in biology.

- Graduate Statistical Physics (Phys 163A): Fall 2009
- Biological Physics (QB105A): Fall 2010, Fall 2011, Fall 2013
- Statistical Physics (Phys40): Spring 2011
- Introductory Physics I (Phys11A): Fall 2012

(iv) Research Support

- National Institutes of Health NIAID (Award No. R01GM108021)

Computational modeling of viral assembly: Encapsulation of nucleic acids and envelopment by lipid membranes

Total Costs: \$1,300,000 (1 PI, role=PI)

September 2013 – April 2018

- National Institutes of Health NIGMS (Award No. R01GM100966)

Collaborative experimental and computational studies of conformational transitions in signaling proteins and enzymes

Total Costs: \$1,605,150 (2 PI's, role=PI)

August 2013 – July 2017

- Keck Foundation

Evolutionary Molecular Self-Organization under Extreme Conditions

Total Costs: \$1,000,000 (4 PI's, role=CoPI)

January 2014 – December 2016

- National Science Foundation (CMMI)

Collaborative Research: Mechanics and Structural Polymorphism of Bacterial Flagellar Assemblies

Total Costs: \$600,000 (3 PI's, role=CoPI)

July 2011 – June 2014

- National Science Foundation (MCB)

Building cellular complexity: from molecular motors to synthetic cilia

Total Costs: \$185,472 (3 PI's, role=CoPI)

December 2013 – December 2015

(v) Publications

38. Ruiz-Herrero, T., Hagan, M.F., “*Virus Assembly on a Membrane is Facilitated by Membrane Microdomains*”, submitted, [arXiv:1403.2269](https://arxiv.org/abs/1403.2269)
37. Fily, Y., Baskaran, A., Hagan, M.F. “Dynamics of Self-Propelled Particles Under Strong Confinement”, submitted, [arXiv:1402.5583](https://arxiv.org/abs/1402.5583)
36. Perkett, M.R., Hagan, M.F., “*Using Markov State Models to Study Self-Assembly*”, submitted, [arXiv:1402.1784](https://arxiv.org/abs/1402.1784)
35. Villali, J., Pontiggia, F., Clarkson, M.W., Hagan, M.F., Kern, D. “*Evidence against the ‘Y-T coupling’ mechanism of activation in the response regulator NtrC*”, J. Mol. Biol, **426**, 1554–1567, (2014), doi: [10.1016/j.jmb.2013.12.027](https://doi.org/10.1016/j.jmb.2013.12.027)
34. Chelakkot, R.; Gopinath, A.; Mahadevan, L.; Hagan, M.F., “*Flagellar dynamics of a connected chain of active, Brownian particles*”, J. R. Soc. Interface, **11**, 20130884 (2014) (<http://dx.doi.org/10.1098/rsif.2013.0884>)
33. Perlmutter, J.D.; Qiao, C.; Hagan, M.F. “Viral genome structures are optimal for capsid assembly”, eLife, 2:e00632, <http://elife.elifesciences.org/content/2/e00632>
32. Redner, G.; Baskaran, A.; Hagan, M.F., “Reentrant Phase Behavior in Active Colloids with Attraction”, Phys. Rev. E, **88**, 012305 (2013), [Subject of a Physical Review Focus, [Physics 6, 134 \(2013\)](https://doi.org/10.1103/PhysRevE.88.012305)]
31. Hagan, M.F. “*Modeling Viral Capsid Assembly*”, Adv. Chem. Phys., **155**, Ch 1 (to appear 2/2014), [arXiv:1301.1657](https://arxiv.org/abs/1301.1657) [invited review article]
30. Redner, G., Hagan, M.F.*, Baskaran, A*, “*Structure and Dynamics of a Phase-Separating Active Colloidal Fluid*” Phys. Rev. Lett., **110**, 055701 (2013), [arXiv:1207.1737](https://arxiv.org/abs/1207.1737)
* co-corresponding author
29. Yu, N., Hagan, M.F., “*Simulations of HIV capsid protein dimerization reveal the effect of chemistry and topography on the mechanism of hydrophobic protein association*” Biophys. J. **103**, 1363-1369 (2012) [Featured Article]
28. Ruiz-Herrero, T., Velasco, E., Hagan, M.F., “*Mechanisms of budding of nanoscale particles through lipid bilayers*” J. Phys. Chem B, **116**, 9595-603 (2012) [arXiv:1202.4691](https://arxiv.org/abs/1202.4691)
27. Giomi L., Mahadevan L., Chakraborty, B., and Hagan, M.F. “*Banding, excitability and chaos in active nematic suspensions*”, Nonlinearity, **25**, 2245–2269 (2012)
26. Dhason, M.S, Wang, J. C., Hagan, M.F., Zlotnick, A. “*Differential assembly of Hepatitis B Virus core protein on single- and double-stranded nucleic acid suggests the dsDNA-filled core is springloaded*”, Virology, **430**, 20-29 (2012)
25. Gopinath, A., Hagan, M.F., Marchetti, M.C., Baskaran, A. “*Dynamical Self-regulation in Self-propelled Particle Flows*” Phys. Rev. E, **85**, 061903 (2012)
24. Ni, P., Wang, Z., Ma, X., Das, N.C., Sokol, P., Chiu, W., Dragnea, B., Hagan, M.F.*, Kao, C.C*., “*An Examination of the Electrostatic Interactions between the N-Terminal Tail of the Coat Protein and RNA in Brome Mosaic Virus*”, J. Mol. Biol., **419**, 284-300 (2012)
*co-corresponding author
23. Patel, A.J; Varilly, P.; Jamadagni, S.N.; Hagan, M.F.; Chandler, D.; and Garde, S. “*Sitting at the edge: How biomolecules use hydrophobicity to tune their interactions and function*”, J. Phys. Chem. B, **116**, 2498-2503 (2012), [arXiv:1109.4431](https://arxiv.org/abs/1109.4431)
22. T. Gibaud, E. Barry, M. Zakhary, A. Ward, C. Berciu, Y. Yang, M.F. Hagan, R. Oldenbourg, D. Nicastro, R. Meyer, Z. Dogic. “*Reconfigurable self-assembly through chiral control of interfacial tension*”, Nature, **481**, 348 (2012)
21. McCandlish, S.R, Baskaran, A., and Hagan, M.F. “*Spontaneous Segregation of Self-Propelled Particles with Different Motilities*”, Soft Matter, **8**, 2527-2534 (2012), [arXiv:1110.2479](https://arxiv.org/abs/1110.2479)
20. Yang Y., Barry E., Dogic Z. and Hagan, M.F. “*Self-assembly of 2D membranes from mixtures of hard rods and depleting polymers*”, Soft Matter, **8**, 707 (2012), [arXiv:1103.2760](https://arxiv.org/abs/1103.2760)
19. Yang Y. and Hagan, M.F. “*Theoretical calculation of the phase behavior of colloidal membranes*” Phys. Rev. E, **84**, 051402 (2011)
18. Hagan, M.F., Elrad O.M., and Jack R.L. “*Mechanisms of kinetic trapping in self-assembly and phase transformation*”, J. Chem. Phys, **135**, 104115 (2011)

17. Giomi L., Mahadevan L., Chakraborty, B., and Hagan, M.F. “*Excitable Patterns in Active Nematics*”, Phys. Rev. Lett **106**, 218101 (2011)
16. Sumedha; Hagan, M.F.; Chakraborty, B. “*Prolonging assembly through dissociation: A self-assembly paradigm in microtubules*”, Phys. Rev. E, **83**, 051904 (2011)
15. [invited] Elrad O.M.; Hagan, M.F. “*Encapsulation of a Polymer by an Icosahedral Virus*”, Phys. Biol., **7**, 045003 (2010), Part of a special focus issue on physical virology.
14. Yang, Y.; Meyer, R.B.; Hagan, M.F. “*Self-limited self-assembly of chiral filaments*”, Phys. Rev. Lett., **104**, 258102 (2010)
13. Kivenson, A.; Hagan, M.F. “*Mechanisms of Capsid Assembly around a Polymer*”, Biophys. J, **99**, 619-628 (2010)
12. Hagan, M.F. and Elrad O.M. “*Understanding the Concentration Dependence of Viral Capsid Assembly Kinetics - the Origin of the Lag Time and Identifying the Critical Nucleus Size*”, Biophys. J, **98**, 1065-1074 (2010)
11. Hagan, M.F. “*A theory for viral capsid assembly around electrostatic cores*”, J. Chem. Phys., **130**, 114902 (2009)
10. Huang, F.; Addas, K.; Ward, A.; Flynn, N.T.; Hagan, M.F.; Dogic, Z.; Fraden, S. “*The pair potential of colloidal stars*”, Phys. Rev. Lett., **102**, 108302 (2009)
9. Whitelam, S.; Feng, E.H.; Hagan, M.F.; Geissler, P.L. “*The role of collective motion in examples of coarsening and self-assembly*”, Soft Matter, **6**, 1251-1262 (2009) (Special issue on Self-Assembly)
8. Elrad, O.M.; Hagan, M.F. “*Mechanisms of size control and polymorphism in viral capsid assembly*”, Nano Letters, **8**, 3850-3857 (2008)
7. Hagan, M. F. “*Controlling viral capsid assembly with templating*”, Phys. Rev. E, **77**, 051904 (2008)

Publications before I was an independent scientist

6. Jack, R. L.; Hagan, M. F.; Chandler, D. “*Fluctuation-dissipation ratios in the dynamics of self-assembly*”, Phys. Rev. E, **76**, 021119 (2007)
5. Hagan, M. F.; Chandler, D. “*Dynamic Pathways for Viral Capsid Assembly*”, Biophys. J., **91**,42 (2006)
4. Hagan, M. F.; Chakraborty, A. K. “*Hybridization Dynamics of Surface Immobilized DNA*”, J. Chem. Phys., **120**, 4958 (2004)
3. Hagan, M. F.; Dinner, A. R.; Chandler, D.; Chakraborty, A. K. “*Atomistic Understanding of Kinetic Pathways for Single Base-Pair Binding and Unbinding in DNA*”, Proc. Natl. Acad. Sci. USA, **100**, 13922 (2003)
2. Hagan, M. F.; Majumdar, A.; Chakraborty, A. K. “*Nanomechanical Forces Generated by Surface Grafted DNA*”, J. Phys. Chem. B, **106**, 10163 (2002)
1. Wu, G.; Haifeng, J.; Hansen, K.; Thundat, T.; Datar, R.; Cote, R.; Hagan, M. F.; Chakraborty, A. K.; Majumdar, A. “*Origin of Nanomechanical Cantilever Motion Generated from Biomolecular Interactions*”, Proc. Natl. Acad. Sci. USA, **98**, 1560 (2001).

(vi) Patents

- Barry, E., Dogic, Z., Hagan, M.F., Yang, Y., Perlman, D. “*Aligned Arrays of Nanorods, and Methods of Making and Using Them*”, patent pending

(vii) Selected Recent Invited Presentations/Appearances

- “*Viral genome structures, charge, and sequences are optimal for capsid assembly*”, APS Annual Meeting, March 2014, Denver, CO
- “*Virus assembly around RNA and on a membrane*”, Harvard Physical Chemistry Seminar, February, 2014
- “*RNA- and membrane-mediated virus assembly*”, MIT Physical Chemistry Seminar, February, 2014
- “*Virus assembly on different topologies: Encapsulation of RNA and envelopment by a membrane*”, U.C. Berkeley Physical Chemistry Colloquium, October, 2013
- “*Viral genome structures are optimal for capsid assembly*”, FNANO 2013, April, 2013, Snowbird, Utah
- “*Computational modeling of viral assembly: encapsulation of nucleic acids and envelopment by lipid membranes*”, UMASS Amherst Condensed Matter Seminar, February 14, 2013

- “*Thermodynamic and Kinetic Constraints on Viral Packaging of ssRNA.*”, January 20, 2013
Physical Virology Gordon Conference, Ventura, CA
- “*Patterns, Structures, and Dynamics in Active Colloidal Systems.*”, September 7, 2012
CECAM Workshop: Design of self-assembling materials, Vienna, Austria
- University of Colorado Boulder Physical Chemistry/Chemical Physics Colloquium, April 2012
- National Institutes of Health, Wednesday Seminar Series of Biochemistry and Biophysics Center at NHLBI, Bethesda, MD, April 2012
- “*Viral capsid assembly kinetics-the roles of the encapsulated polymer and water*”, November, 2011
Purdue University, Structural Biology Seminar Series, West Lafayette, IN
- “*Self-assembly of viruses and self-organization of active filaments*”, October, 2011
Duke University, Computational Biology & Bioinformatics Seminar, Durham, NC
- “*Viral capsid assembly kinetics-the roles of the encapsulated polymer and water*”, September, 2011
Indiana University, Dept. of Chemistry Colloquium, Bloomington, IN
- “*Self Vs. Active Assembly*”, June 20, 2011
Fluctuations and Response in Active Materials: From Driven Granular Systems to Swarming Bacteria,
Lorentz Center, Leiden, Netherlands
- Kavli Institute of Theoretical Physics Workshop: “*Biological Frontiers of Polymer and Soft Matter Physics*”, 2011
University of California, Santa Barbara
- “*Assembly of viruses and chiral filaments*”, May, 2011
Kavli Institute of Theoretical Physics Conference: “Soft Matter Physics Approaches to Biology”
University of California, Santa Barbara
- “*Assembly of viruses and chiral filaments*”, April, 2011
MIT Biophysics Seminar, Cambridge, MA
- “*Assembly of viruses and chiral filaments*”, February, 2011
Univ. of Connecticut, Dept. of Chemistry Colloquium, Storrs, CT
- “*Viral capsid assembly kinetics-the roles of the encapsulated polymer and water*”, January, 2011
Berkeley Mini Statistical Mechanics Meeting, Berkeley, CA

(viii) Honors and Awards

- Alberta Gotthardt Strage '56 and Henry Strage Award for Aspiring Young Science Faculty (2012)
- National Institutes of Health Ruth L. Kirchstein National Research Service Award, Individual Postdoctoral Fellowship, 2005
- National Science Foundation Graduate Research Fellow, 1999

(ix) Outreach Activities

- Co-organizer with S. Whitelam (LBL) and R. Jack (U. of Bath) for CECAM workshop entitled “*Self-assembly: from fundamental principles to design rules for experiment*” March 2013
- Co-organizer for the annual Greater Boston Area Statistical Mechanics Meeting (<http://physics.clarku.edu/gbasml/>)
- Co-organizer with S. Whitelam (LBL) for a focus session at the 2012 APS annual meeting, entitled “Self-assembly of proteins: from capsids to crystals”
- Member of the Lawrence Berkeley National Lab Molecular Foundry Theory Facility Proposal Study Panel
- Session chair at the ACS 2010 National meeting, Boston; APS 2011 March Meeting, Boston; 2011 Berkeley Mini Stat Mech Meeting
- Co-developing an experiential learning exhibit at the Discovery Museums in Acton, MA.
- Reviewer for journals relevant to the field including: *Nature*, *PNAS*, *JACS*, *Biophysical Journal*, *Nature Physics*, *Nature Materials*, *Nature Comm.*, *ACS Nano*, *Nano Letters*, *Physical Review Letters*, *Physical Review E*, *Journal of Chemical Physics*, *Journal of the Royal Society Interface*, *Physical Biology*, *Chemical Physics*, *J. Mol. Biol.*

- Reviewer for funding proposals from agencies including: *NIH, NSF, the Israel Science Foundation, Swiss National Science Foundation, the Medical Research Council (UK), and the Netherlands Foundation for Fundamental Research on Matter*
- Co-wrote transition path sampling module for CHARMM, a publicly distributed program for high-resolution simulations of biological macromolecules. This module makes a new simulation technique for studying rare events accessible to the broader computational biology community.

(x) Affiliations

a) Graduate and Postdoctoral Advisors

Graduate - Arup K. Chakraborty (Massachusetts Institute of Technology)

Postdoctoral - David Chandler (University of California, Berkeley)

b) Thesis Advisor and Postgraduate-Scholar Sponsor

Total Numbers Advised: 9 graduate students (3 graduated), 7 postdoctoral fellows

Postdoctoral Fellows (past 5 years, with current location):

Luca Giomi (Harvard University), Sumedha Sumedha (Assistant Professor at NISER, Bhubaneswar, India), Raghunath Chelakkot (Harvard University), Arvind Gopinath (Brandeis University), Jason Perlmutter (Brandeis University), Yaouen Fily (Brandeis University), Dina Mirijanian (Brandeis)

Graduate Students (past 5 years, with current location):

Oren Elrad (Apple), Yasheng Yang (WorldQuant, Greenwich, CT), Aleksandr Kivenson (Gamma Medica, Salem, NH), Naiyin Yu (Brandeis), Matthew Perrett (Brandeis), Gabriel Redner (Brandeis), Cong Qiao (Brandeis University), William Hicks (Brandeis), Raunak Sakhardande (Brandeis)