

Fred Gittes

Clinical Full Professor, Department of Physics & Astronomy
Washington State University, Pullman, WA 99164-2814
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Degrees: Ph.D. 1994, Bioengineering, University of Washington, Seattle, WA
M.S. 1981, Physics, University of Washington, Seattle, WA
A.B. 1979, Physics, University of California, Berkeley, CA

Teaching this semester (Spring 2015):

Physics 533, Graduate Thermal and Statistical Physics.
Physics 206, Honors physics with calculus I.
Physics 304, Modern Physics II.
Physics 590(2), Graduate Differential Geometry for Physics.

Awards:

Outstanding Lecturer Award, SPIE (2013).

The WSU Distinguished Teaching Award (2009).

College of Sciences Tom Lutz Teaching Award, WSU (2009).

Prior awards: University of Michigan: Scientific Excellence Award, Biophysics Research Division; Chosen as public lecturer ("Physics of the Cell"). University of Washington: NSF Mathematical Biology Training Grant; NIH Molecular Biophysics Training Grant; Shell Scholarship in graduate physics.

Recent research with students:

I am interested in electromagnetism, optics, thermodynamics, classical mechanics, and fluctuations, and have developed theoretical models and new methods of analysis in microscopy, complex fluids, optical trapping and micromanipulation, and biological physics. A new interest is the application of differential geometry to a range of physical topics. Projects with students in recent years include:

Michael Martinez (Physics/Astronomy major; Undergraduate thesis): Unexpected behavior of a rolling ball on arbitrarily moving substrates. In progress, 2015.

Alan Hartquist (Physics/Astronomy major; Undergraduate thesis): Arduino-based physical devices. In progress, 2015.

Stephen Cornthwaite (Non-thesis masters, supervised by FG): Visualizing shallow-water flows and waves. Degree completed, Fall 2014.

Tyler Sperlich (Physics/Astronomy major; Undergraduate thesis): Thomas precession: recent controversies.

John Peters (Physics/Astronomy major; Undergraduate thesis): The Feynman - Smoluchowski Ratchet.

Collin Roholt (Physics/Astronomy major): Research on physics teaching, preparing pedagogy of Physics 150.

Jenna Degreef (Physics/Astronomy major; 2012 Minigrant recipient): Physical models for rates in photosynthesis. (Collaboration with A. Cousins, School of Biological Sciences).

Kyle Welch (Physics/Astronomy and Neuroscience, currently at U. Oregon): 2nd place, 2010 College of Sciences (COS) poster competition (Physical Sciences). Also 2nd place, 2011 COS poster competition (Physical Sciences). Ionic phase transitions for biophysics and engineering. WSU Honor Thesis, Pass with Distinction award, 2011.

Ingmar Saberi (Masters graduate, currently at Caltech). Nonconservative forces in optical trapping. Published in *J. Optical Society of America B*, vol. 28, Issue 10, 2369-2373. [Selected for Spotlight on Optics, <http://www.opticsinfobase.org/spotlight/summary.cfm?uri=josab-28-10-2369>]

Christopher Varney (Physics graduate student): Physics of blood spatter, for forensics and undergraduate teaching. Published in *American Journal of Physics*, vol. 79, Issue 8, 838-842 (2011). [Physics World story: <http://physicsworld.com/cws/article/news/46074>. National CBC News Story (mp3 audio): <http://www.physics.wsu.edu/research/Gittes/CBC-newsitem.mp3>.

Brooks Harrop (Physics/Astronomy graduate student): Non-thesis Master's: **Course design: Physics for Life Scientists**. Work in preparation.

Gunnar Skulason (Physics/Astronomy major): **"Simplest" electric motor**. Entry in **2009 College of Sciences (COS) poster competition** (Physical Sciences).

Honors theses supervised: Nick Ulrich (Physics/Astronomy), **Magnetic monopoles**. **Luke Englund** (Physics/Astronomy), **Casimir effect**. **Kyle Welch** (Physics/Astronomy), **Ionic phase transitions** (Pass with Distinction award).

Graduate committee service

Current and recent (partial list):

David Zartman, Ph.D (degree in progress).

Obaid Alqahtani, Ph.D (degree in progress).

Joseph Lanska, Ph.D (degree in progress).

Sherry Ortman, Non-thesis Masters (degree in progress).

Krystal Kasal, Non-thesis Masters (degree in progress).

Victor Bollen, Ph.D (degree in progress).

Brett Deaton, Ph.D (degree in progress).

Sameneh Tabatabaei, Ph.D (degree in progress).

Stephen Cornthwaite (supervised) Non-thesis Masters, completed 2014. "Visualizing shallow-water flows and waves."

Collin Roholt Non-thesis Masters, completed 2014. "Effects of Various High School Science Teaching Methods on Student Choice of STEM Fields."

Michele Moore, Ph.D, 2014: “Manipulating neuronal activity with low frequency transcranial ultrasound.”

JiaJia Chang, Ph.D, 2013: “Quantum Hydrodynamics in One- and Two-Component Bose-Einstein Condensates.”

Benjamin Anderson, Ph.D, 2013: “Effects of sample thickness, dose, and an applied electric field on reversible photodegradation.”

Shiva K. Ramini, Ph.D, graduated 2012: “Experimental Investigations of a Proposed Chromophore Correlation Model of Self Healing of Disperse Orange 11 Doped in Poly (methyl methacrylate)”

Grant Eastland, Ph.D, graduated 2012: “Acoustic Scattering Boundary Effects Investigated Using Reversible Synthetic Aperture Sonar Filtering and Time Delay Models.”

Nikolay Frik, Masters degree, graduated 2012: Classification of populations of globular clusters. “Stellar Evolution and Study of Old Open Cluster NGC 6791.”

Jennie Schei, Ph.D, graduated 2011: “Optical Imaging of Neural and Hemodynamic Brain Activity.”

Nathan Dawson, Ph.D, graduated 2010: “Modeling the mechanisms of the photomechanical response of a nematic liquid crystal elastomer.”

Brooks Harrop, Masters (supervised), graduated 2009: “Course design: Physics for Life Scientists.”

Desmond Yin, Masters degree, 2010: “PAC studies of eutectic gallium-indium alloys.”

Sean Xia Jiang, Masters degree, 2008: “Cadmium jump frequencies in L1-2 intermetallic gallides and aluminides.”

Honors thesis committee service (recent):

Molly Wakeling, Nominated for Passed With Distinction award (2014);

Aaron Kunkle, Nominated for Passed With Distinction award (2013);

Kyle Welch (supervised), Passed With Distinction award (2011);

Kristofor Nyquist, Passed With Distinction award (2010);

Svetlana Stadnik, Passed With Distinction award (2009).

Teaching chronology:

Fall 2014: Physics 206, Honors physics with calculus II; **Physics 101**, General Physics I; **Physics 566/466 (grad/undergrad)**, Biological Physics.

Spring 2014: Physics 205, Honors physics with calculus I; **Physics 202**, Introductory physics with calculus II; **Physics 303**, Modern Physics I. **Physics 590-2**, Differential Geometry in Physics.

Fall 2013: Physics 206, Honors physics with calculus II; **Physics 101**, General Physics I; **Physics 566/466 (grad/undergrad)**, Biological Physics.

Spring 2013: Physics 205, Honors physics with calculus I; **Physics 202**, Introductory physics with calculus II; **Physics 303**, Modern Physics I. **Physics 590-2**, Differential Geometry in Physics.

Fall 2012: **Physics 206**, Honors physics with calculus II; **Physics 101**, General Physics I; **Physics 566/466 (grad/undergrad)**, Biological Physics.

Spring 2012: **Physics 205**, Honors physics with calculus I; **Physics 202**, Introductory physics with calculus II; **Physics 303**, Modern Physics I.

Fall 2011: **Physics 206**, Honors physics with calculus II; **Physics 101**, General Physics I; **Physics 566/466 (grad/undergrad)**, Biological Physics.

Spring 2011: **Physics 205**, Honors physics with calculus I; **Physics 202**, Introductory physics with calculus II, section 2; **Physics 541**, Electromagnetic Theory I (graduate);

Fall 2010: **Physics 206**, Honors physics with calculus II; **Physics 542**, Electrodynamics II (graduate). **Physics 566/466 (grad/undergrad)**, Biological Physics.

Spring 2010: **Physics 205**, Honors physics with calculus I; **Physics 202**, Introductory physics with calculus II, sections 1 & 2.

Fall 2009: **Physics 206**, Honors physics with calculus II; **Physics 542**, Graduate Electrodynamics II. **Physics 566/466 (grad/undergrad)**, Biological Physics.

Spring 2009: **Physics 205**, Honors physics with calculus I; **Physics 202**, Introductory physics with calculus II, section 2; **Physics 541**, Electromagnetic Theory I (graduate).

Fall 2008: **Physics 206**, Honors physics with calculus II; **Physics 542**, Electrodynamics II (graduate). **Physics 566/466 (grad/undergrad)**, Biological Physics,

Spring 2008: **Physics 205**, Honors physics with calculus I; **Physics 541**, Graduate Electromagnetic Theory I; **Physics 202**, Introductory physics with calculus II, section 2.

Fall 2007: **Physics 206**, Honors physics with calculus II; **Physics 542**, Electrodynamics II (graduate). **Physics 566/466 (grad/undergrad)**, Biological Physics.

Spring 2007: **Physics 205**, Honors physics with calculus I; **Physics 202**, Introductory physics with calculus II, section 2; **Physics 541**, Electromagnetic Theory I (graduate);

Fall 2006: **Physics 206**, Honors physics with calculus II; **Physics 542**, Electrodynamics II (graduate). **Physics 566/466 (grad/undergrad)**, Biological Physics.

Spring 2006: **Physics 202**, Introductory physics with calculus II, sections 1 and 2; **Physics 541**, Electromagnetic Theory I (graduate); **Science 199**, Integrated Science for Honors II.

Fall 2005: **Physics 201**, Introductory physics with calculus I (sections 1 and 2); **Physics 566/466 (grad/undergrad)**, Biological Physics (**Started as new class**).

Spring 2005: **Physics 201**, Introductory physics with calculus I, and **Physics 202**, Introductory physics with calculus II; **Physics 542**, Electrodynamics II (graduate).

Fall 2004: **Physics 201**, Introductory physics with calculus I (sections 1 and 2); **Physics 541**, Electromagnetic Theory I (graduate).

Spring 2004: **Physics 542**, Electrodynamics II (graduate). **Physics 150**, Physics and Your World.

Fall 2003: Physics 201, Introductory physics with calculus I (sections 1 and 2); **Physics 541**, Electromagnetic Theory I (graduate).

Spring 2003: Physics 101, Introductory physics with algebra I; **Physics 342**, Electricity and Magnetism; **Physics 150**, Physics and Your World.

Fall 2002: Physics 201, Introductory physics with calculus I (sections 1 and 2); **Physics 341**, Electricity and Magnetism.

Spring 2002: Physics 101, Introductory physics with algebra , part 1; **Physics 150**, Physics and Your World.

Fall 2001: Physics 201, Introductory physics with calculus I (sections 1 and 2).

Spring 2001: (Vanderbilt University): **Physics 117b**, Introductory physics with calculus II; **Physics 341**, Graduate statistical mechanics; **Honors Physics 121a** (substitute lectures).

Fall 2000: (Vanderbilt University): **Physics 117a**, Introductory physics with calculus.

Spring 2000: (Vanderbilt University): **Physics 341**, Graduate statistical mechanics.

Fall 1999: (Vanderbilt University): **Physics 117a**, Introductory physics with calculus.

1997-99 Guest lectures: **Physics 126, 240, 405, and 406**. University of Michigan.

1996 Three-part public lecture series, “**The Physics of the Cell**,” sponsored by the Department of Physics and the University of Michigan.

1986 Course: “**Energy and Ecology**,” Bellevue Community College, Washington.

Previous positions:

Clinical Associate Professor (2006-2012), Physics & Astronomy, **Washington State University**

Instructor (2001-2005), Physics & Astronomy, **Washington State University**

Assistant Professor (1999-2001), Physics & Astronomy, **Vanderbilt University**, Nashville, TN. Biological physics, optical trapping and polymer dynamics.

Research Fellow (1996-99), Department of Physics, **University of Michigan**, Ann Arbor, MI. Optical trapping, applied optics, motor proteins and theoretical dynamics of polymers and biopolymers.

Research Fellow (1995), Department of Physiology and Biophysics, **University of Washington**, Seattle, WA. Research on motor proteins and the cytoskeleton.

Graduate researcher (1989-94), Department of Physiology and Biophysics and Center for Bioengineering, **University of Washington**, Seattle, WA. Research on motor proteins and the cytoskeleton.

Research staff member (1986-90), Center for Bioengineering, and Department of Biological Structure, **University of Washington**, Seattle, WA. Research in mathematical morphology and statistics, and dynamic light scattering by biomolecules.

Graduate researcher (1982-85), Department of Physics, **University of Washington**, Seattle, WA. Renormalization group calculations, finite-size scaling, surface physics. Atomic physics and laser spectroscopy (1980-82).

Assistant engineer (1979-80), Space Sciences Laboratory, **University of California, Berkeley**, CA. Plasma wave and electric field studies.

Publications:

- Gittes, F., (In preparation). A problem bank for biological physics.
- Gittes, F., (In preparation). Notes for differential geometry applied to Physics.
- Welch, K. J., and F. Gittes (In preparation). Ion-sensitive phase transitions driven by Debye-Hückel non-ideality. <http://arxiv.org/abs/1109.2522>.
- Welch, K. J., and F. Gittes (In preparation). Critical ion sensitivity as a biophysical mechanism.
- Saberi, I., and F. Gittes (2011). Nonconservative forcing and diffusion in refractive optical traps. *Journal of the Optical Society of America B*, vol. 28, Issue 10, 2369.
- Varney, C. R., and F. Gittes (2011). Locating the source of projectile fluid droplets. *American Journal of Physics*, vol. 79, Issue 8, 838-842.
- Skulason, G., and F. Gittes (In preparation). Geometrical approach to simple induction motors.
- Gittes, F. (In preparation, 2011). *Old and New Concepts in Graduate electrodynamics*.
- van Mameren, J., Vermeulen, K., Gittes, F., and C.F. Schmidt (2009). Leveraging single protein polymers to measure flexural rigidity. *Journal of Physical Chemistry B*, vol. 113, Issue 12, 3837-3844.
- Peterman, E. J. G., Gittes, F., and C.F. Schmidt (2003). Laser-induced heating in optical traps. *Biophysical Journal*, vol. 84, 1308-1316.
- Schnurr, B., F. Gittes, and F.C. MacKintosh (2002). Metastable intermediates in the condensation of semiflexible polymers. *Physical Review E*, vol. 65, 61904.
- Agayan, R. R., F. Gittes, R. Kopelman and C.F. Schmidt (2002). Theory of optical trapping near resonance absorption. *Applied Optics*, vol. 41, 2318-2327.
- Gittes, F., B. Schnurr, C.F. Schmidt, P. D. Olmsted, and F.C. MacKintosh (1998). Model for dynamic shear modulus of semiflexible polymer solutions. *Materials Research Society Symp. Proc.*, vol. 489, 49-54.
- Gittes, F., B. Schnurr, C.F. Schmidt, P. D. Olmsted, and F.C. MacKintosh (1998). Model for dynamic shear modulus of semiflexible polymer solutions. *Materials Research Society Symp. Proc.*, vol. 489, 49-54.
- Gittes, F. and F.C. MacKintosh (1998). Dynamic shear modulus of a semiflexible polymer network. *Physical Review E*, vol. 58, R1241-1244.
- Gittes, F. and C. F. Schmidt (1998). Interference model for back-focal-plane displacement detection in optical tweezers. *Optics Letters*, vol. 23, 7-9.
- Allersma, M. W., F. Gittes, M. J. deCastro, R. J. Stewart, and C. F. Schmidt (1998). Two-dimensional tracking of ncd motility by back focal plane interferometry. *Biophysical Journal*, vol. 74, 1074-1085.

- Gittes, F. and C. F. Schmidt (1998). Thermal noise limitations on micromechanical experiments. *European Biophysical Journal*, vol. 27, 75-81.
- Gittes, F. and C. F. Schmidt (1997). Signals and noise in micromechanical measurements (book chapter). In *Methods in Cell Biology*, vol. 55: *Laser Tweezers in Cell Biology*. Ed. M. P. Sheetz. Academic Press, New York pp. 129-156.
- Schnurr, B., F. Gittes, P. D. Olmsted, C.F. Schmidt, and F.C. MacKintosh (1997). Local viscoelasticity of biopolymer solutions. *Materials Research Society Symp. Proc.*, vol. 463, 15-20.
- Schnurr, B., F. Gittes, F.C. MacKintosh, and C.F. Schmidt (1997). Determining microscopic viscoelasticity in flexible and semiflexible polymer networks. *Macromolecules*, vol. 30, 7781-7792.
- Gittes, F., B. Schnurr, P.D. Olmsted, F.C. MacKintosh, and C.F. Schmidt (1997). Microscopic viscoelasticity: shear moduli of soft materials determined from thermal fluctuations. *Physical Review Letters*, vol. 79, 3286-3289.
- Howard, J. and F. Gittes (1997) Motor proteins (book chapter). In *Physics of Biological Systems: From Molecules to Species*. Eds. H. Flyvbjerg, J. Hertz, M. H. Jensen, O. G. Mouritsen, K. Sneppen. Springer Lecture Notes in Physics, Springer-Verlag, Berlin. pp. 155-170.
- Gittes, F. and C. F. Schmidt (1996) Microscopic approaches to dynamics and structure of biological motors. *Curr. Opin. in Solid State & Materials Science*, vol. 1, pp. 412-424.
- Gittes, F., E. Meyhöfer, S. Baek, and J. Howard (1996). Directional loading of the kinesin motor molecule as it buckles a microtubule. *Biophysical Journal*, vol. 70, 418-429.
- Gittes, F., E. Meyhöfer, S. Baek, D. Coy, B. Mickey, and J. Howard (1996). Force generation by the microtubule-based motor protein kinesin (book chapter). In *Nanofabrication and Biosystems*. Eds. H. Hoch, L. W. Jelinski, and H. G. Craighead. Cambridge U. Press., Cambridge, pp. 367-380.
- Hunt, A. J., F. Gittes, and J. Howard (1994). The force exerted by a single kinesin molecule against a viscous load. *Biophysical Journal*, vol. 67, 766-781.
- Gittes, F., B. Mickey, J. Nettleton, and J. Howard (1993). Flexural rigidity of microtubules and actin filaments measured from thermal fluctuations in shape. *Journal of Cell Biology*, vol. 120, 923-934.
- Gittes, F. (1988). Estimating mean particle volume and number from random sections by sampling profile boundaries. *Journal of Microscopy*, vol. 158, 1-18.
- Gittes, F. and R. P. Bolender (1987). Counting cell nuclei with random sections: the effect of shape. *Micron and Microscopica Acta*, vol. 18, 59-70.
- Gittes, F. and M. Schick (1984). Complete and incomplete wetting by adsorbed solids. *Physical Review B*, vol. 30, 209-214.

Academic service

Academic advisor, Physics & Astronomy (advising majors) (2006-2015).
Undergraduate advisory committee, WSU Arts & Sciences (2012-2015).
Ph.D. preliminary exam, Physics & Astronomy, author and panels (2004-2015).
Search committee service, WSU Physics department (2003, 2005-2006).
Physics department assessment committee, WSU Physics, Fall 2005.
Physics Club advisor, WSU Physics dept (2004). Initiated WSU Pumpkin Drop.
Undergraduate curriculum committee, WSU Physics department (2002-2013).
College of Sciences Undergraduate Studies Committee, WSU (2010-11).
Co-principle investigator, WSU Noyce Grant application (Science Secondary Education) (2010).
Workshop contributor, Hispanic Youth Exploring Engineering and Science (HYEES). Engaged visiting high-school students and teachers in physics workshop activities (2008).
Faculty outreach contributor, Future Scientists and Engineers. Engaged visiting high-school students and teachers in physics workshop activities (2007).
Faculty outreach, WSU Cougar Quest. Developed physics workshop activities in **vibrations, waves and music** for high-school students and teachers (2006).
Secondary and Middle-school Science Endorsement Committees, WSU (2009-2011).
WSU General Education Committee (2006-2010).
Board member and WSU Physics representative, Pacific Northwest Association for College Physics (2002-2004).
Vanderbilt University: Pre-major advisor for freshmen and sophomores, College of Arts & Science (2000-2001). **Training Faculty**, Program in Molecular Biophysics (1999-2000). **Faculty Preceptor**, Quantitative Physiology Training Grant. **Graduate Core Exam** author and examiner, Physics Department (2000).

Supervision of GAANN Graduate Fellows:

(Graduate Assistance in Areas of National Need)

Adam Goler (Fall 2009): New demonstration development, Physics 202.
Chris Hamner (Spring 2010): Honors recitation and lab, with innovations.
Josef Felver (Fall 2010): New demonstration development, Physics 202.
Kasey Lund (Fall 2010) - Physics 205: Topic reviews with students, problem solving.
Josef Felver (Spring 2011): Honors 205 lab supervision, with innovations.
Daniel Plotnick (Spring 2011) : Honors 205 recitation; lecture experience.
Wyatt Brege (Fall 2011): Topic reviews with Physics 202 students, problem solving.
Adam Goler (Spring 2012): Physics 202 and 102 lab protocol development.

Invited talks (selected)

Incoming Freshman Talk, Honors College (multimedia, with Mark O’English): “**Nuclear radiation in physics and in popular culture**,” WSU (2011)

Colloquium, Physics & Astronomy department, WSU: “**The physics of blood spatter**.” (2008)

Colloquium, Physics & Astronomy department, WSU: “**The physics of cells**.” (2001)

Colloquium, Bioengineering dept, Vanderbilt University: **Biophysics Night** (2000).

Colloquiums (1999): Physics Colloquium, University of Illinois, Chicago; Mechanical Engineering Colloquium, Northwestern University, Evanston; Physics Colloquium, University of Utah, Salt Lake City; Physics Colloquium, Vanderbilt University, Nashville.

Invited lecturer, “Biophysical and Mathematical Approaches to Cell Biology” workshop, European Molecular Biology Laboratory, Heidelberg, Germany (1999).

Invited speaker, Third International Symposium on Biological Physics, Santa Fe; Physics department Colloquium, University of Arizona, Tucson (1998).

Invited speaker, “Structure of Biopolymer Solutions” workshop, Biophysical Society meeting, Kansas City. (1998)

Colloquium, Biophysics Research Division, University of Michigan (1997).

Three-part public lecture series “The Physics of the Cell,” sponsored in Ann Arbor, MI, by the Department of Physics and University of Michigan. (1996).

Colloquium, Biophysics Research Division Colloquium, University of Michigan. (1995).

Invited talk, “**Force generation by motor molecules**,” Nanofabrication and Biosystems conference, Kona, Hawaii (1994).

Reviewer (past five years):

American Journal of Physics,
European Journal of Physics,
Physical Review Letters,
Optics Express,
JOSA B,
Physical Review E,
Review of Scientific Instruments
Applied Optics,
Biophysical Journal,
Measurement Science and Technology.

Previous years, the above, plus: Journal of Physical Chemistry, Review of Scientific Instruments, Physical Review B, Journal of Rheology, Optics Letters, European Biophysical Journal, Biophysical Chemistry, Macromolecules, Journal of Chemical Physics, NASA Microgravity Research Fundamentals Panel (1998), Washington D. C.