# FRANK VOLLMER

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(617) 497 4681

CURRICULUM VITAE

## ACADEMIC CAREER

**Research Group Leader** — **Harvard University** — 04-
PI, Rowland Junior Fellow — Cambridge, MA — present

## EDUCATION

**Ph.D. Physics & Biology** — **Rockefeller University** — 04
Advisor: Dr. A. Libchaber — New York, NY

*Thesis: "Resonant Detection of Nano- to Microscopic Objects using Whispering Gallery Modes" (collaboration with Dr. S .Arnold, Poly-technic Institute of NYU)*

**M.S. Biochemistry** — **University Hannover** — 98
Advisor: Dr. R.G. Roeder — Germany

*Thesis (external at Rockefeller University): "Cloning and Characterization of a Human Homologue of the TATA Box Binding Protein"*

**B.S. Biochemistry** — **University Bayreuth** — 95
Germany

## ACADEMIC AWARDS AND HONORS

- Rowland Junior Fellowship, Harvard University 04
- Boehringer Ingelheim Fonds Ph.D. Fellowship (www.BIFonds.de) 00
- Valedictorian Moerike Gymnasium Esslingen, Germany 92

## RESEARCH INTERESTS

- Optical Bio-Sensors
- Label-free Biosensing using Optical Resonance Phenomena
- Optical Biosensors for Implants and Lab-on-Chip Technology
- Signal Generation and -Processing in Single Cells
- Photonic Crystals
- Experimental Biophysics, Biophotonics and Nanobioscience

## LICENSES

- Safety Officer for Molecular Biology (Medical School Hannover, Germany, 97)
- Surgical Operations of Small Laboratory Animals (Medical School Hannover, Germany, 96)
- Radio-Labeling of Biomolecules (Medical School Hannover, Germany, 96)

## LEADERSHIP ACTIVITIES & TEACHING

| | | |
|---|---|---|
| Research Experience for Undergraduates (REU, Harvard) | | 05-07 |
| Participated in Freshman Seminar (Harvard) | | 04-05 |
| Rowland Methods Seminar (Rowland Institute) | | 04-09 |
| Photonic Atom Sensors, Inc. (NY) | President | 03-05 |
| Co-organizer, APS March Meeting Symposium | | 07 |

## PROFESSIONAL ACTIVITIES

Referee (Science, Optics Letters, Applied Physics Letters, Biophysical Journal, Lab on a Chip, Optics Express, Journal of Applied Physics, JOSAB, J. Sel. Top. Quant. Electron., IEEE Sensor Journal, Journal of Biophotonics, Analyst, JACS)

## OTHER WORK EXPERIENCE

| | | |
|---|---|---|
| Micro- & Nanofabrication (Center for Nanoscale Systems, Harvard) | | 05-09 |
| Medical-Technical Assistant | Katharinen Hospital<br>Suttgart, Germany | 92-93 |

## PUBLICATIONS

S. Arnold, D. Keng, S. Shapova, S. Holler, W. Zurawsky, **F. Vollmer** "Whispering-Gallery Mode Carousel - a photonic mechanism for enhanced nanoparticle detection in biosensing", *Optics Express* 17 (2009)

**F. Vollmer**, S. Arnold, D. Keng "Single virus detection from the reactive shift of a whispering-gallery mode", *PNAS* 105 (2008)

**F. Vollmer**, S. Arnold "Whispering-gallery-mode biosensing: label-free detection down to single molecules", *Nature Methods* 5 (2008)

J. Yang, J. Heo, T. Zhu, J. Xu, J. Topolancik, **F. Vollmer**, R. Ilic, P. Bhattacharya "Enhanced photoluminescence from embedded PbSe colloidal quantumdots in Si-based random photonic crystal microcavities", *Appl. Phys. Lett.* 93 (2008)

J. Topolancik, B. Ilic, **F. Vollmer** "Experimental observation of strong photon localization in disordered photonic crystal waveguides", *Phys. Rev. Lett.* 99 (2007)

H.-C. Ren, **F. Vollmer**, S. Arnold, A. Libchaber "High-Q microsphere biosensor - analysis for adsorption of rodlike bacteria", *Optics Express* 15 (2007)

J. Topolancik, **F. Vollmer**, B. Ilic "Random high-Q cavities in disordered photonic crystal waveguides", *Appl. Phys. Lett.* 91 (2007)

V. Lien, **F. Vollmer** "Microfluidic flow rate detection based on integrated optical fiber cantilever" *Lab Chip* 7 (2007)

J. Topolancik, **F. Vollmer** "Photoinduced transformations in bacteriorhodopsin membrane monitored with optical microcavities" *Biophysical Journal* 92 (2007)

**F. Vollmer**, P. Fischer "Frequency- domain displacement sensing with a fiber ring-resonator containing a variable gap" *Sensors and Actuators A* 134 (2007)

J. Topolancik, **F. Vollmer** "All-optical switching in the near-IR with bacteriorhodopsin-coated microcavities" *Appl. Phys. Lett.* 89 (2006)

**F. Vollmer**, P. Fischer "Ring- resonator-based frequency-domain optical activity measurements of a chiral liquid" *Optics Letters* 31 (2006)

**F. Vollmer** "Taking detection to the limit" *B.I.F. Futura* 20 (2005), a publication of the Boehringer Ingelheim Fonds, Germany (http://www.bifonds.de/public/inhaltf4.htm).

G. Guan, **F. Vollmer** "Polarized transmission spectra of the fiber-microsphere system" *Appl. Phys. Lett.* 86 (2005)

S. Arnold, M. Noto, **F. Vollmer**, "Ultra-sensitive detection of perturbations by biomolecules" In: B. DiBartolo, O. Forte (eds.) "Frontiers of optical spectroscopy" *Kluwer Academic Publishers* (2005)

M. Noto, **F. Vollmer**, D. Keng, I. Teraoka, S. Arnold "Nanolayer characterization through wavelength multiplexing of a microsphere resonator" *Optics Letters* 30 (2005)

Doctoral Dissertation **F. Vollmer**, "Resonant detection of nano to microscopic objects using whispering gallery modes" *The Rockefeller University* (2004).

**F. Vollmer**, S.Arnold, D. Braun, I. Teraoka, A. Libchaber "Multiplexed DNA quantification by spectroscopic shift of two microsphere cavities" *Biophysical Journal* 3 (2003)

I. Teraoka, S. Arnold, **F. Vollmer** "Perturbation approach to shift of whispering-gallery modes in microspheres by protein adsorption" *Journal of the Optical Society of America B* 20 (2003)

S. Arnold, M. Khoshsima, I. Teraoka, S. Holler, **F. Vollmer** "Shift of whispering-gallery modes in microspheres by protein adsorption" *Optics Letters* 28 (2003)

**F. Vollmer**, D. Braun, A. Libchaber, M. Khoshsima, I. Teraoka, S. Arnold "Protein detection by optical shift of a resonant microcavity" *Appl. Phys. Lett.* 80 (2002)

M. Teichmann, Z. Wang, E. Martinez, A. Tjernberg, D. Zhang, **F. Vollmer**, B.T. Chait, R.G. Roeder, "Human TATA-binding protein-related factor-2 (hTRF2) stably associates with hTFIIA in HeLa cells" *PNAS* 96 (1999)

## CONFERENCE PAPERS

**F. Vollmer**, J. Topolancik "Disorder-induced High-Q cavities in photonic crystal waveguides" *Photonics West LASE*, San Jose, CA, USA (2008)

J. Deng, A. Tippie, **F. Vollmer**, V. Lien, E. Chen "Whispering-gallery-mode microdisk biosensor: fabrication and characterization" *Optics East*, Boston, MA, USA (2007)

J. Topolancik, **F. Vollmer** "Monitoring of molecular transformations with optical microresonators" Technical Digest 18$^{th}$ *International Conference on Optical Fiber Sensors*, Cancun, Mexico (2006)

**F. Vollmer**, S. Arnold, I. Teraoka, A. Libchaber "Whispering gallery mode biosensor" Technical Digest *16$^{th}$ International Conference on Optical Fiber Sensors*, Nara, Japan (2003)

**F. Vollmer**, S. Arnold, D. Braun, et al. "DNA detection from shift of whispering gallery modes in microspheres" *Annual Biophysical Society Meeting*, San Antonio, TX, USA (2003)

**F. Vollmer**, S. Arnold, A. Libchaber "Novel, fiber-optic biosensor based on morphology dependent resonances in dielectric micro-spheres" *Annual Biophysical Society Meeting,* San Francisco, CA (2002)

## PATENT APPLICATIONS

**F. Vollmer**, P. Fischer "Method and apparatus for measuring and monitoring optical properties based on a ring-resonator" *United States Patent* 7,446,880

**F. Vollmer**, J. Topolancik "System and method for strong photon localization by disordered photonic crystal structures (quasicrystals)" 60/941,950 & 60/980,816

**F. Vollmer**, J. Topolanick "Methods and devices for measurement using pump-probe spectroscopy in High-Q microcavities" WO/2008/034118

**F. Vollmer**, V. Lien "Devices and methods for microfluidic flow-rate and particle detection based on integrated optical fiber cantilever" provisional

**F. Vollmer**, J. Topolancik "Methods, materials and devices for light manipulation with oriented molecular assemblies in micronscale photonic circuit elements with High-Q or slow light" WO/2007/134177

S. Arnold, I. Teraoka, **F. Vollmer** "Perturbation approach to resonance shift of whispering gallery modes in a dielectric microsphere as a probe of a surrounding medium" 20040238744

S. Arnold, I. Teraoka, Y. Okamoto, **F. Vollmer** "Using a change in one or more properties of light in one or more microspheres for sensing chemicals such as explosives and poison gases" 20040196465

S. Arnold, I. Teraoka, **F. Vollmer** "Enhancing the sensitivity of a microsphere sensor using a shift of whispering gallery modes in the microsphere caused by adsorption of target entities" 20040137478

## SEMINARS

| | |
|---|---|
| UCLA (Dr. Gimzewski), CA | 03/2009 |
| University of Central Florida/CREOL (Dr. Hickman), FL | 03/2009 |
| University of Texas – Austin (Dr. Sweeney), TX | 02/2009 |
| Brown (Dr. Xu), RI | 01/2009 |
| ESPCI (Dr. Dubertret), Paris | 12/2008 |
| Institute Henri Poincare, Paris (Symposium "50 Years of Anderson Localization") | 12/2008 |
| Yale (Dr. Cao) | 11/2008 |
| UMissouri (Dr. Fan), MO | 05/2008 |
| Queens College (Dr. Genack), NY | 03/2008 |
| UMaine (Dr. Amar), ME | 11/2007 |
| MIT (Dr. Bhatia), MA | 6/2007 |
| Workshop "Physics of Microresonators" UNC Charlotte (Dr. Astratov), NC | 6/2007 |

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|---|---|
| University Massachusetts Boston (Dr. Rao), Boston, MA | 2/2007 |
| Lehigh University (Dr. Vezenov), Bethlehem, PA | 9/2006 |
| Center for Genomics, Harvard University, Cambridge, MA | 5/2005 |
| Courant Institute, Applied Math Seminar (Dr. Zhang), New York, NY | 4/2004 |
| The Rockefeller University, TriLab Seminar, New York, NY | 2/2004 |

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LIST OF REFERENCES

## CONTACT FOR REFERENCES

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- **Prof. Stephen Arnold** Polytechnic Institute of NYU
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- **Prof. Frans Spaepen** Interim Dean, SEAS at Harvard University
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- **Prof. Jim Hudspeth** Rockefeller University
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- **Prof. James K. Gimzewski** UCLA
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  University of California, Los Angeles
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  607 Charles E. Young Drive East
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- **Prof. Iwao Teraoka** Polytechnic Institute of NYU
  expertise: polymer solutions, chromatography, microsphere sensors
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  Brooklyn, NY 11201
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- **Prof. James Hickman** University of Central Florida
  expertise: in vitro cell culture models, nanoscience, electrophysiology
  Nanoscience Technology Center
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