

MANI HOSSEIN-ZADEH

Mailing address:

Center for High Technology Materials (CHTM)
1313 Goddard SE, Room 116A
Albuquerque, NM 87106 E-mail: mhz@chtm.unm.edu

Phone: 323-731-6634 (cell)
505-272-7845 (work)
URL: www.chtm.unm.edu/~mhz
E-mail: mhz@chtm.unm.edu

Research interests: *Resonant photonic sensing* (biosensing, mass sensing, plasmonic enhancement), *Mid-IR microcavities* (narrow linewidth Mid-IR lasers and comb sources, Mid-IR gas and breath sensors), *High-Q optical microcavities* (fabrication, integration and nonlinear optical properties), *Microwave-photonic devices and systems* (modulators, wireless receivers, optically controlled RF devices), *Optomechanical interaction in high-Q optical microcavities* (optomechanical oscillator and its application in RF signal processing and mass sensing) and *Optofluidic cavities* (formation, physics and applications in biosensing)

Professional Experience

- 2008-Present Assistant professor, **University of New Mexico**,
Electrical and Computer Engineering department (ECE),
Center for High Technology Materials (CHTM), and Optical Science Engineering (OSE) program
- 2005-2008 Postdoctoral scholar, **California Institute of Technology**,
Vahala research group & Center for Physics of Information, T. J. Watson Lab of Applied Physics.
- 2000-2005 Research assistant, **University of Southern California**,
Advanced Photonics and Electronics Lab.
- 1996-1999 Research assistant, **Sharif University of Technology**,
Medical Physics Lab.

Education

- 2001-2005 **University of Southern California (USC)**, Los Angeles, California, USA.
Philosophy Doctorate, *Electrical Engineering-Electrophysics*, Dec 2004.
Dissertation title: “*Electro-Optic Microdisk RF-Wireless Receiver*”, Advisor Professor A. F. J. Levi.
- 1999-2001 **University of Southern California (USC)**, Los Angeles, California, USA.
Master of Science, *Electrical Engineering-Electrophysics*, Dec 2001.
- 1995-1997 **Sharif University of Technology (SUT)**, Tehran, IRAN.
Master of Science, *Physics*, Aug 1997.
Final project title: “*KDP crystal growth and second-harmonic generation of Nd: YAG laser*”
- 1990-1995 **Sharif University of Technology (SUT)**, Tehran, IRAN.
Bachelor of Science, *Applied Physics*, June 1995.
Final project title: “*Design and fabrication of a pulsed Nd: YAG laser*”

Research highlights

- 1-Mid-IR Whispering-Gallery mode (WGM) resonators and sources
- 2-Radiation-pressure-driven optomechanical oscillator (OMO) and its applications
- 3-Silicon based optofluidic biosensors
- 4-Low power photonic control of microwave resonators
- 5-Novel WGM optical microresonators (free microtoroid hybrid microtoroid and fluidic cavities)
- 6-Microdisk modulator and photonic wireless microwave receiver

Awards and honors

- University of New Mexico ECE Department *Outstanding Teacher Award* (May 2011)
- *NSF Career Award* (Jan 2011)
- 2-years postdoctoral fellowship from *Center for Physics of Information* (CPI), California Institute of Technology. (Sept 2006-Sept 2008)
- *Student leadership award*, University of Southern California (May 2001).

Courses taught at UNM

- **Advanced Optics-1** (grad/undergrad level, one semester)
- **Advanced Optics-2** (grad level, two semesters)
- **Laser Physics** (grad/undergrad level, one semester)
- **RF/Microwave Photonics: *New Course!*** (grad level, two semesters)
- **Semiconductor Physics and devices** (undergrad level, two semesters)
- **Electromagnetic Fields and Waves** (undergrad level, one semester)
- **Introduction to Modern Biosensor Technologies: *New Course!*** (grad/undergrad level, two semesters)

Research activities

Assistant Professor (2008 – present)

- High-Q Mid-IR Whispering-Gallery resonators, lasers and sources
- Optomechanical Radio receiver
- Thermo-optical oscillator (for gas and breath sensing)
- Dynamic sensitivity enhancement of resonant photonic biosensors
- Mass sensing using optomechanical oscillators (sub-pg sensitivity)
- Resonant photonic control of microwave filters (record low power)
- Novel integrated biosensor based on resonant photonic detection and nanofluidic FETs
- Integration of ultra high-Q microtoroids and Fabrication of hybrid microdisks

Postdoctoral scholar (2005 - 2008)

(VAHALA research group, California Institute of Technology)

- Demonstration and study of *injection locking* in optomechanical oscillators
- Study and design of optical frequency locking systems for application in UH- Q optical microresonators with thermally broadened resonances
- Demonstration of the first all-optical homodyne RF down-converter based on optomechanical oscillator
- Observation and characterization of *optical spring effect* in silica microtoroids.
- Development of techniques for fabrication of *free* ultra-high- Q microtoroid optical resonators for biosensor and multi-pole filter applications.
- Characterization of microtoroid optomechanical oscillators (frequency, phase noise, linewidth, effect of ambient pressure).
- Development of novel techniques for manipulation of liquid droplets in aqueous medium for photonic application. Efficient fiber-taper coupling to high- Q Whispering Gallery modes in liquid droplets for microfluidic applications.

Research assistant (1999 -2005)

(Advanced Network Technology Lab., University of Southern California)

- Experimental demonstration of a new type of RF filter based on adaptive design methodology.
- Development of the first LiNbO₃ microdisk self-homodyne photonic RF-receiver for indoor wireless applications at Ku band.
- Optimizing the sensitivity of LiNbO₃ microdisk resonant optical modulator (about 10 dB below the best reported results) using RF microring resonator.
- Passive photonic RF down-conversion using FBG filter.
- Harmonic modulation in microdisk modulators and extending the modulation frequency up to three times (44 GHz).

- Development of the first LiNbO₃ microdisk resonant optical modulator.
- Characterization of RF Microring resonator on LiNbO₃ microdisk substrate.
- Theoretical study of p-i-n photodiode nonlinear response for passive down-conversion.
- Experimental study of Whispering-Gallery modes in active and passive microdisks and microspheres.
- Multi-pole RF filters using LiNbO₃ cylindrical resonators.

Research assistant (1996-1999)
(Medical Laser Lab., Sharif University of Technology)

- KDP crystal growth and second-harmonic generation of Nd:YAG laser (M.Sc.project).
- Study of time variation of polarization in He-Ne laser.
- Starting the first laser lab (as a 2-unit course) in Sharif Univ. of Tech using home-made lasers and equipments.
- Nd:YAG laser design and fabrication (B.Sc. project)
- Acoustic transducer test and measurement in fluidic medium (for medical applications).

Research grants and funding

- 1-NSF EPMD: "Compact Narrow-linewidth Microresonator- Based Mid-IR Sources for Ultra-Sensitive Molecular Detection", As **PI** (Co-PI: professor R. K. Jain, UNM ECE), My share: 181 K for 3 years, Start date: Aug. 2012.
- 2-UNM OVPR: As **PI** (Single PI project) Junior Faculty Collaborative Research Grant. "Resonant photonic biosensors", 80 K for 2 years. Start date: Aug. 2012.
- 3-Optoelectronic Research Center at UNM CHTM (block grant), As **co-PI** (PI Professor S. R. J. Brueck), My share: 300 K for 3 years, Start date: Jan 2012.
- 4-NSF CAREER, Title: "Radiation Pressure Based Optomechanical RF Signal Processing for Communication and Sensing", As **PI** (Single PI project), 400K for 5 years, Start date: Feb 2011.
- 5-NSF NUE Title: "An Integrated Multidisciplinary Nanotechnology Undergraduate Education Program at the University of New Mexico", As **co-PI** (PI: Professor Z. C. Leseman UNM Mechanical Engineering Department). My portion: 50K for 2 years. Start date Oct. 2010.

Patents

- Issued:** "Method of Fabricating a Microresonator". US 7,951,299 B2, Techniques for fabrications and manipulation of free optical micro-ring resonators. Inventors: Mani Hossein-Zadeh, and K. J. Vahala,
- Pending:** 1) "Photonic RF down-converter based on optomechanical oscillation". US20090263137 A1. Inventors: Mani Hossein-Zadeh, and K. J. Vahala. (Jan 2009). 2) "Biomarker Sensing Based on Nanofluidic Amplification and Resonant Optical Detection", Sang Han, Mani Hossein-Zadeh, Cornelius Ivory, UNM-STC 2010-093. (March 2010)

Publications (See the complete list at the end of CV)

- 30 published articles (1 invited) in peer-reviewed journals.
- 35 conference papers and presentations (4 invited).

Technical presentations and other invited talks

- "Cavity Optomechanics" Invited talk, Center for Quantum Information and Control (CQuIC), UNM (Nov, 2012)
- "Optomechanical interaction and optomechanical oscillation in optical micro-resonators" Invited talk for UNM OSA/SPIE student chapter (April 2010)
- "Electro-optic microdisk modulator and its application in photonic wireless receiver design", Invited talk for The *Albuquerque IEEE Joint Chapter* (Dec 2008)

- “Towards an Ultra-high- Q free microtoroids (I), (II), (III)”, Hughes Research Laboratory (HRL) (October 2005, March and Sept 2006).
- “Phase noise in a radiation-pressure-driven micro-mechanical oscillator”, Invited talk, *Lee center for advanced networking*, California Institute of Technology (May 2006).
- “Electro-optic microdisk wireless receiver”, Invited talk, *Photonic seminar series*, University of Southern California (August 2004).
- “Electro-optic microdisk photonic RF receiver”, Invited talk, *Center for optoelectronic and optical communications*, University of North Carolina at Charlotte (March 2004).
- “Second-harmonic generation and surface SH-generation”, Optics summer school, *The Institute for Advanced Studies in Basic Sciences*, Zanjan-IRAN (June 1997).

Journal Referee

Electronic Letters (since 2004), *Optics Express* (since 2005), *Physical Review Letters* (since 2006), *Physical Review B* (since 2007), *Review of Scientific Instruments* (since 2006), *Nature Photonics* (since 2007), *Optic Letters* (since 2008), *Physical Review A* (since 2008), *Photonic Technology Letters* (since 2008), *Optics Communications* (since 2009), *Applied Physics Letters* (since 2009).

Book

“**Principles, concepts and advanced tests of physics-1 (Mechanics and Optics)**” (Alavi publication Dec. 1998, Tehran-IRAN). I wrote this study guide while I was teaching at high school for the students who were studying for national entrance examinations exam. The book covers classical mechanics and geometrical optics

Pre-UNM Teaching experience

- Supervised and trained M.Sc through PhD level students in Advanced Network Tech. Lab (USC) and Vahala research group (CALTECH).
- Teaching assistant of “Laser Lab” for 3 semesters (Sharif Univ.of Tech. 1996-1999). I started this lab as a 2-unit course.
- High school physics teacher (Hekmat high school, Tehran, 1994-1995)

Service

- Serving on NSF panel.
- Member of UNM School of Engineering Academic Council (representing OSE program).
- Member of graduate committee of Optical Science Engineering (OSE) program at UNM. Responsible for qualification exams and application reviews.
- Member of Photonics subcommittee of FiO (Frontiers in Optics, the annual meeting of Optical Society of America). (FiO-2010 and FiO-2011).

Leadership experience

- Founder and principal investigator of “M.H.Z. Microwave Photonics Lab” at CHTM.
- President of Iranian Graduate Student Association (IGSA) at USC (2000-2001)
- Started the “Laser Lab” as a 2-unit course at Physics Department of Sharif University of Technology (while a graduate student). Supervised the design and implementation of all the experiments mainly based on home-made lasers and devices.

Professional memberships

- **SPIE** (Since 2011)
- **IEEE** (Institute of Electrical and Electronic Engineers), *member* (Since 2000)
- **OSA** (Optical Society of America), *member* (Since 2003)