**A.T. CHARLIE JOHNSON, JR.**

Department of Physics and Astronomy, University of Pennsylvania (Penn)

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**EDUCATION**

**Harvard University** Cambridge, Massachusetts

###### Ph.D. in Physics. November, 1990 Advisor: Prof. M. Tinkham.

###### Thesis: Effect of leads and quantum fluctuations on small superconducting tunnel junctions

**Stanford University** Palo Alto, California

###### B.S. in Physics with distinction. June, 1984

**HONORS AND AFFILIATIONS**

• Fellow of the American Physical Society, November 2011.

• Dean’s Award for Undergraduate Research Mentorship. April 2011.

• Founding Executive Editor, *AIP Advances* December 2010.

• Co-Founder Graphene Frontiers, LLC, through the Penn UPStarts program. June 2010. Graphene Frontiers was selected for the NSF I-Corps program (October 2011) and received an NSF SBIR grant (Jan. 2012).

• Co-Founding Scientist, Adamant Technologies. Start-up commercializing DNA/NT vapor sensor technology invented in the Johnson group.

• Honor for scholarship and academic excellence. Panhellenic and Inter-Fraternity Executive Councils, Penn, 2006.

• Lindback Foundation Award for distinguished teaching at the University of Pennsylvania. 2003.

• Jack Raper Outstanding Technology Directions Paper Award, 1999 International Solid State Circuit Conference.

• Alfred P. Sloan Research Fellow, 1995.

• David and Lucille Packard Foundation Science and Engineering Fellow, 1994 -1999.

• National Research Council Postdoctoral Fellow, 1992 -1993.

• European Union ESPRIT Postdoctoral Fellow 1990 – 1992.

• National Science Foundation Fellow, 1984-1986.

• Danforth Center Award for excellence as a teaching fellow at Harvard, 1987.

• Phi Beta Kappa as college junior, 1983.

• Ranked top 25 in the world, Men’s Swimming, 200 meter butterfly (long course), 1982.

### EXPERIENCE

**University of Pennsylvania** Philadelphia, Pennsylvania

###### Professor of Physics & Astronomy, 2008 – present

*Associate Chair for Graduate Affairs, Jan 2011 - present*

###### Associate Chair for Undergraduate Affairs, 2005 – July 2011

###### Associate Professor of Physics & Astronomy, 2001 – June 2008

###### Secondary Appointment in Electrical and Systems Engineering, 2002 – present

###### Secondary Appointment in Materials Science and Engineering, 2002 – present

###### Director, Penn Micro/NanoFabrication Laboratory (now Wolf Nanofabrication Facility), 2003 –2005

###### Assistant Professor of Physics & Astronomy. 1994 –2001

###### Member : Laboratory for Research on the Structure of Matter (1994 – present); Institute for Medicine and Engineering (2002 – present); Executive Committee of the Nano/Bio Interface Center (2004 – present).

*Research Interests:* Electron and thermal transport in nanostructures and single molecules, including carbon nanotubes, graphene, DNA, synthetic proteins and other biomolecules. Physical properties of hybrid nanostructures and their use in molecular sensing. Development of scanning probe techniques for electronic property measurement of nanomaterials and nanodevices.

**National Institute for Standards and Technology** Boulder, Colorado

*National Research Council Post-doctoral Fellow September 1992 – December 1993*

**Delft University of Technology** Delft, The Netherlands

#### ESPRIT Post-doctoral Fellow August 1990 - August 1992

Member of NanSDev [Nanoscale Devices], a European consortium. First publication showing coexistence of single-electron charging and zero-dimensional states in Ga[Al]GaAs lateral nanostructures. Demonstrated coherent resonant tunneling in the charging regime and clocked single electron transport in the Quantum Dot Turnstile.

**Harvard University** Cambridge, Massachusetts

#### Research Assistant September 1985 – August 1990

Investigated quantum effects in nanometer-scale superconducting tunnel junctions.

**SUMMARY OF RESEARCH ACHIEVEMENTS**

My research interests include transport phenomena (charge, energy, and spin) in nanoscale systems, including carbon nanotubes and graphene, and hybrid nanostructures based on these materials conjugated with proteins, synthetic peptides, and DNA. Recent research accomplishments include: Creation of bio-inspired vapor sensors based on carbon nanotube transistors functionalized with mammalian olfactory receptors. Crystallographic etching of graphene. Large-scale production of very large graphene oxide membranes. Demonstration of Feedback Controlled Electromigration, an atomically precise fabrication method for nanogap contacts for molecular electronics (patent pending). Invention of a DNA/Nanotube Gas Sensor appropriate for use in an electronic nose system (patent awarded), and quantitative comparison of experiment with all-atom Molecular Dynamics simulation. Development of a quantitative theory of Scanning Conductance Microscopy, including a demonstration of direct measurement of the dielectric constant of a polymer nanowire. Quantitative characterization of individual defects in a nanotube device. First fabrication of air-stable, n-type nanotube field effect transistors. Design and demonstration of a nanotube memory cell. Discovery and control of the Schottky barriers in carbon nanotube field effect transistors using Scanning Gate Microscopy. First observation of the impurity-induced conversion of a nanotube FET into a nanotube diode, and elucidation of the mechanism. Demonstration of 20nm channel nanotube FETs and quantum dots. Discovery of 1-dimensional quantized phonon subbands in nanotubes. First production of nanotube-epoxy composite materials for thermal management (patent pending). Fabrication of “nanogap” electrical contacts for molecular electronic circuits (patent awarded).

# EXTRAMURAL FUNDING

1. *DNA-Functionalized Graphene Sensors*, PI. Lockheed Martin Corporation. 12/1/11 – 7/31/12. $75,000.
2. *Graphene Nanoribbons*, PI. Intel (through Semiconductor Research Corporation). 12/1/11 – 11/30/12. $120,000 (planned for 3 years at $120K/yr based on research progress).
3. *Pilot Production of Large Area Uniform Single-Crystal Graphene Films*. PI. NSF I-Corps (“Innovation Corps) Program. 10/1/11 – 5/31/12. $50,000
4. *DNA-Nanotube Sensor Array for Detection of Human-derived VOCs.* PI. Lockheed Martin Corporation. 9/1/11 – 12/31/11. $50,000.
5. *DNA-Nanotube Sensor Arrays for Detection of Odorless Volatile Organic Compound Taggants,* PI. US Air Force, URES. 8/1/10 – 7/31/12. $299,590
6. *Antibody-Functionalized Carbon Nanotube Transistors as Biosensors for the Detection of Prostate Cancer*. Co-PI. PI is Matthew Robinson, Ph.D. (Fox Chase). DoD Congressionally Directed Medical Research Program. 7/1/09 – 6/30/12 - $577,602.
7. *DARPA Real Nose Program Penn Subcontract*. PI. 11/1/08 – 1/31/10 - ~$500,000
8. *Graphene- and Metal-Based Atomically Precise Nanoelectronics*, PI. Co-PI D. Strachan, Univ of Kentucky. Funded by NSF. 7/1/08 – 5/31/12 -- $444,871
9. *IGERT Fellowships in Nanoscale Science and Engineering: The Two University/One Campus Approach,* NSF-IGERT*.* 12/1/07 - 11/31/12 -- $3,199,198 Co-PI. Training Grant.
10. *Nano-based Methods to Detect Immune Responses to Therapeutic Monoclonal Antibodies*. A research team within Nanotechnology Institute of the Commonwealth of Pennsylvania. 7/07 – 6/08. Allocation $85,000.
11. *Ultra-sensitive “Nose-like” Detection of Vapor Phase Threats with DNA-Decorated Carbon Nanotubes*. PI. Intelligence Community Postdoctoral Research Fellow Program. 7/1/07 – 6/30/10. $120,000/yr.
12. *Wireless Organic Chemical Sensor*. Co-PI (PI G. Piazza). NSF-MASINT Special Project. 6/1/07 – 5/31/09. Allocation ~ $90,000/yr.
13. *Fundamental Investigations of the Physics and Chemistry of DNA-Decorated Carbon Nanotubes.* PI. Co-PI M. Klein. JSTO/DTRA and the Army Research Office. 9/06 – 8/09. $992,000.
14. *NSEC Umbrella Grant. Nano/Bio Interface Center*. National Science Foundation Nanoscale Science and Engineering Center. I am co-leader of Research Team 1. Allocation $65,000/yr. The NSEC has been successfully renewed.
15. *MRSEC Umbrella Grant. Laboratory for Research on the Structure of Matter.* National Science Foundation Materials Science and Engineering Center. Seed Grant, $40,000/yr.
16. *NIRT: Heterogeneous Integration of Nanowires for Chemical Sensors*. National Science Foundation 7/03 – 7/07. $360,000.
17. *NIRT: Complex Nanostructures of Dissimilar Elements: Synthesis Assembly and Proximal Electrical and Optical Properties*. NSF. 8/03 – 7/07. Total grant ~$1.2M.
18. *Confined Phonons and the Thermal Properties of Single Wall Carbon Nanotubes*, Petroleum Research Foundation. 9/01 – 8/03. $90,000.
19. *NIRT: Single-Molecule Electrical Transport: Collaborative Nanoscale Research Bridging Chemistry & Physics*, an NSF-funded Nanoscience Interdisciplinary Research Team (NIRT). $275,000/yr, 9/01 – 8/05. Co-PIs include J. Barton, J. Hone, N. Lewis, and M. Roukes (Caltech).
20. *Carbon Nanotube Derived Materials*, an Interdisciplinary Research Group (IRG) within the Laboratory for Research in the Structure of Matter, 9/00 – 9/04. Co-Group Leader on the project. LRSM was funded at $3.4M/yr for 4 IRGs.
21. *Nanoscale Biosensors.*  A research team within the Commonwealth of Pennsylvania Nanotechnology Institute. Budget, $80,000/yr for 3 years.
22. *4th Winter School J. J. Giambiagi Nanophysics, Nanoscience and Nanotechnology*. Proposal to the NSF for support of an International Meeting. This proposal was funded for $25,000. 1/02 – 9/02.
23. *Manipulation, Assembly and Electronic Properties of Carbon Nanotubes,* Co-PI (PI – J. Fischer).NSF-funded Focused Research Group. $160,000/yr, 9/98-9/01.
24. Packard Fellowship for Science and Engineering. $100,000/year, 9/94-9/99.
25. Sloan Fellowship. $30,000. 1995 – 1997.

**SELECTED PRESENTATIONS AND INVITED TALKS**

1. *Bio/Nano Hybrids for Chemical Detection.* Condensed Matter Seminar. Temple University. Philadelphia, Pensnylvania. April, 2012.
2. *Cutting Edge Nanoscience.* Invited presentation at the 14TH Annual Emerging Technologies Update Day. Mack Center for Technological Innovation. Wharton School, Penn. February 2012.
3. *Bio-Nano Hybrids for Chemical Detection*. Seminar at MIT Lincoln Laboratory. Lexington, Massachusetts. November 2011.
4. *Bio/Nano Hybrids for Chemical Detection.* Invited lecture at the Nano4Defense Conference. Seattle, Washington. October 2011.
5. *Bio-Nano Hybrids for Chemical Detection*. Seminar of the Laboratory for Surface Modification, Rutgers University. October 2011.
6. *Adventures at the Bio/Nano Interface: Biomimetic Chemical Sensors.* Invited lecture at the Sensing at the Human Interace Workshop. Stone Mountain, Georgia. June 2011.
7. *Functionalized Carbon Nanostructures for Chemical Detection*. Invited lecture at BD Technologies Research Facility. Raleigh, North Carolina. June 2011.
8. *Nanocarbon-Biomolecule Hybrids for Chemical Detection.* International Conference on Polymers as Advanced Materials. Pretoria, South Africa. May 2011.
9. *Nano-electronic Nose.* Penn LRSM Science Café. Stony’s Bar and Grill. Wilmington, Delaware. April 2011.
10. *Adventures in Nanoscience: Biomimetic Chemical Sensors and DNA Translocation through Graphene Nanopores*. Physics Colloquium. Tufts University. Medford, Massachusetts. April 2011.
11. *Bio-Nano Hybrids for Chemical Detection*. Invited presentation at the Spring Colloquium of the Monell Chemical Senses Center. March 2011.
12. *Interlayer Physics in Few Layer Graphenes.* Invited talk at the March Meeting of the American Physical Society. Dallas, Texas. March 2011. Talk given by collaborator E.J. Mele.
13. *Biomimetic Chemical Sensors.* Colloquium at the Center for Nanobiotechnology Research, Alabama State University. Montgomery, Alabama. November 2010.
14. *Adventures in Nanoscience: Biomimetic Chemical Sensors and DNA Translocation through Graphene Nanopores*. Colloquium of the Department of Physics and Astronomy, University of Kentucky. Lexington, Kentucky. September 2010.
15. *Biomimetic Chemical Sensors.* Invited lecture at the Workshop on Sensing at the Nano/Bio Interface: Integrated Materials and Techniques for Multi-functional Sensing using Conformal Substrates. Skamania Lodge, Stevenson, Washington. August 2010.
16. *Adventures in Nanotechnology: Biomimetic Chemical Sensors and DNA Translocation through Graphene Nanopores.* Invited lecture at the Center for Integrated NanoTechnologies (CINT) User Meeting.Albuquerque, New Mexico. August 2010.
17. *Biomimetic Chemical Sensors*. Invited presentation at NT 2010. Montreal, Canada. July 2010. Talk given by Postdoctoral Fellow Brett Goldsmith.
18. *Undergraduate Adventures in Nanotechnology: Carbon Nanotubes, Graphene, Nanoparticles, and All That*. Invited lecture at the Gordon Research Conference on Physics Research and Education. South Hadley, Massachusetts. June 2010.
19. *Chemical Sensing with Biomolecule-Nanocarbon Hybrids.* Invited lecture at the “Nano Helps Bio” Conference, Santa Fe, New Mexico. April 2010.
20. *Biomolecule-Nanocarbon Hybrids for Chemical and Biological Sensing,* invited lecture at Chem/Bio Defense-Physical Science and Technology Meeting. Dallas, Texas. November 2009.
21. *Chemical Sensing with Functionalized Carbon Nanostructures*, Colloquium of the Monell Chemical Senses Center. Philadelphia, Pennsylvania. September 2009.
22. *Physics of Graphene,* Intel Graphene Symposium. Hillsboro, Oregon. July 2009.
23. *Nose-like Sensing with Functionalized Carbon Nanotube Transistors.* Quarterly Meeting of the DARPA Real Nose Project. Falmouth, Massachusetts. July 2009.
24. *Functionalized Carbon Nanostructures for Chemical Sensing.* Colloquium of the Electrical Engineering Department at the University of Delaware. March 2009.
25. *Invited lecture at Graphene Week 2009.* Innsbruck Austria. Declined.
26. *Functionalized Carbon Nanostructures for Chemical Sensing.* Chemical and Biological Defense, Physical Science and Technology Meeting. New Orleans, Louisiana. November 2008.
27. *Nose-like Sensing with Functionalized Carbon Nanotube Transistors.* Kick off Meeting of the DARPA Real Nose Project. Alexandria, Virginia. November 2008.
28. *Functionalized Carbon Nanostructures for Chemical Sensing.* Invited lecture at the 7TH Korea Conference on Innovative Science and Technology, Electronic Properties of Carbon Based Materials. Phoenix Park, Korea. October 2008.
29. *Detection of biologically-derived odorants using DNA-functionalized carbon nanotubes.* Invited lecture in a special symposium commemorating the 40TH anniversary of the Monell Chemical Senses Center. Annual meeting of the American Chemical Society, Philadelphia, August 2008.
30. *Nose-like Sensing with Functionalized Carbon Nanostructures*, PREM Materials Research Symposium. University of Puerto Rico, Humacao. May 2008.
31. *Electrons and Phonons in Carbon Nanotubes and Graphene;* and *Biomolecular Sensing with Functionalized Carbon Nanotubes.* Two invited lectures at the Escuela de NanoEstructuras, Valparaiso, Chile, January 2008.
32. *DNA-Decorated Carbon Nanotubes for Chemical Sensing: Experiment and Computer Simulation*. Presentation at the 2007 Nanoelectronic Devices for Defense & Security (Nano-DDS) Conference. Washington DC, June 2007.
33. *DNA-Decorated Carbon Nanotubes for Chemical Sensing*. Condensed Matter Physics Seminar. Rutgers University, April 2007.
34. *DNA-Decorated Carbon Nanotubes for Chemical Sensing*, Physics and Astronomy Colloquium, Dartmouth College, February 2007.
35. *Fundamental Investigations of DNA-Decorated Carbon Nanotubes.* At the 2007 Joint Science and Technology Office for Chemical and Biological Defense, Physical Science and Technology Basic Research Review. Washington DC, January 2007.
36. *Nanotubes and Nanowires for Chemical Sensing.* Invited Focus Group Presentation at the Nanotechnology for Chemical and Biological Defense 2030 Workshop, Santa Fe, January 2007.
37. *Nanotubes and Nanowires for Chemical Sensing.* Invited lecture at the 6th Edward Bouchet-Abdul Salam Institute (EBASI) Meeting, Cape Town, South Africa, January 2007.
38. *DNA-Decorated Carbon Nanotubes for Chemical and Biological Sensing*. Invited lecture at FNANO 06, Foundations of Nanoscience: Self-assembled Architectures and Devices. Snowbird, April 2006.
39. *DNA-Decorated Carbon Nanotubes for Chemical and Biological Sensing*. Invited presentation at the DARPA Workshop on Nanotubes and Nanowires for Defense Applications. Napa, March 2006.
40. *DNA-Decorated Carbon Nanotubes for Chemical and Biological Sensing*. Invited lecture at IWEPNM 2006, the International Winterschool on the Electronic Properties of NanoMaterials. Kirchberg, Austria, March 2006.
41. *Thermal and Thermoelectric Phenomena in Carbon Nanotube-derived Materials,* Invited lecture at the Spring Meeting of the Materials Research Society, San Francisco, March 2005.
42. *Science and Technology of Single-walled Carbon Nanotubes,* National University of Lesotho, March 2005.
43. *New Results in Carbon Nanotube Electronics*. Annual Symposium of the NanoCenter. University of South Carolina. November 2003.
44. *Memory Effects in Nanotube Electronics.* Condensed Matter Physics Seminar. University of Alicante, Spain. November 2003.
45. *Carbon Nanotube Electronics: The Inside Story.* Condensed Matter Physics Seminar, University of Delaware. September 2003.
46. *Carbon Nanotube Electronics: The Inside Story.* Invited lecture at the 2003 Meeting of the Electrochemical Society. Paris, April 2003.
47. *Memory Effect and Role of Defects in Carbon Nanotube Circuits.* Invited lecture at the 2003 March Meeting of the American Physical Society. Austin, March 2003.
48. *Local Electronic Properties of Carbon Nanotube Circuits*. Invited lecture at the Fall Meeting of the Materials Research Society. Boston, December 2002.
49. *Measuring the Local Electronic Properties of Nanotube Field Effect Transistors*. Lecture at the NSF/EU Workshop on Nanotechnology. Boston, December 2002.
50. *Carbon Nanotube Electronics*: *The Inside Story*. Condensed Matter Physics Seminar, Pennsylvania State University. October, 2002
51. *Carbon Nanotube Electronics:* *The Inside Story.* Nanotechnology Seminar, University of Washington, October 2002.
52. *Carbon Nanotube Electronics: The Inside Story.* Invited lecture at the International Workshop on Disordered Systems, Universidad Autonoma de Puebla, Mexico, August 2002.
53. *Electronic and Thermal Properties of Carbon Nanotubes*. A set of 3 invited lectures at the Winterschool J.J. Giambiagi, University of Buenos Aires, Buenos Aires, Argentina. July 2002. I was a co-organizer of this Winterschool.
54. *Carbon Nanotube Nanoelectronics*, Colloquium of the Department of Mechanical Engineering and Applied Mechanics, Drexel University, May 10, 2002.
55. Imaging *and Characterization of Defects within Nanoscale Electronic Devices*, presentation at the LRSM Nanotube IRG Workshop, April 2002.
56. *Advances in Nanotube Nanoelectronics.* invited presentation at the 16th Kirchberg Winterschool on Molecular Nanostructures, March 2002.
57. *Undergraduate Research: Perspective from the Research University*. Invited Lecture at the Meeting of the American Association of Physics Teachers, Philadelphia, February 2002.
58. *Carbon nanotube nanoelectronics,* Physics Colloquium, West Virginia University, October 2001.
59. *Thermal and Electronic Transport Phenomena in Single Wall Carbon Nanotubes*, a set of three invited lectures at the Pan American Advanced Study Institute, Costa Rica, July 2001.
60. *Quantum Confinement of Electrons and Phonons in Single Wall Carbon Nanotubes*, Physics & Astronomy Colloquium, University of Texas at Dallas, May 2001.
61. *Quantum Confinement of Electrons and Phonons in Single Wall Carbon Nanotubes*, Physics & Astronomy Colloquium, New York University, April 2001.
62. *Quantized Phonon Subbands and Thermal Conductivity of Single Wall Carbon Nanotubes*, invited talk at the Spring Meeting of the Materials Research Society, April 2001.
63. *Quantum Confinement of Electrons and Phonons in Single Wall Carbon Nanotubes*, Materials Science and Engineering Colloquium, Northwestern University, April 2001.
64. *Quantized Phonon Subbands and Thermal Conductivity of Single Wall Carbon Nanotubes*, invited talk at the March Meeting of the American Physical Society, March 2001.
65. *Quantum Confinement of Electrons and Phonons in Single Wall Carbon Nanotubes*, Physics & Astronomy Colloquium, North Carolina State University, 2001.
66. *Quantum Confinement of Electrons and Phonons in Single Wall Carbon Nanotubes*, Physics & Astronomy Colloquium, Ohio University, March 2001.
67. *Carbon Nanotube Nanoelectronics*, Nanoscale Science and Engineering Seminar hosted by the School of Engineering and Applied Science, University of Pennsylvania, February 2001.
68. *Quantum Confinement of Electrons and Phonons in Single Wall Carbon Nanotubes*, Physics Department Colloquium, North Carolina State University, February 2001.
69. *Effect of Quantum Confinement on Electron and Thermal Transport in Carbon Nanotubes*, Physics Department Colloquium, University of Virginia, December 2000.
70. *Confined Electrons and Phonons in Single Wall Carbon Nanotubes*, Physics & Astronomy Colloquium, Georgetown University, October 2000.
71. *Confined Electrons and Phonons in Single Wall Carbon Nanotubes*, Physics & Astronomy Colloquium, University of Pennsylvania, September 2000.
72. *One-dimensional electrons and phonons in single wall carbon nanotubes*, Physics Department Colloquium, Ohio University, May 26, 2000
73. *One-dimensional electrons and phonons in single wall carbon nanotubes*, Special Condensed Matter Physics Seminar, Harvard University, May 10, 2000.
74. *One-dimensional electrons and phonons in single wall carbon nanotubes*, Condensed Matter Physics Seminar, Johns Hopkins University, May 3, 2000.
75. *One-dimensional electrons and phonons in single wall carbon nanotubes*, Condensed Matter Physics Seminar, Rice University, April 24, 2000.
76. *One-dimensional electrons and phonons in single wall carbon nanotubes*, Condensed Matter Physics Seminar, Duke University, April 6, 2000.
77. *One-dimensional electrons and phonons in single wall carbon nanotubes*, Condensed Matter Physics Seminar, University of North Carolina – Chapel Hill, April 5, 2000.
78. *Single wall carbon nanotube electronics*, invited presentation at the 14th Kirchberg Winterschool on Molecular Nanostructures, March 2000.
79. *New physics and technology with carbon nanotubes*, Condensed Matter Physics Seminar, Georgia Institute of Technology, February 18, 2000.
80. *New physics and technology with carbon nanotubes*, Physics Department Colloquium, Clemson University, February 17, 2000.
81. *New physics and technology with carbon nanotubes*, Physics Department Colloquium, Northwestern University, February 2, 2000.
82. *New physics and technology with carbon nanotubes*, Colloquium of the James Franck Institute, University of Chicago, February 1, 2000.
83. *Single nanotube molecular electronics*, Univ. of Wisconsin Condensed Matter Physics Seminar, Jan. 2000.
84. *Carbon nanotube molecular electronics*, University of Puerto Rico Meeting of the CIRE project affiliated with the LRSM. November 13, 1999.
85. *Carbon nanotube electronics*, University of Pennsylvania Physical Chemistry Seminar, September 30, 1999.
86. *Effect of backscattering on transport in carbon nanotubes,* invited presentation at the Centennial Meeting of the American Physical Society, Atlanta, 1999.
87. *Electronics of single wall carbon nanotubes*. International Solid State Circuit Conference, February 1999. Recipient of the Jack Raper Award for the Outstanding Technology Directions Paper.
88. *Carbon nanotubes: Structure and transport below 1 µm*, Condensed Matter Physics Seminar, New York University, January 1999.
89. *Carbon nanotubes: Structure and transport below 1 µm*, NEC Research Institute, November, 1998.
90. *Single-wall carbon nanotubes: Structure and Transport below 1 µm*. Condensed Matter Physics Seminar, University of Pennsylvania, September 1998.
91. *Atomic-resolution STM imaging of bundles of single-wall carbon nanotubes*, Wilfried Clauss, D.J. Bergeron, and A.T. Johnson, invited presentation at the 12th Kirchberg Winterschool on Molecular Nanostructures. Kirchberg, Austria, March 1998.
92. *The quantum physics and artificial chemistry of nanostructures*. Temple University Physics Colloquium, December, 1996.
93. *Effect of magnetic field on lateral quantum dots in the charging regime*, invited talk at the Third NRC Workshop on Quantum Dots, at the Institute for Microstructural Sciences, Natural Research Council of Canada, June 1993.
94. *Single electron charging and zero-dimensional states in semiconductor nanostructures,* California Institute of Technology, February 1993.
95. *Zero-dimensional states and single electron charging in semiconductor quantum dots*, invited talk at the General Conference of the Condensed Matter Division of the European Physical Society, Prague, Czechoslovakia, April 1992.
96. *Quantized current in a semiconductor Quantum Dot Turnstile*,ESPRIT Joint Workshop on Nanostructures, Glasgow, United Kingdom, June 1991.
97. *Realization of a single-electron turnstile in a GaAs/AlGaAs heterostructure*, Seminaire de la Laboratoire de Physique des Solides, Université Pierre et Marie Curie, Paris, France, April 1991.

# TEACHING EXPERIENCE

Physics 150, Engineering Physics I, Spring 1994 110 students. SCUE rating: 3.1/4.0

Physics 150, Engineering Physics I, Spring 1995 67 students. SCUE rating: 3.4

Physics 150, Engineering Physics I, Fall 1995 81 students. SCUE rating: 3.4

Physics 151, Engineering Physics II, Spring 1996 78 students. SCUE rating: 3.6

Physics 521, Graduate Lab, Fall 1996 9 students. SCUE rating: 3.4

Physics 414, Senior Lab, Spring 1997 15 students. SCUE rating: 3.3

Physics 521, Graduate Lab, Spring 1997 2 students. SCUE rating: 3.5

Physics 521, Graduate Lab Spring 1997 (run with Ph 414) 2 students. SCUE rating: 3.5

Physics 521, Graduate Lab, Fall 1997 26 students. SCUE rating: 3.4

Physics 414, Senior Lab, Spring 1998 5 students. SCUE rating: 4.0

Physics 150, Engineering Physics I, Fall 1998 40 students. SCUE rating: 3.0 \*

Physics 151, Engineering Physics II, Spring 1999 97 students. SCUE rating: 3.4

Physics 199, Freshman Physics Seminar 80 students, team taught.

Physics 150, Engineering Physics I, Fall 1999 64 students. SCUE rating: 3.2 \*

Physics 151, Engineering Physics II, Spring 2000 110 students. SCUE rating: 3.4

Physics 170, Freshman Honors Physics I, Fall 2000 28 students. SCUE rating

Physics 171, Freshman Honors Physics II, Spring 2001 25 students, SCUE rating: 3.9.

Physics 170, Honors Physics I, Fall 2001 30 students, SCUE rating: 3.7

Physics 171, Honors Physics II, Spring 2002 20 students, SCUE rating: 3.7

Physics 170, Honors Physics I, Fall 2002 28 students, SCUE rating: 3.8

Physics 171, Honors Physics II, Spring 2003 23 students. SCUE rating: 3.9

Physics 518, Solid State Physics. Spring 2004 18 students. SCUE rating: 3.4

Physics 150, Engineering Physics I. Fall 2004 80 students. SCUE rating: 3.5

Physics 518. Solid State Physics. Spring 2005 30 students. SCUE rating: 3.2

Physics 518, Intro. Condensed Matter Physics, Spring 2006 26 students. SCUE rating: 2.8

Physics 401, Stat. Mechanics & Thermo., Fall 2006 15 students. SCUE rating: 3.1

Physics 518, Intro. Condensed Matt. Physics, Spring 2007 19 students. SCUE rating: 3.3

Physics 518, Intro. Condensed Matt. Physics, Spring 2008 15 students. SCUE rating: 3.0

Physics 230, Vibrations and Waves, Fall 2008 32 students. SCUE rating: 3.2

Physics 418, Intro. Condensed Matt. Physics, Spring 2009 24 students. SCUE rating: 3.2

Physics 230, Vibrations and Waves, Fall 2009 28 students. SCUE rating: 3.3

Physics 351, Analytical Mechanics, Spring 2010 28 students. SCUE rating: 3.6

Physics 230, Vibrations and Waves, Fall 2010

Physics 351, Analytical Mechanics, Spring 2011

Physics 351, Analytical Mechanics, Spring 2012.

\* - The course combined Physics 150 and Math 140 (Introduction to Calculus).

# RESEARCH SUPERVISION

## Postdoctoral

1. **Ganghee Han**, *Growth of large-area graphene for biosensors.* Jan 2012 – present.
2. **Eric Dattoli**, *Large-scale arrays of DNA-NT vapor sensors.* Jan 2012 – present.
3. **Brett Goldsmith.** *Large-scale arrays of DNA-NT vapor sensors.* August 2008 – present.
4. **Sasa Zaric.** *Vapor sensors based on hybrids of nanotubes and olfactory receptors.* February 2008 – present.
5. **Zhengtang Luo.** *Synthesis of ultra-large graphene oxide membranes*.August 2007 – present.
6. **Douglas Strachan***, Electrical contacts to single peptide molecules.* September 2003 – August 2008. Current position, Assistant Professor of Physics, University of Kentucky.
7. **Ncholu Manyala,** *Carbon nanotube electronics*. Periodic 1-month visits: June 2004; June 2005; July 2007. July 2009. Manyala was a Professor of Physics at the National University of Lesotho, Roma, Lesotho but has recently taken a position as Chair for Carbon Nanomaterials at the University of Pretoria, South Africa.
8. **Prof. Nicholas Pinto***, Electronics and gas sensing characteristics of individual polymer nanofibers*, June – August 2000; Regular visits thereafter, including a 2 week visit June 2007. Pinto visits my lab as part of an NSF-funded PREM (Partnership for Research and Education on Materials) project associated with the LRSM. Pinto visits my lab for 2-4 weeks most summers, sometimes accompanied by undergraduate researchers.
9. **Martin Ntwaeaborwa**, *CVD growth of single walled carbon nanotubes*. November 2005 – January 2006. Ntwaeaborwa is an Assistant Professor at the University of the Free State, Bloemfontein, South Africa.
10. **Jonas Goldsmith**, *Electronic properties of polymer nanofibers*. September 2002 – September 2003. Current position, Assistant Professor of Chemistry, Bryn Mawr College.
11. **Scott Paulson,** *Integrated circuits of carbon nanotube peapods***.** September 2001 – September 2004. Current position, Assistant Professor of Physics, James Madison University
12. **James Hone**. *“Nanogap” contacts for electrical characterization of single molecules.* September 1998-May 2000. Current position: Assistant Professor of Mechanical Engineering, Columbia University.
13. **Jacques Lefebvre**. *Single wall carbon nanotube electrical circuits.* September 1997-September 1999. Current position, Scientist, Canada National Research Council, Ottawa, Canada..
14. **Wilfried Clauss**. *Atomic-resolution STM and AFM imaging of single-wall carbon nanotubes*, July 1996*.* Current position: Zeiss, Inc.
15. **Thomas Heinzel**. *Measurement of the electron-electron scattering time inside a nanostructure.* September 1994 – September 1996. Current position: Professor of Physics at the University of Düsseldorf.

## Graduate

1. **Nick Kybert.** *Bio-enabled nanosensor for detection of volatile biomarkers of ovarian cancer.* Thesis research.
2. **John Qi**, *Microfluidic approaches to chemical functionalization of arrays of carbon nanotube and graphene based chemical sensors.* Thesis research.
3. **Mitchell Lerner**, *Functionalized carbon nanotube transistors for detection of prostate cancer biomarkers.* Project in collaboration with Dr. Matthew Robinson (Fox Chase Cancer Center)
4. **Mopeli Fabiane.** *CVD growth of large-area graphene*.Fabiane is from South Africa. He plans to complete his Ph.D. with my collaborator Prof. N. Manayla at U. Pretoria.
5. **Stephanie Feldman**. *Functionalized carbon nanotubes devices for cancer biomarker detection.* June-Aug 2009. Summer project in collaboration with Dr. Matthew Robinson (Fox Chase Cancer Center).
6. **Marzie Taheri Sajani.** *Wireless organic chemical sensor*. Collaboration with Prof. G. Piazza (ESE). 2007-2009.
7. **Robert Johnson,** *Molecular dynamics simulations of nanotube/DNA gas sensors*. Thesis defended April 2009. Work done in collaboration with Prof. Michael Klein (Penn Chemistry, now Temple).
8. **Ye Lu**. *Electronic, structural, and sensing properties of graphene nanostructures.* Thesis defended September 2011 .
9. **Luke Somers**. *Graphitic attachment of single-stranded DNA and metal nanoparticles.* Thesis defended July 2011.
10. **Sam Khamis**. *Nanotube/DNA vapor sensors*. Thesis defended April 2009. Currently employed at Nanosense, Inc., a company whose goal is the production of a commercial e-nose system that incorporates the DNA/NT sensor concept pioneered in my lab.
11. **Yaping Dan**. *Graphene vapor sensors*. Dan received his Ph.D. from Penn ESE in December 2008.
12. **Michelle Chen**. *Carbon nanotube biosensors.* Co-supervised with J.E. Fischer (MSE). Thesis defended December 2007. Present position – Assistant Professor of Physics, Simmons College.
13. **Danvers Johnston**. *Atomically precise electrical contacts for single molecule electronics.* Thesis defended August 2008. Present position – Postdoctoral Fellow, Center for Functional Nanomaterials, Brookhaven Laboratory.
14. **Kumhyo Byun.** *Silicon nanowires for electronics beyond CMOS.* Co-supervised with J.E. Fischer (MSE). Thesis defended Byun is now employed at Applied Materials.
15. **Cristian Staii.** *Advances in carbon nanotube electronics*. Thesis defended June 2005. Postdoctoral fellow at Princeton. Currently a postdoctoral fellow at the University of Wisconsin Madison.
16. **Yangxin Zhou**. *Chip-based “nanostencils” for nanowire characterization*. Thesis defended 2004. Postdoctoral fellowships at University of Illinois Urbana-Champaign and UCLA. Currently employed at Spectrawatt, a solar startup.
17. **Marky Llaguno**. *Thermoelectric effect measurements of individual single wall carbon nanotubes*. Collaboration with J.E. Fischer. Thesis defended August 2004. Postdoctoral fellow at U.C. Berkeley. Currently employed at University of Texas Dallas.
18. **Huiming Qiu**. *Electrical characterization of single synthetic peptide molecules.* Collaboration with Prof. P. Les Dutton of Penn Biophysics and Biochemistry. Qiu is employed at Credit Suisse.
19. **Marcus Freitag**. *Local measurements of electrical properties inside carbon nanotube circuits.* Thesis defended July 2002. Now a Member of the Technical Staff at IBM T.J. Watson Research Laboratory.
20. **Marko Radosavljevic**. *Fabrication and characterization of carbon nanotube networks.* Thesis defended September 2001. Now a Member of the Technical Staff with Intel’s Advanced Transistor Research Group.
21. **Zhiming Yu**. *Transport and single-electron spectroscopy measurements of a quantum dot array.* Thesis defended April 2000. Yu is employed by Credit Suisse.
22. **David Bergeron**. *STM and AFM of monolayers of synthetic peptides.*  Collaboration with P. Leslie Dutton of Penn Biophysics and Biochemistry. Thesis defended April 2000. Now with Oliver, Wyman & Co.
23. **Radoslav Antonov**. *Electrical measurements of individual single-wall carbon nanotube molecules*. Thesis research. Thesis defended April 1999. Now a Vice President at Lehman Brothers.
24. **Jerry Carter**. *Electron charging in quantum dots*. Master’s thesis supervision.
25. **Mang-mang Ling**. Research Assistant, summer 1996.

## Undergraduate (Penn students unless otherwise indicated)

1. **Alex Crook**. *Use of large-area graphene as the transparent conductor in a touch screen display.* LRSM REU program. Summer 2011.
2. **Julia Steinberg**. *DNA-Graphene vapor sensors based on wafer-scale graphene.* PURM project, Summer 2011.
3. **Akshay Amin**. *Nanoscale hybrids of biomolecules and graphene.* PURM project, Summer 2011.
4. **Brandon Comella** (Caltech). *Array of DNA-nanotube vapor sensors for detection of ovarian cancer biomarkers.* Comella will join my lab for a summer research project, funded the Mellon Minority Undergraduate Fellowship Program.
5. **Yuxiao Dai (Hong Kong U of Science and Technology).** I have issued an invitation to Mr. Dai to visit Penn for a summer research project. Dai was recommended by Prof. Yilong Han (HKUST), once a postdoctoral fellow in our department.
6. **Aurélien Masson (Minatec, Grenoble)**. *Measurements of nanotube devices in a microfluidic environment.* Through the NBIC-Minatec partnership.
7. **Yarely Davila Vazquez (U. Puerto Rico-Humacao).** *Controlled doping of graphene using ultraviolet irradiation*. A paper on this work was submitted to Applied Physics Letters with Vazquez as co-author.
8. **Jorrell Fredericks (Alabama State)**. *Optimized growth parameters for carbon nanotube transistors*. Fredericks is an African American scientist
9. **Nicole Kawamoto (Simmons).** *CVD growth of wafer-scale graphene*. Kawamoto worked two summers with my group as part of a collaboration between me and her advisor, Prof. Michelle Chen (now at Point Loma Nazarene University).
10. **Michael Chien.** *Coarse-grain modeling of DNA-nanotube hybrids.* Summer REU project June-August 2010. Also Physics Dept honors thesis research, Sept 2010 – April 2011.
11. **Nathalia Garcia (Temple).** *Simple microfluidic system for carbon nanotube biosensors*. LRSM REU program. Woman URM scientist who will begin as a graduate student at Rutgers in Fall 2011.
12. **Thomas Ly**
13. **Sydney Mbachu.** *Carbon nanotube electronics.* Mbachu, an African American student at Penn, was funded by an REU Supplement to my NSF Graphene grant.
14. **Jake Robins.**
15. **Nicholas Kybert (Warwick).** *Graphene nanoelectronics*. June 2008 – Sept 2008. LRSM REU program. Kybert has returned to my lab summer 2009. He joined Penn as a graduate student Sept 2010.
16. **Jennifer Dailey.** *Detection of Lyme disease using protein-nanotube hybrids.* REU as part of my NSF Graphene grant, 6/1/09 – 8/15/09. Jen worked in the lab during summer 2010 and 2011. She is also conducting her honors thesis research with my group (Physics 499). She has been funded through a combination of the LRSM REU program, my NSF Graphene REU supplement, and Penn’s University Scholars program.
17. **Jonathan Cinque.** *Crossbar arrays for nanotube devices.* REU as part of my NSF Graphene grant. 6/1/09 – 8/15/09
18. **Dan Singer**. *CVD growth of graphene.* 6/1/09 – 8/15/09
19. **Axel Rivera (Humacao).** *Molecular dynamics simulations of peptide-nanotube hybrids.*
20. **Jong Hsien Lim (Swarthmore).** *Fabrication of graphene nanoconstrictions with atomically precise sidewalls.* 6/1/09 – 8/15.09. Lim continued his work with my group during the academic years and summers 2009-2011.
21. **Matthew Berck**. *Nanotube sensors for cancer biomarkers.* June 2009 – August 2009. June 2008 – Aug 2008. Vagelos Scholar Research Program. Accepted into the Harvard graduate program.
22. **Ryan Jones**. *Carbon nanotube electronic nose.* May 2007 – present. LRSM REU program. Recipient of a NSF NCMR Research Fellowship for his work with my group on *Wireless Organic Vapor Sensors.*
23. **Blake Rego (Columbia)**. *Molecular dynamics simulations of protein-functionalized carbon nanotubes*. LRSM REU program.
24. **Joseph Panetta**. *Molecular dynamics simulations of DNA-Nanotube Hybrids.*
25. **Rebekah Sheldon.** *Molecular Dynamics simulations of single-stranded DNA/single walled carbon nanotube hybrid nanostructures.* October 2006 – present.
26. **Journee Islip (Columbia).** *Construction of an system for electrochemistry measurements of self-assembled monolayers*. SUNFEST REU program project June – August 2006.
27. **Alex Fried.** *AFM measurements of the diameter change of carbon nanotubes due to DNA coating*. June – August 2005. Fried’s work was awarded a E. Ward Plummer prize for Physics in the LRSM REU program. Fried continued with my group on a second project: *Microfluidic system for nanotubes sensor measurements in liquids.* January – May 2007. Attended 2007 APS March Meeting. Enrolled in PhD program in Physics at Stanford.
28. **Sujit Datta.** *EFM of graphene.* June 2007 – June 2008. *AFM measurements of protein functionalized nanotubes.* June – August 2006. *Construction of an outgasser/filling system for synthesis of carbon nanotube peapods.* June – August 2005. Datta was first author on two articles in Nano Letters, and co-author on a Physical Review Letter and a Nano Letter. **Awarded the 2008 LeRoy Apker Award of the American Physical Society for outstanding undergraduate achievement in Physics.**
29. **Chenghong Huang.** *Carbon nanotube devices for biomedical sensing.* January 2006 – May 2006.
30. **Jon Sobota (Columbia).** *Rotating stage for fabrication of Pt nanogap contacts for measurements of single molecule optoelectronics.* June – August 2005. Supported by the LRSM REU program.
31. **Emmanuel Oneygam (Univ of Texas Dallas)**. *On-chip lithographic gate for carbon nanotube biosensors*. June 2004 – August 2004. SUNFEST REU program. PhD student in Electrical Engineering at UT Austin.
32. **Hem Wadhar**. *Carbon nanotubes peapods.* June – August 2004. LRSM REU program. PhD student in Applied Mathematics at UCLA. NSF Graduate Research Fellow.
33. **Evan Hindman (Stanford)**. *Micromachined substrates for development of advanced nanotube materials.* June – August 2004.LRSM REU program.
34. **Michael Stern.** *Does the human thyroid hormone T3 dope carbon nanotubes?* Stern’s project as a Vagelos Scholar and Physics major. PhD program in Biophysics at UCSF.
35. **Lindsay** **Karpowich.** *Optimized contact metallization for nanotube field effect transistors*. Senior Design project in Penn’s Materials Science and Engineering department.
36. **Erika Nelson**. *Carbon nanotube based biosensors.* February 2003 – June 2003.
37. **Carl Pfendner**. *Optical masks for mass production of carbon nanotube circuits.* September 2002 – June 2003. *Growth of CVD nanotubes using evaporated iron thin film catalyst.* LRSM REU program June – August 2002.
38. **Enrique Rojas.** *Interaction of carbon nanotubes with biomolecules.* September 2002 – present. *Optimizing CVD growth parameters for single wall carbon nanotubes*. LRSM REU June – August 2002. Attended APS March Meeting 2004. **Co-author of publication [28].**
39. **Jawaad Mahmood**. *Current breakdown characteristics of carbon nanotubes under Ultra-High Vacuum.* Senior Design Project for Electrical and Systems Engineering, September 2002 – present. *Electronic characterization of individual silicon nanowires*. LRSM REU program June – August 2002.
40. **Steve Lee**. *Current breakdown characteristics of carbon nanotubes under Ultra-High Vacuum.* Senior Design Project for Electrical and Systems Engineering, September 2002 – June 2003.
41. **Kiran Thadani**. *Magneto-transport properties of cobalt-contacted carbon nanotube circuits.* LRSM REU program June – August 2001. Physics major honors thesis project 2001 - 2003. **Co-author of publication [33].**
42. **Michael Biercuk**. *Thermal conductivity of nanotube composites.* Laboratory for Research on the Structure of Matter Research Experience for Undergraduates (LRSM REU) program June – August 2000. Continued as a Physics Department Senior Honors project during the 2000/2001 academic year. **Co-author of publications [35], and [37]. Presentation at the March Meeting of the American Physical Society, March 2001.** Completed PhD in Physics at Harvard.
43. **Jerome Hyun (Colubmia).** *Thermal conductivity of nanotube composites.* Laboratory for Research on the Structure of Matter Research Experience for Undergraduates (LRSM REU) program June – August 2001. **Co-author of publications [35].**
44. **Ian Gelfand.** *Fabrication of a nanotube electromechanical switch*. LRSM REU program summer of 2000. Senior design project in the Penn Materials Science and Engineering (MSE) department, Sept. 2000 – May 2001. *Fabrication of flat electrical contacts for single wall nanotube circuitry.* Penn MSE student in the SUNFEST REU program (Electrical Engineering). June-August ’99. Work-study project September 1999 – May 2000. **Presentation at the March Meeting of the American Physical Society, March 2000. Presentation at the April Meeting of the Materials Research Society, April 2001.** Completed PhD in Applied Physics at Harvard.
45. **Sarah Winnacker**. *Improved single wall nanotube field effect transistors.* Senior design project in the Penn MSE department. September 1999 – May 2000.
46. **Gregory Grason**. *Role of hydration in the electrical properties of peptide monolayers.* Penn SAS student (Physics & Astronomy) in the LRSM REU program. June-August ’99. Continued as a Senior Honors thesis project, September 1999 – May 2000. **Co-author of publication [50].** Completed PhD in Physics at Penn.
47. **Rony Wiener**. *Measuring the conductivity of single DNA molecules.* Penn Bio-engineering student in the LRSM REU program. June-August ’99.
48. **Ilan Gur (Berkeley)**. *Probe-station for single wall nanotube circuitry.* LRSM REU program. June-August ’99.
49. **Joseph Lynch**. *Fabrication of a nanotube-nanotube junction using an Atomic Force Microscope.* Penn Physics & Astronomy student in the LRSM REU program. June-August ’98. Senior Honors Project, September 1998 – April 1999. **Co-author of a refereed publication [51] and non-refereed [9].** **Presentation at the Centennial Meeting of the American Physical Society, Atlanta, 1999**.
50. **Kristian Hahn.** *Making electrical contact to individual single-wall carbon nanotubes.* Penn Chemical Engineering student in the LRSM REU program. June-August ’97 and June - August ’98. Completed PhD in Physics at Penn.
51. **Nafatari Manigault (Lincoln)**. *Optical masks for making electrical circuits containing single-wall carbon nanotubes.* LRSM REU program. June-August ’97.
52. **Sunitinder Sekhon**. *Electron beam lithography patterns for contacting individual single-wall carbon nanotubes.* Work-study student (Engineering). September ’97 – April ‘98.
53. **Andrew Potts (Ursinus)**, *Fabrication and characterization of nanocluster samples suitable for Scanning Tunneling Microscopy*. LRSM REU program. June-August ’96*.*
54. **Jason Motz**. *Installation of a computerized temperature control system in a dilution refrigerator.* Penn Physics & Astronomy. Physics Department Summer Research Fellowship. June – Aug, ’96.
55. **Sheila Chang (RPI)**. *Fabrication and characterization of low-temperature microwave filters*. LRSM REU program. June-August ’96.
56. **Joe Piñon**. *A “negative tone” photolithography process for nanostructure fabrication.* Penn Physics & Astronomy. Physics Department Summer Research Fellowship.. 6/95-8/95.
57. **Jonah Paransky**, Electrical Engineering Senior Design Project. *Fabrication and optical band structure measurements of a photonic crystal*. Work-study student. Collaboration with Prof. Arjun Yodh and graduate student Tony Dinsmore of Penn Physics & Astronomy. Sept. ‘96 – May ’97. Awarded a Goldberg Travel Fellowship to continue his research at the Technion, Israel. September 1994 – July 1995. Received the Rose Award. **Presentation at the March Meeting of the American Physical Society, May 1997**.
58. **Kwabena Asamoah (Morgan State)**. *Construction of low-noise electronics*. LRSM REU program. June-August ’94.

## Other Research Supervision

1. **Jeremy Yodh.**
2. **Thomas Ly.** *Nanotube/DNA vapor sensors.* High school student from Philadelphia public school system. July 2007 – present. Ly will enroll at Penn in September 2009.
3. **Peilin Zhao.** *Effect of contact metallization on the performance of carbon nanotube transistors.* High school student from Philadelphia public school system. June 2008 – December 2008. Zhao enrolled as an undergraduate at Drexel University, Sept 2009 - .
4. **Daniel Bergey**. *Nanotubes solubilized in water for electronic devices.* Sept 2002 – June 2003. High school student. **Co-author of publication [28].** Bergey pursued undergraduate studies at MIT.
5. **Marc Baron.** *Properties of carbon nanotube electronic devices.* LRSM Research Experience for Teachers program. June – August 2004. From the Phliadelphia public school system.
6. **Fran Poodry**. *Structural changes in metal layers exposed to CVD conditions.* LRSM Research Experience for Teachers (RET) program June – August 2002. From the Philadelphia public school system.
7. **John Pak Lee**. *AFM structural analysis of CVD-grown carbon nanotubes*. LRSM RET program June – August 2001. From the Philadelphia public school system.
8. **Alan Bronstein**. *Manipulation of single wall nanotubes into electrical circuits.* LRSM RET program June – August 1999. From the Philadelphia public school system.

# STAFF SUPERVISION

1. **Dr. Jose Vithayathil**, Research Specialist IV. Responsibilities include maintenance / development of Advanced Laboratory.. Labs added to the curriculum: DC SQUID and Optical Pumping. 1996/97 and 1997/98.

# COMMITTEES AND ADMINISTRATIVE ASSIGNMENTS

**A. Department**

1. Chair of the Ad Hoc Committee for Promotion of Marija Drndic to Professor. March 2012-present.
2. Member of the Ad Hoc Committee on Dr. Cullen Blake. This Committee collected the necessary information and made a unanimous recommendation that Blake be offered a position as an Assistant Professor in our Department. My understanding is that Blake is considering Penn's offer.
3. Graduate Chair. Jan 2011 – present. Member of the Planning Committee. Chair of the Graduate Committee. Chair of the Graduate Admissions Committee. Chair of the Graduate Group.
4. Member of the Nano/Bio Physics Search Committee Sept 2011 – April 2012. This search resulted in the hire of Alison Sweeney.
5. Member of the Biological Physics Search Committee Sept 2006 – Sept. 2008. An unsuccessful offer was made to Dr. T. Gregor.
6. Undergraduate Chair. July 2005 – July 2011. Member of the Planning Committee.
7. Chair of the Undergraduate Committee. July 2005 – July 2011.
8. Member of the Ad Hoc Committee for the Introductory Laboratory. Sept 2005 – July 2011.
9. Chair of the Condensed Matter Seminar Committee. June 2004 – 2007.
10. Chair of the Committee to oversee the Instructional Laboratory and Demonstration Laboratory. September 2002 – July 2011.
11. Colloquium Committee, September 2001 – May 2002. Host for Vicki Colvin and Ali Yazdani.
12. Co-organizer of a Symposium in honor of the 65th birthday of Brooks Harris, March 2000.
13. Qualifying Examination Committee (3 years).
14. Graduate Admissions Committee (94-95, 95-96, 96-97, 97-98, 98-99).
15. Faculty Search Committee (Junior CMP Exp. 95-96, 98-99; Junior CMP Theory 96-97. Current open search in Condensed Matter Experiment). Successful hires of Kamien, Kikkawa, and Goulian.
16. Ad hoc committee on Graduate Recruiting (97-98). The committee developed an on-line brochure and novel “Admission with Advanced Standing” program.
17. Ad hoc committee on the Tandem Building (97-98).
18. Ad hoc committee on the Advanced Laboratory (96-97, 97-98). Led to my initiating an ongoing rebuild of the Advanced Laboratory. Primary supervisor of Jose Vithayathil during this time.
19. Member of the department Ad Hoc Committee on the Graduate Curriculum, 1996. Led to more flexible curriculum requirements.
20. Condensed Matter Seminar Committee (significant participant every year).
21. Pre-thesis advisor for first year graduate students (97-98, 98-99).
22. Organized the visit of Michael Tinkham, 1997 Selove lecturer in Experimental Physics. I have given many lectures to undergraduates, graduate students, and incoming (prospective) graduate students about Research in Condensed Matter Physics at PENN.

## B. SAS/SEAS/University Service

1. Member of the Middle States Commission on Higher Education Self Study Undergraduate Research Working Group, March 2012-present.
2. Member of the Senate Committee on Academic Freedom. Jan 2012-present.
3. Member of the NanoAdvisory Board convened by the Vice Provost for Research. July 2011-present. This Committee provides advice to the VPR regarding all aspects of the operations affecting research in the new Singh Nanotechnology Building.
4. External member of the ESE Search committee, charged with recruiting a new Chair for the Department of Electrical and Systems Engineering. September 2010 – July 2011.
5. Member of the Executive Committee, Micro/NanoFabrication Laboratory. July 2005 – present.
6. Member of the Executive Committee of the Nano/Bio Interface Center. July 2004 – present.
7. Director, Micro/NanoFabrication Laboratory. January 2003 – July 2005.
8. Member of the ESE Search committee, 2004-5 and 2005-6. Prof. G. Piazza was recruited to Penn. An offer to M. Loncar was declined (Loncar accepted a position at Harvard).
9. Member, Executive Committee of the Weiss Technical Hub, September 2002 – July 2006.
10. External member of the ESE Search committee, charged with recruiting a new Chair for the Department of Electrical and Systems Engineering. September 2002 – July 2004.
11. Executive Board Member, Center for Science and Engineeering of Nanoscale Systems (SENS). January 2002 – present.
12. Secondary appointments in Electrical and Systems Engineering (July 2002 – present) and Materials Science and Engineering (September 2002 – present).
13. External member of the SEAS Nanoscience Initiative Search Committee, charged with recruiting 3 Nanoscience faculty to the Penn Engineering School. September 2001 – 2003.
14. Member, School of Arts and Sciences Curriculum Committee. September 2001 – April 2002.
15. External member of the SEAS Committee on Nanotechnology. This committee report is being used as the foundation of an Engineering School Nanotechnology initiative, including 3 faculty hires.
16. Co-Group Leader, Nanotube IRG within the Laboratory for Research on the Structure of Matter. September 2000 – present.
17. Co-organizer of the First Symposium on the Science and Technology of Nanomaterials: Nanotubes, March 1999. Penn hosted the event in collaboration with U. North Carolina – Chapel Hill and Princeton.
18. Frontiers Lectures Organizing Committee. This is a seminar series focused on interdisciplinary topics. It has brought a number of prestigious speakers to campus over the years and promoted the visibility of Penn’s efforts in Condensed Matter Physics and related fields. In March 2000, I organized the visit of Sumio Iijima, the discoverer of nanotubes.
19. Member of the committee that developed a Master’s degree in Medical Physics in collaboration with the Department of Radiology and Radiation Oncology in the Medical School.
20. Member of the LRSM Education, Human Resources Development and Outreach Committee.
21. Active participant in the LRSM / University of Puerto Rico Collaborative to Integrate Research and Education. Prof. Nicholas Pinto of UPR is working in my lab this summer to measure the electronic properties of individual polymer nanofibers.
22. PENN Freshman Advisor 1994 – 1999.

# PATENTS AND OTHER ACTIVITIES

1. “Protein-Graphene Nanohybrids for Optical and Chemical Detection”. Provisional Application filed.
2. “Biomimetic Chemical Sensors Using Nanoelectronic Readout of Olfactory Receptors”. Docket Number W5587/UPN-5498. Provisional Application filed 6/2010.
3. “Growth of Uniform Wafer-Size Graphene”. Provisional Application #61/372,589 filed 8/2010.
4. “Method for Fabrication of a Graphene Nanoconstriction FET”. Disclosure filed with Penn CTT Dec. 22, 2009. Provisional US Patent Application …
5. “DNA-Graphene Chemical Sensors”. Disclosure filed with Penn CTT Sept. 2009. Provisional US Patent Application
6. “Photolithographically Defined Contacts to Carbon Nanostructures”. Disclosure filed with Penn CTT Nov. 2008. Provisional U.S. Patent Application #61177768 files May 13, 2009.
7. “Design for Electrical Contacts to Paralllel Arrays of Chemical Sensors”. Disclosure filed with Penn CTT Nov. 2008. Patent filed August 2009.
8. U.S. Patent filed Dec. 23, 2008, Application No. 61/140,555. “High Yield Preparation of Macroscopic Graphene Oxide Membranes”. Attorney Docket UPNA-0122/V5018.
9. U.S. Patent application filed Jan. 23, 2009. Application number 61/146,866. “System and methods for detecting a gaseous analyte in a gas”.
10. “Atomically Precise Nanoribbons Formed by Catalytic Etching with Nanoparticles”. Provisional patent filed June 2, 2008. Attorney Docket UPNA-0115/U4697
11. U.S. Patent provisionally filed Aug. 9, 2007. Serial No. 60/954,884. “Nanogap junctions made of brittle materials”. Penn CTT Docket No. T4510.
12. U.S. Patent filed July 13, 2007. Serial No. not available. “Improved NT/DNA sensor”. Penn CTT Docket No. S4286.
13. U.S. Patent filed Feb 13, 2007. Serial No. 60/901,360. “Parallel fabrication of controlled electromigrated nanogaps”. Penn Docket No. T4431. US Patent Application No. 12/526,710.
14. Patent disclosure submitted Apr. 5, 2007. “Functionalized carbon nanotubes for detection of viral proteins”. Penn CTT Docket No. T4495.
15. U.S. Patent filed March 29, 2006, Serial No. PCT/US06/012005. “Electronic Nose”. Penn CTT Docket No. R3766.
16. U.S. Patent Number 7,977,054 B2, **issued July 12, 2011.** “Single walled carbon nanotubes functionally adsorbed to biopolymers for use as chemical sensors.”
17. Organizer, J.J. Giambiagi International Winter School on NanoPhysics, NanoScience, and NanoTechnology. Buenos Aires, Argentina. July 2002.
18. Organizer of “A Workshop on the Science and Technology of Nanotubes and Related Nanomaterials”, hosted by the Nanotube IRG of the LRSM. March 2002.
19. U.S. Patent Number 6,720,553, **issued Apr. 13, 2004.** “Tip Calibration Standard and Method for Tip Calibration for Scanning Impedance Microscopy”. Penn CTT Docket No. O2639.
20. U.S. Patent filed Aug. 17, 2005. Serial No. 10/507,879. “Nanostructure Composites”. Penn Docket No. O2686.
21. Co-organizer of *Order and Disorder: A Symposium in Honor of the 65th Birthday of A. Brooks Harris*, March 17 & 18, 2000.
22. Co-organizer of the *First Annual Symposium on the Science and Technology of Nanomaterials: Nanotubes,* March 19 & 20, 1999 at the University of Pennsylvania Museum.
23. U.S. Patent Number 6,897,009, **issued May 24, 2005.** “Fabrication of Nanogap Electrical Contacts”. Penn CTT Docket No. M2171.

**COMPLETE PUBLICATION LIST**

**\* indicates an undergraduate researcher. \*\* a high school researcher**

## Refereed Journals

1. S.J. Hong, D.I. Kholin, J.H. Yu, M.W. Lee, S.W. Chu, S. Baek, M. Park, D.H. Jeong, A. Yurgens, A.T. Charlie Johnson, and Y.W. Park, *Synthesis of uniform bilayer graphene with low methane flow in atmospheric pressure chemical vapor deposition*, submitted to Applied Physics Letters (2012).
2. A. Choi, K.H. Kim, S.J. Hong, M. Goh, K. Akagi, R.B. Kaner, N.N. Kirova, S.A. Brazovskii, A.T. Johnson, D.A. Bonnell, E.J. Mele, and Y.W. Park, *Probing spin-charge separation by magnetoconductance in one-dimensional polymer nanofibers*, submitted to Science (2012).
3. Sung-Wook Nam, Hee-Suk Chung, Yu Chieh Lo, Liang Qi, Ju Li, Ye Lu, A.T. Charlie Johnson, Yeonwoong Jung, and Ritesh Agarwal,*In Situ Observation of Electric-Pulse-Induced Mobile Dislocations Serving as Precursors for an Amorphization of Ge2Sb2Te5*, submitted to Science (2012).
4. Mitchell B. Lerner, Jimson D’Souza, Tatiana Paina, Jennifer Dailey\*, Brett R. Goldsmith, Matthew K. Robinson, and **A.T. Charlie Johnson,** *Hybrids of a Genetically Engineered Antibody and a Carbon Nanotube Transistor for Detection of Prostate Cancer Biomarkers*, submitted to ACS Nano (2012).
5. S.M. Khamis, R.A. Jones, **A.T.C. Johnson,** G. Preti, J. Kwak, and A. Gelperin, *DNA-decorated carbon nanotube-based FETs as ultrasensitive chemical sensors: Discrimination of homologues, structural isomers, and optical isomers*, in press, AIP Advances (2012).
6. Ye Lu, Mitchell B. Lerner, Zhengqing John Qi, Joseph J. Mitala, Jr., Johg Hsien Lim, Bohdana M. Discher, and **A.T. Charlie Johnson**, *Graphene-protein bioelectronic devices with wavelength-tunable photoresponse,* Applied Physics Letters, **100**, 033110 (2012).
7. Ye Lu, Christopher A. Merchant, Marija Drndić, and **A.T. Charlie Johnson**, *In-situ electronic characterization of graphene nanoconstrictions fabricated in a transmission electron microscope*, Nano Letters **11**, 5184 – 5188 (2011).
8. Mitchell B. Lerner, Brett R. Goldsmith, Ronald McMillon, Jennifer Dailey,\* Shreekumar Pillai, Shree R. Singh, and **A.T. Charlie Johnson**, *A carbon nanotube immunosensor for Salmonella*, AIP Advances **1**, 042147 (2011).
9. Zhengtang Luo, Seungchul Kim, Nicole Kawamoto,\* Andrew M. Rappe, and **A.T. Charlie Johnson**, *Growth Mechanism of Hexagonal Shape Graphene Flakes with Zigzag Edges*, to appear in ACS Nano (2011).
10. S.L. Johnson, D.P. Hunley, A. Sundararajan, **A.T. Charlie Johnson,** and D.R. Strachan, *High-throughput nanogap formation using single ramp feedback control,* IEEE Transactions on Nanotechnology **10**, 806 – 809 (2011).
11. S.M. Khamis, R.A. Jones,\* and **A.T. Charlie Johnson**, *Optimized photolithographic fabrication process for carbon nanotube devices,* AIP Advances **1**, 022106 (2011).
12. Z. Luo, Y. Lu, D.W. Singer,\* M.E. Berck,\* L.A. Somers, B.R. Goldsmith, and **A.T. Charlie Johnson,** *Effect of Substrate Roughness and Feedstock Concentration on Growth of Wafer-Scale Graphene at Atmospheric Pressure*, to appear in Chemistry of Materials (2011).
13. Brett Goldsmith, Joseph J. Mitala, Jr., Jesusa Josue, Ana Castro, Mitchell B. Lerner, Timothy H. Bayburt, Samuel M. Khamis, Ryan A. Jones, Joseph G. Brand, Stephen G. Sligar, Charles W. Luetje, Alan Gelperin, Paul A. Rhodes, Bohdana Discher, **A.T. Charlie Johnson,** *Biomimetic chemical sensors based on carbon nanotube transistors functionalized with olfactory receptor proteins,* submitted to ACS Nano (2011).
14. C.K. Riley,\* E.A. Muller\*, B.E. Feldman, C.M. Cross, K.L. van Aken, D.E. Johnston, Y. Lu, A.T. Charlie Johnson, J.C. de Paula, and W.F. Smith, *Effects of O2, Xe, and gating on the photoconductivity and persistent photoconductivity of porphyrin nanorods,* Journal of Physical Chemistry C ASAP (2010).
15. L.A. Somers, N.A. Zimbovskaya, **A.T. Johnson,** and E.J. Mele, *Nanoparticle shape selection by repulsive interactions: Metal islands on few layer graphenes*, to appear in Physical Review B (2010).
16. Y. Lu, B.R. Goldsmith, D.R. Strachan, J. Lim\*, Z. Luo, **A.T. Charlie Johnson**, *Graphene nanoconstriction field effect transistor*, Small **23**, 2748 – 2754 (2010).
17. Y. Lu, B.R. Goldsmith, N.J. Kybert,\* **A.T. Charlie Johnson,** *DNA-decorated graphene chemical sensors,* Applied Physics Letters **97**, 083107 (2010).
18. Christopher Merchant, Ken Healey, Meni Wanunu, Vishva Ray, Neil Peterman,\* John Bartel,\* Michael Fischbein, Kimberly Venta, Zhengtang Luo, **A.T. Charlie Johnson,** and Marija Drndic, *DNA translocation through graphene nanopores,* Nano Letters **10**, 2915 – 2921(2010).
19. **A.T. Charlie Johnson,** S.M. Khamis, G. Preti, J. Kwak, and A. Gelperin, *DNA-coated nanosensors for breath analysis*, IEEE Sensors **10**, 159 – 166 (2010).
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