BRANDON H. McNAUGHTON

Address: 450 Church Street, Ann Arbor, MI 48109-1040
Telephone: 734.764.7446
E-Mail: bmcnaugh@umich.edu
Web: umich.edu/~bmcnaugh

Objective:

To innovate diagnostic technologies that will have drastic clinical impacts and develop rapid, inexpensive, and portable technologies for the identification of pathogens.

Discipline: Applied Physics

Research Highlights:

I have developed a new method that allows for fluidic-based detection of single bacterial cells. The method is based on a patent pending technique that utilizes shifts in the nonlinear rotational frequency of magnetic particles (i.e. magnetic microspheres), driven by an external magnetic field. The method is the first demonstration of a nano/micro-scale oscillator that can detect a single bacterium in a viscous environment and is extremely sensitive to shape and size changes of an attached pathogens. In addition to detection, this technique is very sensitive bacterial growth and could have significant application for the study of single bacteria growth dynamics and for antibiotic susceptibility measurements (see McNaughton et al. Appl. Phys. Lett. **91**, McNaughton et al. J. Phys. Chem. **110**, 18958 (2006), and McNaughton et al. Sens. Actuators B **121**, 330 (2007)).

Education:

- Ph.D. in Applied Physics, April 2007, University of Michigan, Ann Arbor, MI
- B.S. in Physics, May 2002 California State University Bakersfield, Bakersfield, CA
- 38 Upper Division Semester Credits in Organizational Management, 2000-2002 Vanguard University of Southern California, School for Professional Studies, Costa Mesa, CA, USA

Employment History:

- Postdoctoral Researcher with Professor Roy Clarke, University of Michigan, Physics Department, January 2007 – Present.

Honors, Fellowships and Awards:

- Michigan Universities Commercialization Initiative Grant – for prototype development (July, 2007).
- NSF Travel Award to present at a NATO Advanced Study Institute (April, 2007).
- American Physical Society travel award for the March 2006 meeting (Dec, 2005).
- Rackham Domestic Travel Award (Spring, 2005).
- Rackham International Travel Award (Summer, 2004).
- Scientific and Clinical Applications of Magnetic Carriers Travel Award (May, 2004).
- Pryor Hale Business Plan Finalist (Spring, 2004).
- Two Time University of Michigan Applied Physics Fellow (2002-2004).
- Two Time CE Strange Physical Science Scholarship (2000-2002).
- Research Experience for Undergraduates at the University of Toledo (Summer, 2001).

Publications:

1) Published and accepted papers in peer reviewed journals

1. C.J. Behrend, J.N. Anker, **B.H. McNaughton**, T.G. Roberts, M. Brasuel, M.A. Philbert, R. Kopelman, *Metal-capped brownain and magnetically modulated optical nanoprobes (MOONs): micromechanics in chemical and biological microenvironments*, Journal of Physical Chemistry B **108**, 10408-10414 (2004).
2. **B.H. McNaughton**, J.N. Anker, R. Kopelman, *Magnetic microdrill as a modulated fluorescent pH sensor*, Journal of Magnetism and Magnetic Materials **293**, 696 (2005).
3. C.J. Behrend, J.N. Anker, **B.H. McNaughton**, R. Kopelman, *Microrheology with modulated optical nanoprobes (MOONs)*, Journal of Magnetism and Magnetic Materials **293**, 663-670 (2005).
4. **B.H. McNaughton**, K.A. Kehbein, J.N. Anker and R. Kopelman, *Sudden breakdown in linear response of a rotationally driven magnetic microparticle and application to physical and chemical microsensing*, J. Phys. Chem B. **110**, 18958 (2006).
5. **B.H. McNaughton**, R.R. Agayan, J.X.Wang, and R. Kopelman, *Physiochemical Microparticle sensors based on non-linear magnetic oscillations*, Sensors and Actuators B **121**, 330 (2007).
6. I. Podlubny, V. Despotovic, T. Skovranek, and **B.H. McNaughton**, *Geometrical interpretation of fractional integration: shadows on the walls*, Journal of Online Mathematics and its Applications, (2007).
7. **B.H. McNaughton**, R.R. Agayan, R.G. Smith, R. Clarke, and R. Kopelman, *Single bacterial cell detection with nonlinear rotational frequency shifts of driven magnetic*, Applied Physics Letters, Accepted (2007).

2) Published and accepted conference proceedings

8. R.A. Lukaszew, **B. McNaughton**, V. Stoica, and R. Clarke, *Surface reconstruction and induced uniaxial magnetic fields on Ni films*, Mat. Res. Soc. Symp. Proc. **696**, N3.29 (2002).
9. J.N. Anker, C.J. Behrend, **B.H. McNaughton**, T.G. Roberts, M. Brasuel, M.A. Philbert, *Characterization and applications of modulated optical nanoprobes (MOONs)*, Mat. Res. Soc. Symp. Proc. **790**, 4.4.1-12, (2004).
10. R.R. Agayan, T. Horvath, **B.H. McNaughton**, J.N. Anker, R. Kopelman, *Optical manipulation of metal-silica hybrid nanoparticles*, Proceedings of SPIE. **5514**, 502-513 (2004).
11. **B.H. McNaughton**, V.A. Stoica, J.N. Anker and R. Kopelman, *Fabrication of uniform magnetic nanoparticles*, Mat. Res. Soc. Symp. Proc. **899E**, 0988-N04-03 (2006).

3) Manuscripts in preparation and submitted

12. **B.H. McNaughton**, R.R. Agayan, R. Kopelman, *In situ detection of single micron-sized magnetic bead using a nonlinear magnetic micro-oscillator*, In Preparation (2007).
13. **B.H. Mcnaughton**, M. Shlomi, P. Argyrakis, and Raoul Kopelman, *True one-dimensional Brownian rotation of a magnetic microsphere*, In Preparation (2007).

4) Newspaper Articles

14. **B.H. McNaughton**, *Saturday science*, Michigan Daily, December 14, 2004.
15. **B.H. McNaughton**, *Marshall scholar winner tackles dark matter mystery*, Michigan Daily, January 11, 2005.
16. **B.H. McNaughton**, *Nobel laureate speaks on ultra-cold matter*, Michigan Daily, April 12, 2005.
17. **B.H. McNaughton**, *A century beyond Einstein: physics theme semester commemorates three ground-breaking papers by the legendary scientist*, Michigan Daily, September 20, 2005.

5) PhD thesis

18. **B.H. McNaughton**, Magnetic micro and nano nonlinear oscillators with applications to the dynamic detection of a single bacterium and to physical and chemical sensing (January 2007)

Invited Presentations:

1. University of Michigan Applied Physics Seminar (Ann Arbor, MI, Oct., 2007).
2. University of Michigan Applied Physics Seminar (Ann Arbor, MI, March, 2005).
3. Guest Class Lecture at Bakersfield College on Fractional Calculus (Bakersfield, CA, February, 2005).
4. Bakersfield College Math Articulation Day (Bakersfield, CA, 2002).
5. Bakersfield College Math Articulation Day (Bakersfield, CA, 2001).

Contributed Presentations:

Talks

6. Emerging Nanoscience Applications in Technology and Biomedicine (Detroit, MI, October, 2007).
7. NATO Advanced Study Institute: Functionalized Nanoscale Materials, Devices, and Systems for Chem.-Bio Sensors, Photonics, and Energy Generation and Storage (Sinai, Romania, June, 2007).
8. American Physical Soceity (Denver, CO, March, 2007)
9. American Physical Society (Baltimore, MD, March, 2006).
10. American Society for Engineering Education (Ann Arbor, MI, August, 2005).
11. Perspectives on Chemistry Research at the University of Michigan (Ann Arbor, MI, June, 2005).
12. American Physical Society (Los Angeles, CA, March, 2005).
13. Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy (Chicago, IL, March, 2004).
14. Futurtech Quick Pitch Competition (Ann Arbor, MI, Fall, 2004).

Posters

15. MORIS 2007: Workshop on Thermal and Optical Magnetic Materials and Devices (Pittsburgh, PA, September, 2007).
16. Optical Society of America - Ann Arbor Section - Student Poster Session (October, 2006).
17. American Physical Society (Baltimore, MD, March, 2006).
18. DARPA BioMagnetics (Arlington, VA, 2006).
19. DARPA BioMagnetics (Potomac, MD, September, 2004).
20. Scientific and Clinical Applications of Magnetic Carriers (Lyon, France, May, 2004).
21. Syposium on Nanotechnology in Honor of Dr. Raoul Kopelmans 70th Birthday (Ann Arbor, MI, November, 2003).
22. DARPA BioMagnetics (Coronado Island, CA, Summer, 2003).
23. University of Michigan Applied Physics Symposium (Ann Arbor, MI, Summer, 2003).
24. Materials Research Society Fall Meeting (Boston, MA, Fall, 2002).
25. Southern California Conference Mathematical Association of America (MAA) (California Institute of Technology, Pasadena, March, 2002).
26. Southern California Conference MAA (Cal. State University Fullerton, March, 2001).
27. Southern California Conference MAA (UCLA, March, 2000).

Patents:

1. J.N. Anker, C.J. Behrend, R. Kopelman, and **B.H. McNaughton**, *Modulated physical and chemical sensors*, Patent Pending (2006).
2. **B.H. McNaughton** and Raoul Kopelman, *Nonlinear rotation rate shifts of driven particles and uses thereof*, Patent Pending (2007).

Skills and techniques:

- Biology: Functionalization of microspheres and nanoparticles with antibodies and culturing of bacteria.
- Computer Skills: Autodesk Inventor, Excel, Fortran 90, LabView, LATEX, Illustrator, Matlab, Mathematica, Maple, Metamorph, Origin, PowerPoint, Word.
- Materials Growth: Aluminum vapor deposition, pulsed laser deposition, ultra high vacuum vapor deposition and DC magnetron sputtering.
- Microscopy: Extended experience with scanning electron, fluorescent, reflection, darkfield and transmission microscopy.
- Nanopatterning: Focused ion beam fabrication, colloidal monolayers, and nanosphere lithographic techniques.
- Nanofabrication: Synthesis of sol-gel nanoparticles loaded with dye and magnetic particles. Fabrication of uniform cobalt and iron nanoparticles.
- Optics: Laser Alignment, magneto-optic Kerr effect magnetometry, and other laser techniques.
- Prototype Development: Instrument interfacing for computer control and feedback, construction of new devices, rapid prototyping.
- Spectroscopy. Energy dispersed X-ray and fluorescent spectroscopy.
- Web Design: Extensive experience with Frontpage and some HTML.
- Experience with time resolved X-ray scattering and user at the Advanced Photon Source at Argonne National Lab.

Other pertinent information:

- Entrepreneurial Boot Camp – Ann Arbor Spark (November, 2007)
- Mentored and trained five students in Raoul Kopelman's Lab (2004 – Present).
- Scientific advisor to Ram Holdings, Inc. (2004 – Present).
- Applied physics mentor for first year graduate students (2003 – Present).
- Representative in the Rackham Student Government (2006).
- Michigan Daily science reporter (2004 – 2005).
- Founded everydaynano.com (2004).
- Volunteer for University of Michigan Physics Olympics (2004).
- Volunteer for UM Women in Science and Engineering Physics Camp (2003 – 2004).
- Founder and President of CSU Bakersfield Society of the Physics Students (2001 – 2002).