

DAVID B. HILL

CURRICULUM VITAE

EDUCATION:

Ph.D., Physics; Wake Forest University, July 2003
Dissertation: Measuring the Work of Motor Proteins in PC12 Neurites
Advisor: George Holzwarth
BS; Physics; Stetson University, May 1998

PROFESSIONAL EXPERIENCE:

Graduate Dean's Fellow; Wake Forest University, June 1998 – July 2003
Post Doctoral Fellow, Department of Physics and Astronomy, UNC Chapel Hill, July 2003 – March 2006
Research Associate: Cystic Fibrosis Center, UNC Chapel Hill, March 2006 – Present

RESEARCH PROJECTS:

Primary area of research is in lung defense, particularly the role the mucus layer plays in the trapping and removal of pathogens from the airways. Specific interest include the biochemical and biophysical (Rheological) characterization of the mucus layer, and how these properties affect mucociliary clearance and are effected by diseases such as Cystic Fibrosis and Chronic Pulmonary Obstructive Disease.

Current

- Mucus Rheology: Employing the techniques of microbead rheology, cone and plate, and driven magnetic bead rheology, the goal of this project is to determine the physical properties of mucus so that the fluid can be successfully modeled
- Three Dimensional Force Microscope (3DFM): The 3DFM allow us to evaluate the viscoelastic modulus of fluids to viscous to be studied with Microbead Rheology, apply forces directly to biological systems (CF Mucus, ActA, and beating cilia), and map the topography of entangled mess networks often found in viscoelastic fluids
- Cilia induced Stress-Strain in Mucus: The motion of tracer particles is examined to determine the amount of deformation imposed on mucus by cilia and examine how the deformation is propagated thru the fluid.
- Modeling mucus flow and small molecule diffusion: Experimental results are used to determine the correct constitutive laws to model and predict small molecule diffusion and mucus flow.
- Micro-Parallel Plate Rheometer (MPPR): The MPPR is an optically based rheometer that determines the bulk viscoelastic properties of fluids using quintiles less than 10 μ L.

Previous

- Polarization-Modulate Differential Interference Contrast Microscopy
- Digital Image Processing
- Magnetic Design / Manipulation of Magnetic Beads

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GRADUATE COMMITTEE SERVICE: Brian Eastwood (Computer Science, 2009, Russell Taylor Advisor), Ke Xu (Mathematics, 2009, M. Gregory Forest Advisor), Lingxing Yao (Mathematics, 2007, M. Gregory Forest Advisor), and Brandon Lindley (Mathematics, 2008, M. Gregory Forest Advisor).

RESEARCH MENTORING: Serving as laboratory mentor for Dr. Jaydeep Lamba (Ph.D, MD), UNC Pulmonary Fellow. Project: "Exploring the role of poly-ethylene glycol functionalization for enhanced diffusive transport through airway mucus."

FUNDING:

Mucus Heterogeneity. Cystic Fibrosis Foundation. \$80,000 Direct, \$6400 Indirect. 04/01/2008 – 03/31/2011. The major goals of this project are to identify the roles of Muc5B and Muc5AC play in the creation of successful mucus (i.e., one that can be cleared from the airways), and to establish how the changes in the chemical composition of mucus that are brought on by CF and COPD manifest itself into changes in physical and functional properties of the mucus layer. Role: PI

Mathematically Guided Experiments of Lung Mucus Transport Properties. NSF. \$898,828 Direct, \$418,659 Indirect. 06/15/2011 – 05/30/2015. The goal of this research project is to integrate new mathematical techniques with experiments examining two transport phenomena in airway mucus: diffusion and mucociliary transport. Role: PI

Comparisons of GGE with NAC and Ambroxol Effect on Mucus Rheology. Research Testing Contract with Rickett Benckiser. \$19,576 Direct, \$9396. 07/01/2011 – 06/30/2011. The goal of this study is to quantify the effect of several compounds on the rheological properties of mucus isolated from cell culture model systems dosed with the target compounds. Role: PI

PUBLICATIONS:

- 2010 Fallesen, T., D. B. Hill, et al. "Magnet polepiece design for uniform magnetic force on superparamagnetic beads." *Rev Sci Instrum* **81** (7): 074303.
- 2010 Hill, D. B., V. Swaminathan, et al. "Force Generation and Dynamics of Individual Cilia under External Loading." *Biophysical Journal* **98** (1): 57-66.
- 2010 Lindley, B., M. G. Forest, et al. "Spatial Stress and Strain Distributions of Viscoelastic Layers in Oscillatory Shear." *Mathematics and Computers in Simulation*
doi:10.1016/j.matcom.2010.07.031.
- 2009 Lindley, B., E. Howell, et al. "Stress Communication and Filtering of Viscoelastic Layers in Oscillatory Shear." *Journal of Non-Newtonian Fluid Mechanics* **156**: 112-120.
- 2008 Hill, D. B., J. C. Macosko, et al. "Motion-enhanced, differential interference contrast (MEDIC) microscopy of moving vesicles in live cells: VE-DIC updated." *J Microsc* **231** (3): 433-9.
- 2008 Mitran, S. M., M. G. Forest, et al. "Extensions of the Ferry shear wave model for active linear and nonlinear microrheology." *J Nonnewton Fluid Mech* **154** (2-3): 120-135.
- 2006 Matsui, H., V. E. Wagner, et al. "A physical linkage between cystic fibrosis airway surface dehydration and Pseudomonas aeruginosa biofilms." *Proc Natl Acad Sci U S A* **103** (48): 18131-6.
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CURRICULUM VITAE CONTINUED

- 2004** Hill, D. B., M. J. Plaza, et al. "Fast vesicle transport in PC12 neurites: velocities and forces." European Biophysics Journal with Biophysics Letters **33** (7): 623-632.
- 2002** Holzwarth, G., K. Bonin, et al. "Forces required of kinesin during processive transport through cytoplasm." Biophysical Journal **82** (4): 1784-1790.
- 2000** Holzwarth, G. M., D. B. Hill, et al. "Polarization-modulated differential-interference contrast microscopy with a variable retarder." Applied Optics **39** (34): 6288-6294.

PREPRINTS:

- 2011** Hill, D. B., B. Lindley, et al. "The Micro-Parallel Plate Rheometer." Journal of Non-Newtonian Fluid Mechanics **Preprint**.
- 2011** Xu, K., D. Hill, et al. "Uncertainty reduction in the dynamic moduli of biological fluids." Journal of Rheology **PrePrint**.

PROFESSIONAL MEETING PRESENTATIONS:

- 2009** Hill, D. B., B. Lindley, et al. "Measuring and Mimicking Mucociliary Clearance" *North American Cystic Fibrosis Conference*
- 2009** Swaminathan, V., D. B. Hill, et al. "Force Generation and Dynamics of Individual Cilia under External Loading" *North American Cystic Fibrosis Conference*
- 2008.** Hill, D. B. Force Response of Human Airway Cilia to External Force. 2008 Carolina Biophysics Symposium. Chapel Hill, NC.
- 2007** Estes, A., E. T. O'Brien, et al. "Spot-labeling of Magentec microbeads and applications in biological force measurement" *Biophysical Society*
- 2006** Hill, D. B., J. Cribb, et al. "Force Response of Airway Cilia" *Biophysical Society*
- 2006** Kesimer, M., G. Demaria, et al. "Characterization of mucin-protein complexes in human epithelial cell culture secretions: an investigation into the human respiratory mucus "interactome". " *North American Cystic Fibrosis Conference*
- 2005** Cribb, J., D. B. Hill, et al. "Measuring local microrheological properties of human mucus with magnetically driven microbeads" *Biophysical Society*
- 2005** Hill, D., M. G. Forest, et al. "Mucus Rheology, Experiments and Modeling" *Society of Rheology*
- 2005** Hill, D. B., J. Cribb, et al. "Oscillations in mucus flow" *Biophysical Society*
- 2004** Hill, D. B., J. Cribb, et al. "Forces acting on bacteria in Human Tracheo-Bronchial Mucus" *Biomedical Engineering Society*
- 2004** Hill, D. B., J. Cribb, et al. "Bacterial motion in mucus" *Biophysical Society*
- 2004** Holzwarth, G., D. B. Hill, et al. "Molecular motors in live cells: Velocities and forces" *Biophysical Society*
- 2003** Hill, D. B., K. Bonin, et al. "Fluctuations in the number of motors pulling one vesicle within a live neurite" *Biophysical Society*
- 2003** Hill, D. B. and G. Holzwarth. "Fast Vesicle Transport in PC12, Motor Proteins at Work" *Southeast Section of the American Physical Society*
- 2002** Hill, D. B., G. Holzwarth, et al. "Forces Required of Kinesin During Processive Transport in Cells" *Biophysical Society*
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CURRICULUM VITAE CONTINUED

PROFESSIONAL MEETING PRESENTATIONS (CONTINUED):

- 2002** Hill, D. B., G. Holzwarth, et al. "Velocity and Drag Forces on Motor-Protein Driving Vesicle Transport" *Southeast Section of the American Physical Society*
- 2001** Hill, D. B. and G. Holzwarth. "Imaging Biological samples with PM-DIC" *Biophysical Society*
- 2000** Hill, D. B., G. Holzwarth, et al. "Polarization-Modulation DIC Microscopy with a Variable Wave Retarder" *American Physical Society*
- 2000** Oliver, T. N., D. B. Hill, et al. "Retraction fiber dynamics in fish epidermal "comb" cells revealed by polarization-modulated differential interference contrast (PM-DIC) microscopy" *American Cell Biology Society*
- 1999** Hill, D. B., G. Holzwarth, et al. "Polarization-Modulated Differential Interference Contrast Microscopy" *Southeast Section of the American Physical Society*
- 1999** Holzwarth, G., D. B. Hill, et al. "Polarization-modulated DIC microscopy" *Biophysical Society*