Stephen L. Levy

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Employment

Summer 2009	**Juelich Research Center** Visiting Scientist Institute of Bio-Nano Systems, Bioelectronics (IBN-2)
2006 – Present	**Cornell University** Research Associate Harold Craighead Group, Nanotechnology
2003 – 2006	**University of Chicago** Research Associate, Member of CDF collaboration at the Fermi National Accelerator Laboratory
1999 – 2003	**UCSB** Research Assistant, Member of BaBar collaboration at the Stanford Linear Accelerator Center (SLAC)
2002 – 2003	UCSB Teaching Assistant, Graduate Particle Physics
1998 – 1999	UCSB Teaching Assistant, Physics for Majors
1997 – 1998	Lockheed Martin Air Traffic Management Software Engineer

Education

1998 – 2003	**University of California Santa Barbara** (UCSB), Graduate studies in physics **Emphasis**: Experimental particle physics **Advisor**: Claudio Campagnari Ph.D. Thesis: "Observation of *CP* Violation in the Neutral *B* Meson System"
1993 – 1997	**University of Richmond**, B.S. Physics, Math. *Magna Cum Laude*

Awards and Honors

2008	Co-authored a 5 year grant funded by the National Institute of Health for epigenomic analysis on a nanoscale device

1998	GAANN Fellowship recipient (UCSB)
1997	Phi Beta Kappa R. Loving Award given to most promising physics major (University of Richmond)
1996	Pi Mu Epsilon, mathematics honor society
1996	Sigma Pi Sigma, physics honor society
1993	National Merit Finalist Varsity Tennis Scholarship (University of Richmond)

Nanotechnology Postdoctoral Research

My work in the Craighead Group at Cornell has focused on fabricating nanoscale structures in fused silica substrates for observation and detection of confined DNA molecules and other biomolecules. The fabrication has been performed at the Cornell NanoScale Science and Technology Facility, a class 1000 clean-room funded by the National Science Foundation.

- Designed and fabricated 100 nm channels in fused silica substrate using electron beam lithography to optically observe single DNA molecules. We described the dynamics of DNA molecules that unfold inside the channels due to an entropic force and observed increased DNA extension in the folded region resulting from excluded volume interactions. Nanochannels are a promising technology for the study of individual DNA molecules since the molecules are elongated in the confined geometry and their thermal motion is substantially reduced due to hydrodynamic friction with the channel walls. This work has been published in *Nano Letters*.

- Measured diffusion of individual DNA molecules in nanoslits (trenches with micron length width and depths of 30 to 500 nm) as a function of slit depth and DNA length. The results deviated slightly from polymer theory but agreed with previous experiments in larger slits where the diffusion was found to scale with slit depth to the one-half power and scale inversely with DNA length, indicating screened hydrodynamic interactions. The measurement was published in *Macromolecules*.

- Initiated a collaboration with Prof. Soloway in the Life Sciences Division of Nutritional Science to use multi-color fluorescent microscopy

in nanofluidic channels to identify epigenetic marks on DNA, such as methylated cytosine nucleotides, and histones. Methylation is an epigenetic modification to chromatin that can affect gene expression as profoundly as mutations. We aim to develop the first technology capable of accurately and rapidly identifying multiple epigenetic marks simultaneously using individual molecules. We recently received a five year R01 grant as part of the NIH Roadmap Epigenomics Program for this work.

- Worked with a graduate student to Integrate a carbon nanotube within a nanofluidic channel for the electrical detection of individual DNA molecules flowing through the channel. The carbon nanotube acts as a sensitive field effect transistor whose conductance varies from gating by an electric field generated by a nearby DNA molecule. The fabrication requirements are stringent since the DNA molecule needs to travel within approximately one Debye length of the nanotube (since its intrinsic charge is screened) in order serve as an effective gate, implying that the channels needs to be sub-50 nm in diameter using a low salt solution buffer. This work is ongoing.

- Developing a multiplexed magnetic microfluidic assay for sensitive fluorescent detection of proteins. A PDMS chip is designed to capture magnetic beads, which are used as the sandwhich-assay substrate, each carrying a different primary antibody in parallel channels for multiplexed detection. This work is ongoing.

Knowledgable in design, fabrication, and physics of nanofluidic channels in silica substrates including polymer theory, Debye-Huckel theory, navier-stokes equation. Extensive nanofabrication experience: electron beam lithography, photolithography, thin film deposition, thin film etching, metrology. Frequent user of scanning electron microscope, atomic force microscope, confocal epifluorescence microscopy. Proficient programmer in C++, Matlab, Labview, Fortran, Perl, Root. Proficient in bash and tcsh shell scripting. Familiar with Oracle and MySQL databases.

High Energy Physics Postdoctoral Research

- Developed a novel algorithm for the identification of tau leptons that decay hadronically, which was used to search for new physics in a $t\bar{t}$

enriched sample . The algorithm is significantly more efficient with comparable misidentification rates compared to previous efforts. The results are summarized in a public web-page and conference note.

- Co-leader of the CDF High Pt B–Tag Group. Led a group of approximately 20 physicists in developing the analysis tools fundamental for studying top quarks. During this time, we collected the world's largest sample of events containing top and anti-top quarks ($t\bar{t}$) that were identified using a secondary vertex tagging algorithm optimized to find heavy flavor quarks. This sample was subsequently used to make the world's most precise measurement of the top quark mass [6] and to measure the $t\bar{t}$ production cross section [7].

- Co-leader of the CDF Silicon Studies Group designed to study the detector performance of the CDF silicon vertex detector (SVX II). The SVX II is composed of seven layers of double sided radiation hard silicon sensors in three 30 cm long barrels whose 400k channels can be read out in $< 10\,\mu$s.

- Served three month shift in detector operations to run and monitor CDF data taking. The CDF detector and data acquisition system filters roughly 1.5 million events per second down to 100 that satisfy a given physics requirement and which are then recorded to tape for further study at a rate of 20 Mb/s. This complex system requires constant monitoring of the electronics and data quality to ensure maximum efficiency.

Invited Talks

- Entropic Unfolding of DNA Molecules in Nanofluidic Channels. Cornell NanoScale Science and Technology Facility Annual Meeting, Ithaca, NY, September 11, 2008.

- A Sensitive Multiplexed Microfluidic Assay Proposal. Scientific Advisory Board of life science research bio-tech company, February 5, 2008.

- An Experimental Investigation of the Dynamics of Single DNA Molecules Confined in Nanoslits. Biophysical Society Meeting, Long Beach, California, February 5, 2008

- Tau Identification at the Tevatron. Hadron Collider Physics 2005, Les Diablerets, Switzerland, July 7 2005.
- Sin2β and γ Measurements from B-Factories. University of Chicago High Energy Physics Seminar, Chicago, IL, November 17, 2003.
- Sin2β in ccbar K_S^0 Events. University of Chicago High Energy Physics Seminar, Chicago, IL, April 21, 2003
- Time-Dependent Analysis of B^0 Decays into a Charmonium State and a K_S^0. Proceedings of the annual meeting of the DPF of the APS, Philadephia, PA, April 5, 2003.
- Time-Dependent Analysis of B^0 Decays into a Charmonium State and a K_S^0. Harvard High Energy Seminar, Boston, MA, March 5, 2003.

Selected Publications

[1] S. Levy, H. Craighead. "DNA manipulation, sorting and mapping in nanofluidic systems," *Chemical Society Reviews*. Accepted for publiction.

[2] S. Levy†, J. Mannion†, J. Cheng, C. Reccius, H. Craighead. "Entropic Unfolding of DNA Molecules in Nanofluidic Channels," *Nano Letters* **2008** *8*, 3839-3844. †These authors contributed equally.

[3] E. Strychalski†, S. Levy†, H. Craighead. "DNA Diffusion in Nanoslits," *Macromolecules* **2008**, *41*, 7716-7721. †These authors contributed equally.

[4] B.R. Cipriany, R. Zhao, P.J. Murphy, S.L. Levy, C.P. Tan, P.D. Soloway, H.G. Craighead. "Single Molecule Epigenetic Analysis in a Nanofluidic Channel," Draft under preparation.

[5] S. Levy, T. Onuta, H. Craighead."Microfluidic magnetic immuonassay," Draft under preparation.

[6] A. Abulencia *et al.* [CDF Collaboration], "Top quark mass measurement using the template method in the lepton + jets channel at CDF II," Phys. Rev. D **73**, 032003 (2006) [arXiv:hep-ex/0510048].

[7] D. Acosta *et al.* [CDF Collaboration], "Measurement of the t anti-t production cross section in p anti-p collisions at s**(1/2) = 1.96-TeV using lepton + jets events with secondary vertex b-tagging," Phys. Rev. D **71**, 052003 (2005) [arXiv:hep-ex/0410041].

[8] D. Acosta *et al.* [CDF Collaboration], "Evidence for the exclusive decay B/c+- → J/psi pi+- and measurement of the mass of the B/c meson," Phys. Rev. Lett. **96**, 082002 (2006) [arXiv:hep-ex/0505076].

[9] A. Abulencia *et al.* [CDF Collaboration], "Search for anomalous semileptonic decay of heavy flavor hadrons produced in association with a W boson at CDF II," Phys. Rev. D **73**, 051101 (2006) [arXiv:hep-ex/0512065].

[10] A. A. Affolder *et al.* [CMS Silicon Strip Tracker Collaboration], "Test of CMS tracker silicon detector modules with the ARC system," Nucl. Instrum. Meth. A **535**, 374 (2004).

[11] B. Aubert *et al.* [BABAR Collaboration], "Measurement of the branching fraction and polarization for the decay B- → D0* K*-," Phys. Rev. Lett. **92**, 141801 (2004) [arXiv:hep-ex/0308057].

[12] B. Aubert *et al.* [BABAR Collaboration], "Measurement of the CP-violating asymmetry amplitude sin 2beta. ((B))," Phys. Rev. Lett. **89**, 201802 (2002) [arXiv:hep-ex/0207042].

[13] B. Aubert *et al.* [BABAR Collaboration], "A study of time dependent CP-violating asymmetries and flavor oscillations in neutral B decays at the Upsilon(4S)," Phys. Rev. D **66**, 032003 (2002) [arXiv:hep-ex/0201020].

[14] B. Aubert *et al.* [BABAR Collaboration], "Observation of CP violation in the B0 meson system," Phys. Rev. Lett. **87**, 091801 (2001) [arXiv:hep-ex/0107013].

[15] B. Aubert *et al.* [BABAR Collaboration], "Measurement of CP violating asymmetries in B0 decays to CP eigenstates," Phys. Rev. Lett. **86**, 2515 (2001) [arXiv:hep-ex/0102030].

[16] S. L. Levy, "Observation of CP violation in the neutral B meson system," SLAC-R-0729

[17] V. Re *et al.*, "The BaBar silicon vertex tracker: Performance, running experience, and radiation damage studies," IEEE Trans. Nucl. Sci. **49**, 3284 (2002).

All CDF Publications

[1] Please follow the CDF publications link on the following web-page: http://www.stephenlevy.net/curriculum.html

All BaBar Publications

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