# Mark Daniel Mascaro

167 Willow Ave #1
Somerville, MA 02144

E-mail: doublemark@gmail.com
Telephone: (603) 321-8652

## Education:

- (2007-2012) Massachusetts Institute of Technology, Cambridge, MA
  Ph.D. candidate in Materials Science and Engineering (expected June 2012). GPA 4.6/5.0
  Dissertation: Physics of 360 Degree Domain Walls in Thin-Film Magnetic Nanowires for Magnetoelectronic Memory and Logic Applications
  Advisor: Caroline Ross
- (2003-2007) Massachusetts Institute of Technology, Cambridge, MA
  B.S. Materials Science and Engineering. GPA 4.8/5.0

## Skills:

- Languages: proficient in Python, C/C++, MATLAB, GLSL; past experience with Scheme, Mathematica
- Libraries/Tools: numpy, wxPython, Twisted, cilk, pthreads, matplotlib, OpenGL

## Relevant Coursework:

- 6.172 - Performance Engineering of Software Systems [A+]
  - Topics include assembly tuning, parallelism using pthreads and cilk, parallelized quadtrees, parallel memory allocators, cache-efficient and cache-oblivious algorithms, lock-based and lock-free synchronization
  - Implemented a memory allocator modeled after jemalloc, along with custom profiling and debugging tools, which outperformed libc malloc. Modified it to be scalable and threadsafe for use with multithreaded applications. C++.
  - Implemented an AI to play the board game Khet which won the class tournament. C++.
  - Implemented a parallelized collision detector which tied for fasted in class. C++.
- 6.001 - Structure and Interpretation of Computer Programs [A]

## Employment:

- **Research Assistant**, Ross Group, MIT Department of Materials Science and Engineering (2008-present).
  - Implemented and maintained data-gathering and control software for laboratory hardware. Python.
  - Implemented interfacing software to link circuit and magnetic simulation packages, allowing simulation of large-scale magnetoelectronic circuits. Python, numpy.
  - Created support software packages for the OOMMF micromagnetic simulation package:
    - GUI-driven cross-platform postprocessing utilities to convert the simulator's native data format to common/open formats. Python, wxPython, numpy.
    - Metaprogramming system to hide simulator's verbose scripting language with a simple Python scripting interface, designed for non-programmers, which provides batching capabilities and input validation with clear error messages. Python.
    - Queueing service to manage execution of multiple simulations and accept job requests from multiple networked clients. Python, wxPython, Twisted.
- **Research Intern**, IBM (Summer 2009).
  - Derived a mathematical model for perpendicular-field magnetoresistance behavior.
  - Created data analysis and visualization code to evaluate experimental results in terms of this model. Python, numpy.

  - Implemented analysis of ferromagnetic resonance using a best-fit heuristic to identify multiple two-dimensional magnetic resonance modes in noisy data. Python, numpy, matplotlib.
- **Consultant**, Varian Semiconductor Equipment Associates (Feb 2011).
  - Taught use of the OOMMF micromagnetic simulation package; provided ongoing support on design of micromagnetic simulations.
- **Teaching Assistant**, Massachusetts Institute of Technology.
  - 3.091 - Introduction to Solid State Chemistry (Fall 2011). Highest-rated TA by students.
  - 3.042 - Materials Project Laboratory (Fall 2007, Spring 2007).
- **Undergraduate Researcher**, Stellacci Group, Massachusetts Institute of Technology (Summer 2006). Electronic behavior of functionalized carbon nanotubes.
- **Undergraduate Researcher**, Rubner Group, Massachusetts Institute of Technology (Summer 2005). Antireflection coatings and superhydrophilic materials.

## Personal Projects:

- Implemented event model for a multiplayer orbital simulator game that allowed networked clients free bidirectional travel through the history of the system. Python, Twisted.
- Created an OpenGL-based 2D sprite library for Python providing order-of-magnitude speed improvements over existing libraries by reducing calls from Python into OpenGL from O(n) to O(1) per frame. Python, OpenGL, GLSL.

## Publications and Presentations:

### First-Author Publications

- 360 domain wall mediated reversal in rhombic Co/Cu/NiFe magnetic rings. Applied Physics Letters (2011).
- ac and dc current-induced motion of a 360° domain wall. Physical Review B (2010).
- Interactions between 180° and 360° domain walls in magnetic multilayer stripes. Applied Physics Letters (2010).
- Perpendicular-field magnetoresistance and thermal-ferromagnetic resonance measurement of easy-plane anisotropy in nanostructured magnetic tunnel junctions. Journal of Applied Physics (2010).

### Contributing Author Publications

- Formation and structure of 360 and 540 degree domain walls in thin film magnetic stripes. Accepted and in production; Applied Physics Letters (2012).
- Domain wall induced magnetoresistance in a superconductor/ferromagnet nanowire. Applied Physics Letters (2011).
- Magnetostatic control of vortex chirality in Co thin film rings. Applied Physics Letters (2010).
- Magnetic remanent states and quasistatic switching behavior of Fe split-rings for spin field-effect-transistor applications. Applied Physics Letters (2009).
- Current-driven vortex formation in a magnetic multilayer ring. Applied Physics Letters (2009).
- Electrical observation of asymmetric magnetization configurations in the vortex state of NiFe and Co rings. Journal of Physics D: Applied Physics (2009).

### Presentations

- Behavior of 360 Degree Domain Walls Driven by Simultaneous AC and DC Current. 56th Annual Conference on Magnetism and Magnetic Materials (2011).
- Simulation of AC and DC Current-Driven Behavior of 360 Degree Domain Walls. 55th Annual Conference on Magnetism and Magnetic Materials (2010).
- The role of 360 degree domain walls in the reversal of rhombic NiFe/Cu/Co thin film rings. 11th Joint MMM-Intermag Conference (2010).

- Perpendicular-field magnetoresistance and thermal-ferromagnetic resonance measurement of easy-plane anisotropy in nanostructured magnetic tunnel junctions. 11th Joint MMM-Intermag Conference (2010).

## Fellowships:

- IBM Ph.D. Fellowship (2009-2010).

## Interests:

I study and design game mechanics for all manner of games, and playtest tabletop roleplaying game designs with groups of my friends. I play classical and jazz trumpet, rock guitar and drums, and terrible piano. I arrange music for the sound chip in the NES. I enjoy machining work in my department's machine shop and rapid fabrication lab.