1) Student name: Craig Cahillane
2) Faculty mentor name: Professor Michael Niemier
3) Project title: Application Level Hardware with Magnetic Logic

4) Briefly describe any new skills you acquired during your summer research:

This summer I learned a lot about running simulations and analyzing data. I also learned how to read, fix, and write code in MATLAB, and used it to help write files in other, more complicated programming languages.

5) Please briefly share a practical application/end use of your research:

Our research is critical because it offers a new way to continue fulfilling Moore's Law of continually reducing computing areas. Energy consumption can be a hindrance for large computers, but NML devices do not require nearly as much energy to operate as transistors. NML also is non-volatile, meaning that it does not need a constant energy supply to store data.

Project summary:

We are reaching a stage where transistor-based logic is at its limits. Researchers are searching for new ways to process information quickly and energy-efficiently. One direction is development of Nanomagnet Logic (NML), using the fringing fields to effectively "flip" bits of information using the tiny magnetization fields. NML, while slower than transistor logic, is much more energy efficient and a non-volatile form of logic. If properly developed and harnessed, the combination of NML and transistor logic in computers can push further the limits of today's traditional computing.

My research specifically dealt with running simulations of 3x3 squares of nanomagnets and analyzing the results. The simulations consisted of a 3x3 square with each nanomagnet flipped down, and an increasing external magnetic field that served to flip the magnets upwards. Each square of magnets would have different physical properties: thickness, input size, K value, and magnet spacing were all tested, and the results were checked for consistency in flipping time and magnetic field at the time of the flip. The next step in this research is to run thousands of simulations, and check which physical layout is the best for actual experimentation.

Publications (papers/posters/presentations):

(Poster) - Architectures for Out of Plane Nanomagnet Logic (oNML) Devices to Perform Non-Boolean and Cellular Computing