RESEARCH STATEMENT

SARAH M. FLEMING

I am interested in participating in the Emory REU, and though all of the projects appeal to me, I would most like to work on the project on elliptic curves and Galois representations. Out of all my coursework at Williams College, the class I enjoyed the most was Galois theory. I found the subject incredibly beautiful, and I would love to have the chance to conduct research in it. I am also interested in elliptic curves, which I first encountered in a course I took on cryptography, "Protecting Information: Applications of Abstract Algebra and Quantum Physics." After attending several talks at MathFest on algebraic geometry and on elliptic curves, I wanted to learn more. This past January, I completed an independent study in algebraic geometry with Professor Thomas Garrity, and I plan to continue studying the material on my own. I am currently taking courses in algebraic number theory and homological algebra (as well as harmonic analysis) in order to gain a deeper understanding of algebra and its applications to other fields of math. So far, I have found algebraic number theory fascinating, and I am eager to put this knowledge to use through conducting research at the intersection of number theory and algebraic geometry. The project on elliptic curves and Galois representations would synthesize two of my key interests in math in an exciting new way.

I have spent the past two summers participating in research programs in math and physics. Two summers ago, I worked as a research assistant to the Physics Department at Williams College. I first worked with Professor Protik Majumder on constructing an interferometer to measure distance precisely using light. We succeeded in building one, and Professor Majumder plans to use these methods in his lab in order to calculate precise electric field values. For the remainder of the summer, I worked on a project in theoretical physics with Professor William Wootters. We investigated probability distributions to determine if—and, if so, why—the Boltzmann factor is optimal in producing the correspondence between classical and quantum expectations for the behavior of a particle in a box. Though this was a question rooted in physics, the project drew heavily from math. In fact, I found the mathematical aspect to be the most enjoyable and engaging component of the project. This experience motivated me to seek out more opportunities in mathematical research.

This past summer, I participated in the SMALL REU at Williams College. I worked in the Commutative Algebra group with four other undergraduates under the supervision of Professor Susan Loepp. We studied the relationship between a local ring and its completion by examining the relationship between their spectra. We originally set out to answer a question posed by William Heinzer, Christel Rotthaus, and Judith Sally concerning the dimensions of the formal fiber rings of an excellent local domain at its height one ideals, but we ended up answering a much more general question and characterizing a much larger class of rings. We have presented our results at several conferences, and we produced two papers on our work. Next year, I plan to write a thesis under the supervision of Professor Loepp building on the work we did over the summer, and we intend to start research for the project this spring. These experiences have encouraged me to attend graduate school in math and pursue a career in math research as a professor, and as a result, I am especially interested in pursuing further research in math to prepare me for this path.

I would love to have the opportunity to build on my knowledge of algebra from previous coursework and research and to broaden my understanding of number theory. Participating in the Emory REU would be a wonderful opportunity to do so.