Samuel J. Novario **Exit Report**

In early 2015, I was awarded a FUSTIPEN grant which funded my trip to attend the TALENT school *Many-body methods for nuclear physics* at GANIL in Caen, France in July 2015. The grant was specifically used to pay for my travel from East Lansing and for lodging and meals during the TALENT school. Not only was this experience a unique opportunity to live abroad for my first time, it also allowed me to work and build relationships with experts and peers in my field. Additionally, I gained invaluable knowledge and developed vital skills directly related to my research as well as complimentary information from outside my specific concentration.

During my time in France, I lived and worked with graduate students of all different academic backgrounds from all over the world. Every weekday morning, we would attend lectures given by the TALENT organizers on range of topic. While I had previously seen some of the derivations and techniques discussed—dealing mostly with second quantization, the many-body Hamiltonian, and diagrammatics—the lecturers expanded my knowledge by explaining these concepts in new ways and applying them to new problems. Specifically, while I was familiar with Coupled-Cluster calculations of finite nuclei, the lecturers applied this technique to infinite nuclear matter. In addition, the lecturers introduced me to other methods, such as Self-Consistent Green's Functions, that I had never used, let alone implemented, which helped expand my reach of understanding to other corners of the many-body community.

In the afternoons, my fellow students and I would apply the lecture material by developing our own many-body projects. The project goal was to build an application from scratch to calculate the correlation energy of both a simple pairing model and then of infinite nuclear matter with periodic boundary conditions using either Coupled-Cluster or Self-Consistent Green's Functions. I decided to write a Coupled-Cluster code because I could use it as a basis for the calculations I would need for my thesis project, and I could utilize the Coupled-Cluster expertise of the TALENT lecturers to deal with specific complications that I would inevitably reach. My team developed a program that constructs a many-body basis, integrates the interaction, and performs Coupled-Cluster Doubles (CCD) iterations. One great benefit to working directly with the TALENT organizers was their advice in helping me increase the speed of my application by orders of magnitude by transforming the CCD section to a series of matrix-matrix multiplications following state-of-the-art Coupled-Cluster code.

In addition to the specific techniques that I learned during my time at GANIL, I was also able to build useful relationships with other attendees and the organizers. Because my fellow graduate students will become my future colleagues and the TALENT lecturers will become possible future employers, developing these associations was a critical step in my scientific career. I have met many professors and graduate students at conferences and workshops prior, but these rarely offered an experience comparable to that at GANIL where I worked directly with others in a research environment. This not only allowed me to form these unique relationships, but also to build the social skills needed for a successful collaboration which are arguably as important as the physics and programming skills I gained.

Since changing my research topic to nuclear theory, I've been excited to experience the small, close-knit community that I had joined. Also, since beginning my research, I've been excited to improve my skills and knowledge by taking advantage of the expertise that this community provides. Attending the TALENT course, *Many-body methods for nuclear physics*, at GANIL gave me a unique experience to engage all of these components and set a promising course for my scientific future, and I am extremely grateful to the TALENT organizers and FUSTIPEN for granting me that opportunity.