

Reflective Essay

By 2014, I had overcome my academic and personal difficulties, and concluded my strongest interest lied in astrophysics and cosmology. Then, I found Dr. Ricotti's information on the Joint Space-Science Institute website and began working with him. He initially proposed a research question: "how did the first galaxies form?" I took his idea and started narrowing down my research topic by gathering information on galaxy formation. As I gained more knowledge and discussed various cosmology questions with Dr. Ricotti, I noticed my focus fixed on star formation and its role in early galaxy formation. My literature review suggested that some ultra-faint dwarf galaxies in the Local Group mostly contain ancient stars as these dwarfs stopped star formation since the epoch of reionization, 12 billion years ago. The present day relics of these dwarf galaxies are called "fossil galaxies," and are among the smallest and faintest galaxies ever formed in the universe. But we expect that there are many failed dwarf galaxies in the universe: dark matter halos that are too small to form any normal star. Unfortunately, we do not know what the characteristic mass is at which a halo fails to form stars. In other words, the question main question I attempted to answer in my research project is the following: What is the minimum dark matter halo mass that a galaxy must have in order to form low mass stars with lifetimes of the order of 12 billion years? The detection of extended stellar halos around isolated dwarf galaxies is an original, innovative test of the star formation efficiency in the first galaxies and of whether the recently discovered ultra-faint dwarf satellites of the Milky Way are fossils of the first galaxies. These are new and creative ways to tackle galaxy formation problems and I had an amazing opportunity to jump into the research project with Dr. Ricotti's guidance.

My literature review began with two papers on galaxy formation and simulation which were given to me by Dr. Ricotti. I needed more information so I turned to Research Port and relied on access to databases, both provided by UMD. However, there were so many articles and journals that I did not know where to begin. When I sought help from Dr. Ricotti, he suggested I use ADS for database and start with references listed in the two papers. While following his advice, I noticed that most papers had key words included. This allowed me to utilize those words to find relevant sources without having to rely on references. I also discovered arXiv database which offered more of back ground information type papers whereas ADS offered more of experimental data type of papers. In addition, I used cosmology books from the UMD library to fill gaps in my knowledge. The process of using books was significantly slower than using online resources since I could not go to the page I want instantly by using "find" function. As I continued my literature review, I developed the ability to make out information buried in those papers efficiently without having to read the entire paper. There was a pattern in how these papers were written so that I could go to that particular section to pick out what I need. In addition, I utilized date published, "AND," and "OR" features to find appropriate papers.

No matter how much I improved my searching technique, there were more than enough papers to read. Thus, I needed a way to select and evaluate my sources. Since cosmology is an evolving field which relies on technology, I decided to only look at papers published within 5 years for experimental data. These would have the least error and the most advanced technology to produce the most accurate results. With enough attention to detail, I found some universities and authors were mentioned more than others. Therefore, I tended to follow their colleagues and affiliations.

My research advisor, Dr. Ricotti, had a huge impact on my research project. Not only did he give me tips to search for literature review efficiently, but he also evaluated my weekly progress to make sure I am on the right track. For example, I often proposed new ways of approaching our research question based on information I gained from my sources. Then, he would show me how to check whether my idea is correct. By the end of my thesis, I attained enough understanding of my subject that I could validate my own ideas up to an extent.

Writing this thesis has confirmed that I truly love cosmology and astrophysics research. I want to pursue astrophysics for the sake of self-knowledge and finding some truth about the universe we live in. Moreover, I want to share the same fulfillment with the general population in hopes of influencing more of them to support and pursue astrophysics. Such desires have led to three career options with becoming a professor being number one since I can do all of the above as a professor. But because professorships are hard to come by, my plan B is to become an astrophysics researcher at either a public or a private sector. Lastly, I am considering a career in science policy, to advocate astrophysics.

Throughout my research project, I have realized the importance of information. Without my professor, I probably would have struggled to find appropriate literature review mainly because I did not know what the library could offer. I would have liked to have a tour of the library specifically for physics related research and a concise guide with examples to search and extract information. Also, if there was a very short seminar or a one credit course like UNIV100, that probably would have exposed me to various library sources.