Starting in February of 2012 as a Gatton Academy junior, I began working with Dr. Steven Gibson on a project involving the interstellar medium (ISM), literally the stuff in between stars, and its properties. This material is much more complicated than its definition, because it is an extremely dynamic system that has numerous atoms and molecules as constituents of the gas and dust that make it up. The ISM evolves over time, and is important to study because collapsed clouds may ultimately become stars and is critical in the understanding of galactic evolution while being a major topic in astrophysics in its own right.

During my first year on the project, I utilized the WKU astronomy lab to write and run scripts and programs to create histograms of the distributions of various different cloud properties like column density, optical depth, and spin temperature throughout the hydrogen data cubes. The goal of this analysis was to see how different assumptions, such as the opacity and fraction of atomic to molecular hydrogen, affect other properties that must be computed for at a range of galactic longitudes. This would allow an indirect analysis to see which assumptions have the most prominent effect on physical cloud properties and what they would be. However, a few graphs had non-Gaussian distributions, which did not follow the behavior I expected and suggested that cloud behavior is also influenced by other phases of hydrogen. To counter this problem, I began to include other constituents of the ISM in the analysis, which would allow me to account for the column density of molecular hydrogen (H_2) and use dust as a tracer for everything. The prime advancement of the project is that I must now account for the column density of all the hydrogen in the ISM, which is no small task.

A major problem with H_2 in particular is that it does not emit at extremely cold temperatures (traditionally under 100 K). I need these cold temperatures to see Hydrogen I self-absorption (HISA), or when a cold hydrogen cloud absorbs emission from another behind it. This phenomenon can tell us a lot more than just pure hydrogen emission by giving us an outline of a cloud, so I can compare data values from on and off the cloud. So in order to determine how much H_2 there is I have to use a proxy that does emit at cold temperatures. The best proxy for H_2 is carbon monoxide (CO), because it actually relies on H_2 to form in interstellar space. However, it is not perfect, so some H_2 is missed, and this "hidden" portion must be found indirectly. This involves taking dust data from the *Planck* satellite, and subtracting the column density of the CO to account for some H_2. Now, by taking column density measurements from the hydrogen emission (HIE), CO, and dust data that are located within the regions of the HISA cloud and comparing those to similar measurements taken outside of the HISA contours, I can calculate differences in column densities, which allow me to further compute cloud properties such as the fraction of atomic to molecular hydrogen, optical depth, and spin temperature, which have always been difficult to constrain and extreme upper and lower limits were the only values guaranteed certain, if unrealistic. This new analysis provides a hope that I will not have to make such extreme assumptions again for other future projects, because I will be able to see more localized limits.

What makes this project special is that the analysis is fairly unprecedented in method, and never before has dust data as high quality as that from *Planck* been available. I intend to move this project forward by formulating a criterion for an algorithm that will search out different points in my data and perform the necessary computations on them to calculate different cloud properties for a wide range of galactic longitudes and latitudes. I have faith in this method because I have already calculated preliminary results by hand that show much promise. With a larger set of numerical results from different clouds, I would then be able to actually make maps of said properties that would allow me to see at what stage of evolution various clouds are in and how they may differ according to galactic location. Again, because of the novelty of this project, maps similar to the ones I want to make do not exist, but when they do, they will provide invaluable information about cloud evolution and properties.