The Quiet Sun's Magnetic Fields

Codie Gladney – University of Georgia
Location of Research: High Altitude Observatory
Mentors: Rebecca Centeno, Matthias Rempel

Until recently, it was thought that solar magnetic fields existed only within "Active Regions", where we find sunspots. The vast remainder of the Sun was termed the "Quiet Sun" because it was considered to be magnetically "quiet." But along with advancements in instrumentation came the discovery of weak magnetic fields pervading the entire solar surface. While these newly discovered fields are individually weak, the net effect of the Quiet Sun's magnetic fields actually dominates the magnetic flux and energy budget of the Sun.

In order to understand the true significance of these magnetic fields, we need to obtain a proper understanding of their distribution. What percentage of the Quiet Sun contains weak magnetic fields? What percentage has strong fields? Observational data has been obtained from separate instruments, using different analysis techniques, and distinctly different distribution curves were obtained. One curve has a descending distribution of magnetic field strengths, with no contributions at 1600 Gauss or higher. The other has a similar distribution until around 1500 Gauss, where there is a significant increase in the distribution, indicative of a larger amount of magnetic energy stored in the Quiet Sun. The scientific community is in disagreement as to which magnetic field distribution curve accurately describes the Sun, and my goal is to assist with this determination.

Observational data is accompanied with various errors such as those introduced by instruments, spectral line inversion codes, light pollution, and more. Because the distribution curves were obtained from observations, there are errors that must be accounted for, and these errors, undoubtedly, are responsible for the discrepancy between the observed curves. From simulated data, synthetic Stokes profiles are generated. I have degraded these profiles in order to introduce the aforementioned errors. Following the degradation process, a spectral line inversion code was run on the degraded synthetic Stokes profiles in order to obtain parameters such as the magnetic field strengths, which are used to plot the synthetic distribution curve. I conclude with a comparison of the resultant, synthetic field data and the observed data, which will assist in the determination of the Quiet Sun's true magnetic field distribution.