5.2. Coalignment

The ability to maintain coalignment of the four channels is dependent on knowledge of the thermal and mechanical stability of the system, which affects the rotation of the telescope mirrors. Because of the mechanical instabilities described above, observations in all but the LWRS aperture require multiple peakups per orbit in order to maintain a reasonable throughput. Observations made through the LWRS aperture, where coalignment is much less critical, can typically be maintained for weeks without interruption, with small adjustments of the FPAs and mirrors, as long as pointing angle constraints are followed.

A number of tests have been executed to determine how to most efficiently implement observing in the MDRS and HIRS apertures. Based on data taken for several different targets in the CVZ, the image motions are very repeatable with orbital phase. Using this information allows a determination of when to perform peakups in the MDRS or HIRS aperture as a function of orbital phase, and a prediction of how long we can observe before new peakups are necessary to keep the channels aligned. After more data is obtained, and the shape of this channel motion is well calibrated, we are hopeful that only a single peakup at the beginning of the target's visibility period will be necessary, and then the FPAs can be moved autonomously throughout the orbit in order to keep the channels aligned, thus avoiding the necessity of performing time-consuming peakups throughout the orbit.

5.3. Spectrograph Resolution and Instrument Focus

The resolution, R= $\lambda/\Delta\lambda$, of the FUSE spectrographs has been determined by measuring the widths of absorption features in the spectra of astrophysical objects. Changes in resolution as a function of wavelength are caused by both the optical design and variations of the intrinsic detector PSF with position. **Figure 3** shows the type of data used to measure resolution; it shows data taken along the line of sight to the white dwarf WD0439+466, which is a hydrogen-rich central star of an old planetary nebula. Since FUSE is limited to observing faint objects, the velocity structure along the line of sight to these objects is often complex, which can significantly broaden the lines. It has been a challenge to find appropriate lines of sight which are known to have narrow lines. At our current focus position, the SiC channels show a resolution of ~18,000, and the LiF channels show ~23,000 in the LWRS. Additional adjustments are planned in order to improve these values further. Once optimization is complete, the Science Data Pipeline (see below) will be updated to include the proper algorithms to recover the highest resolution. Most of the earliest FUSE observations were made with the mirrors at their launch position, which yields slightly lower resolution numbers, but are in the 15,000 - 20,000 range. Observations in the smaller apertures, where the positions of the FPAs are important, have begun as the characterization of the thermally-induced mirror motions has been understood in more detail.

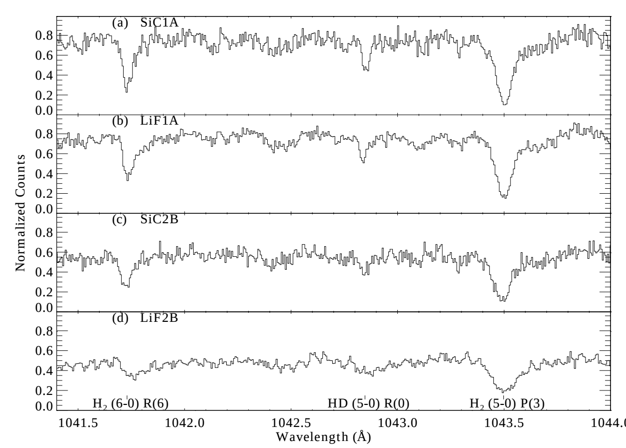

Figure 3 A spectrum of the line of sight towards WD0439+466 showing the (6-0) R(6) and (5-0) P(3) transitions of H_2, and the (5-0) R(0) line of HD in all four channels. The variation in resolving power between channels is apparent. The HD line shows a resolving power of up to ~25,000, depending on channel.

In the LWRS aperture, where most observations have been made thus far, the focus of the instrument is determined solely by the position of the mirrors, and the resolution is limited by the telescope PSF, the satellite pointing stability, the mirror and grating stability, and the fact that the LWRS is off axis. The highest possible resolution will require use of the HIRS aperture, but this will likely result in a significant loss of throughput, particularly in the SiC channels.