5.4. Wavelength Calibration

In-flight wavelength calibration is done using astrophysical sources. During spectrograph integration and test, H_2 spectra were used to map the wavelength scale, which is nonlinear because of the variation in size of the of the analog detector pixels with position. High order polynomials were developed to describe this distortion to an accuracy of better than one spectrograph resolution element, which is expected to remain stable, aside from the expected stretches and shifts caused by variations in detector temperature. A combination of downward looking airglow and astronomical sources is being used to tie the ground-based solution to the in flight data.

5.5. Scattered Light

Scattered light is known to be present at several levels. A vertical "stripe" of enhanced counts is present on one detector segment; its intensity varies with the Lyman-β airglow, so it is thought to be caused by light entering the spectrograph from a stray light path. In addition, the overall background rate is seen to vary between day and night. Both of these effects are at a level of a few percent, so they have an effect on the data for only the lowest flux targets, and then typically only near the bottom of saturated lines[1].

6. SENSITIVITY

The current estimate of the effective area, based primarily on observations of hot hydrogen-rich white dwarf stars, is shown in **Figure 4** for each of the channels as a function of wavelength. Errors are estimated to be 10%, and will decrease as more measurements are made. As part of our regular calibration program, we return to these calibration targets roughly once per month in order to monitor the expected decrease in effective area with time. Early indications are that this drop is less than the budgeted 20% per year.

The high throughput of the LiF channels below ~1000 Å is a result of the great lengths to which the FUSE project went in order to minimize exposure of these optics to air with a relative humidity above ~50%. As the LiF coating absorbs water, the short wavelength cutoff moves to longer wavelengths[9]. Maintaining high sensitivity at OVI λλ1036, 1038 Å , in particular, is important to the scientific goals of the FUSE mission. The mirrors and gratings were exposed to room air with a humidity > 30% for a total of only five days during all instrument and subsystem testing.

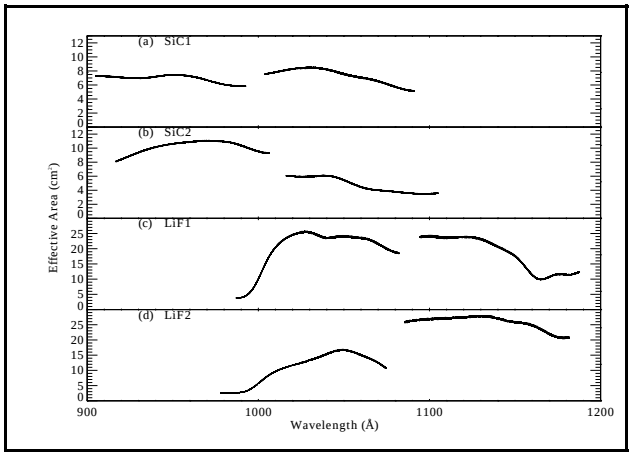

Figure 4 Estimated effective area of the four channels of the FUSE instrument, based on measurements of white dwarfs and model spectra. Due to variations in coating reflectivity, grating efficiency, and detector sensitivity, there is a substantial variation between channels. Note that the scales are different for the SiC and LiF channels.

Similar efforts were made to minimize particulate, and molecular contamination in the instrument. An additional precaution taken in order to keep the reflectivities high was limiting pointing to only the continuous viewing zone (CVZ) for the first part of the mission. During a typical observation, a target is occulted by the earth every orbit. Since the satellite remains pointed at the object (using its onboard gyros rather than the FES), the bright earth illuminates the mirrors each time this happens. Ultraviolet light from the earth can lead to a polymerization of contaminants on the optics. For this reason, potential molecular contaminants were limited in the construction of the satellite – particularly in the optical cavity which contains the mirrors and gratings. Restricting early pointings to the CVZ allowed as much of the contaminantion as possible to outgas in order to limit these effects. In addition, the grating and mirror surfaces are being kept several degrees warmer than the surrounding surfaces in order to minimize condensation of contaminants.

To further limit on-orbit degradation of the mirror reflectivities, a ram avoidance angle of 20 ° has been implemented as an operations constraint, in particular to avoid atomic oxygen directly striking the SiC channel telescope mirrors. Atomic oxygen has been implicated in the loss of reflectivity of SiC optics on numerous other space missions [10,11].