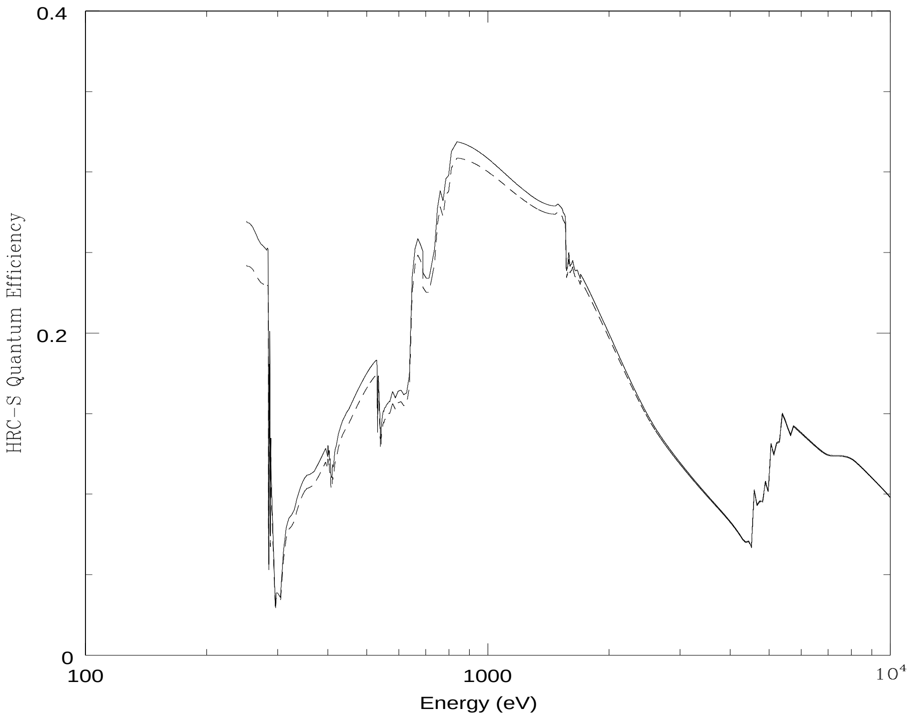

Figure 8: Pre-flight QE of HRC-S (MCP QE and UVIS transmission) in 1st order of the LETG (i.e. QE of the HRC-S at the position where the first order at energy E is dispersed by the LETG) versus energy. The solid curve is the -1 order, the dashed curve is the +1 order.

The second type of calibration observations is HRC-S/LETG observations of the white dwarfs Sirius B and HZ 43. These observations are used as standard candles to determine the long wavelength response of the HRC-S/LETG combination as the EUV/soft X-ray flux from these sources is reasonably well know. The third type of observations are ACIS-S/LETG and HRC-S/LETG cross-calibrations of Capella, a line dominated source, and 3C273, a continuum source which extends to 10 keV. We will present some preliminary analyses from each of these calibration observations.

4.1.1 Broadband Quantum Efficiency Calibration

The supernova remnants Cas A and G21.5-0.9 were observed by the HRC-I, HRC-S, and ACIS-S instruments to cross-calibrate the broadband QE above ~0.8 keV. Each segment of the HRC-S was illuminated by both sources, but unfortunately the observations on the +1 segment were slightly misaligned and a significant fraction of the flux fell in the gap between the +1 and central segments. Analysis of that data would require a detailed exposure correction and is not considered here. As described elsewhere in these proceedings (Kenter *et al.* 2000), the measured rate in the HRC-I agrees within ~10% for both sources with the flux measured by ACIS-S. Given that agreement, we have compared the broadband fluxes for the HRC-S observations of the central and -1 segments with the HRC-I observations. The results are summarized in Table 3. The observation on the -1 segment is approximately 20 arcminutes off-axis so a substantial correction must be applied to that data to account for telescope vignetting. Background was estimated in a region near the source. The estimated rate based on the pre-flight quantum efficiency and ACIS-S spectrum is also given. As described above the pre-flight QE of the HRC-S is somewhat lower than that of the HRC-I, and as can be seen from Table 3, the in-flight calibration is roughly consistent with these pre-flight measurements. For example, we predict a rate of 0.406 cts/s in the

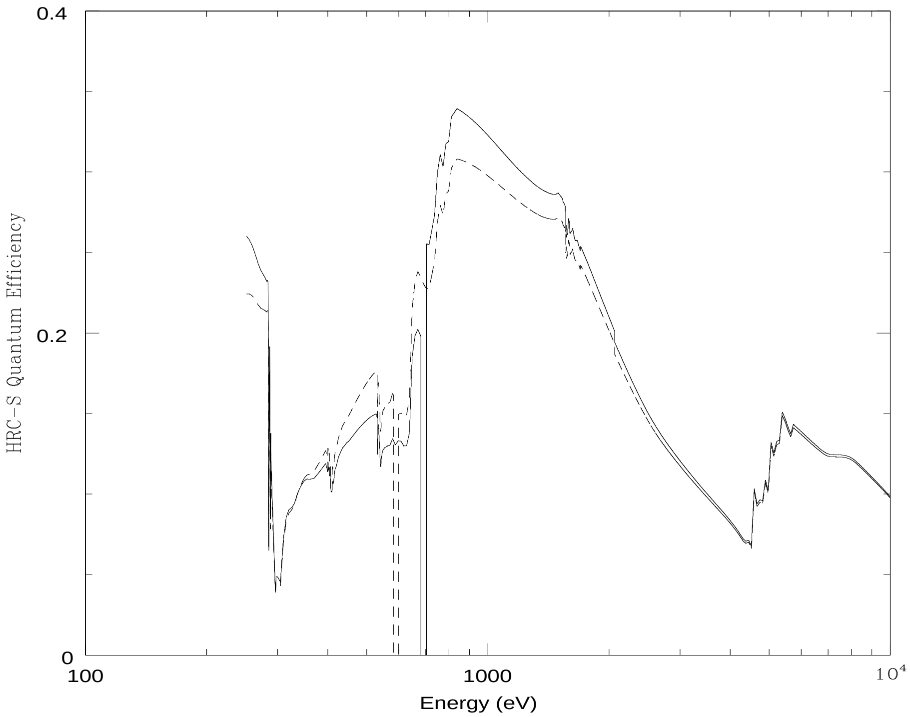

Figure 9: Pre-flight QE of HRC-S (MCP QE and UVIS transmission) in 3rd order of the LETG (i.e. QE of the HRC-S at the position where the third order at energy E is dispersed by the LETG) versus energy. The solid curve is the -3 order, the dashed curve is the +3 order. The dropouts at 700 eV and 600 eV are caused by the gaps between the segments.

central segment based on the ACIS-S observation, and measure a rate of 0.39 cts/s. The G21.5-0.9 observation gives very good agreement in the broadband QE between both segments of the HRC-S and the HRC-I, but the spectrum is well described by an absorbed powerlaw, and the spatial morphology of the remnant is reasonably simple. There is a somewhat larger difference ($\sim$10%) between predicted and measured QEs for Cas A; the predicted rate in the center segment is 78.8 cts/s and the measured rate is 71.9 cts/s. This object has a complex spatial morphology and a line dominated spectrum that ACIS cannot fully resolve, and a more detailed analysis than that given here including the effects of telescope vignetting, spatial variations in the detector efficiencies, and spectral variations in the source may improve the agreement. We therefore conclude that the average, broadband QE above $\sim$0.8 keV is consistent with our pre-flight estimates based on ground calibration data.

Source	HRC-I rate (cts/s)	HRC-S seg 0	HRC-S seg -1	HRC-S pred.
Cas A	82.1	71.9	39.4 (73.9)	78.8
G21.5-0.9	0.56	0.39	0.21 (0.40)	0.406

Table 3: Summary of HRC-S/HRC-I broadband QE cross-calibration observations. The entries in the table are the measured counting rates (cts/s). The HRC-S predicted rate is the rate estimated using the pre-flight quantum efficiency model and the observed ACIS-S spectrum. The rate in parenthesis in the -1 segment column is the rate after correction for the telescope vignetting ($\sim$0.53). The observations with the -1 segment were 20 arcminutes off axis.