

DUST MOTES AND BLEMISHES IN THE CCD SPECTRAL MODES

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ABSTRACT

A set of 84 dust mote features and blemishes have been identified in STIS CCD flat fields. These 84 regions are flagged in the bad pixel table and will be propagated to extracted spectra. The current defaults place the spectra at the Y center of the CCD, where two motes can cause spurious spectral features. Since flat field correction of the dust motes is inadequate for spectra of point sources, these artifacts can be up to 3% deep with a width of several pixels after flat field correction. Several Figures are included as guides to placing spectra onto regions of the CCD where blemishes have minimal impact.

1. Introduction

Particulate contamination on the window of the CCD produces out-of-focus regions of lower sensitivity on the CCD. In addition to these dust motes with sizes in the 8-30 pixel range, a few other blemishes of similar sizes appear on the CCD itself. Figures 1-2 are flat fields for the low and medium resolution modes, respectively, that illustrate the blemishes. Because of differences in the optical magnification, the low dispersion motes are smaller and deeper than the medium resolution motes. Figure 3 is an example of the effect of a mote in an extracted spectrum of a star.

2. Results

The mote positions are flagged in circular regions of radius 12 or 16 pixels for the low and medium resolution modes, respectively. The two motes that influence spectra that are centered on the detector have smaller radii of 8 and 12 pixels, respectively. Since the first order spectra lie nearly along the X direction of the CCD, an inventory of the effects of the motes as function of Y (row number) is required. Figures 4-5 count the number of pixels in motes encountered in each row, while Figures 6-7 are the corresponding total depth below the unit average flat field level for all of those flagged pixels.

Examples of regions that avoid blemishes are near Y=457 or 773. The number of rows in a region needed to totally avoid blemishes is the seven-pixel width of the spectral extraction region, plus the tilt of the spectrum across the detector (typically < 7px), plus a couple of pixels for mechanism repeatability.

For spectra of the highest purity, Figures 4-7 can be used to select dither positions or place a target spectrum at a Y location that avoids the CCD blemishes. For example to center a target at a particular Y pixel value, use the spectral Y locations in Table 1 and the CCD cross-dispersion plate scale of 0.05071 arcsec/pixel to calculate the proper POSTARG value. The STIS mode select mechanism usually positions the spectrum at the same place on the CCD to 1-2 pixels. All Y pixel locations quoted in this ISR are based on counting the first pixel as one, rather than the IDL convention of zero.

Table 1.

Y Location of Spectra for the CCD Primary Modes

Mode	Cenwave (Å)	Rootname	Y (px)
G230LB	2375	O45A13010	509
G430L	4300	O45A13020	509
G750L	7751	O45A13030	510
G230MB	1713	O4A506020	512
G230MB	1854	O4A506030	511
G230MB	1995	O4A506040	513
G230MB	2135	O4A506050	515
G230MB	2276	O4A506060	510
G230MB	2416	O4A506070	510
G230MB	2557	O4A506080	512
G230MB	2697	O4A506090	513
G230MB	2836	O4A5060A0	508
G230MB	2976	O4A5060B0	513
G230MB	3115	O4A5060C0	508
G430M	3165	O4A5050L0	517
G430M	3423	O4A5050M0	515
G430M	3680	O4A5050N0	517
G430M	3936	O4A5050O0	516
G430M	4194	O4A5050P0	516

Mode	Cenwave (Å)	Rootname	Y (px)
G430M	4451	O4A5050Q0	516
G430M	4706	O4A5050R0	512
G430M	4961	O4A5060D0	516
G430M	5216	O4A5060E0	532
G430M	5471	O4A5060F0	511
G750M	5734	O4A505030	516
G750M	6252	O4A505040	515
G750M	6768	O4A505050	516
G750M	7283	O4A505060	517
G750M	7795	O4A505080	510
G750M	8311	O4A5050A0	513
G750M	8825	O4A5050C0	514
G750M	9336	O4A5050E0	509
G750M	9851	O4A5050G0	512
G750M	10363	O4A5050I0	511

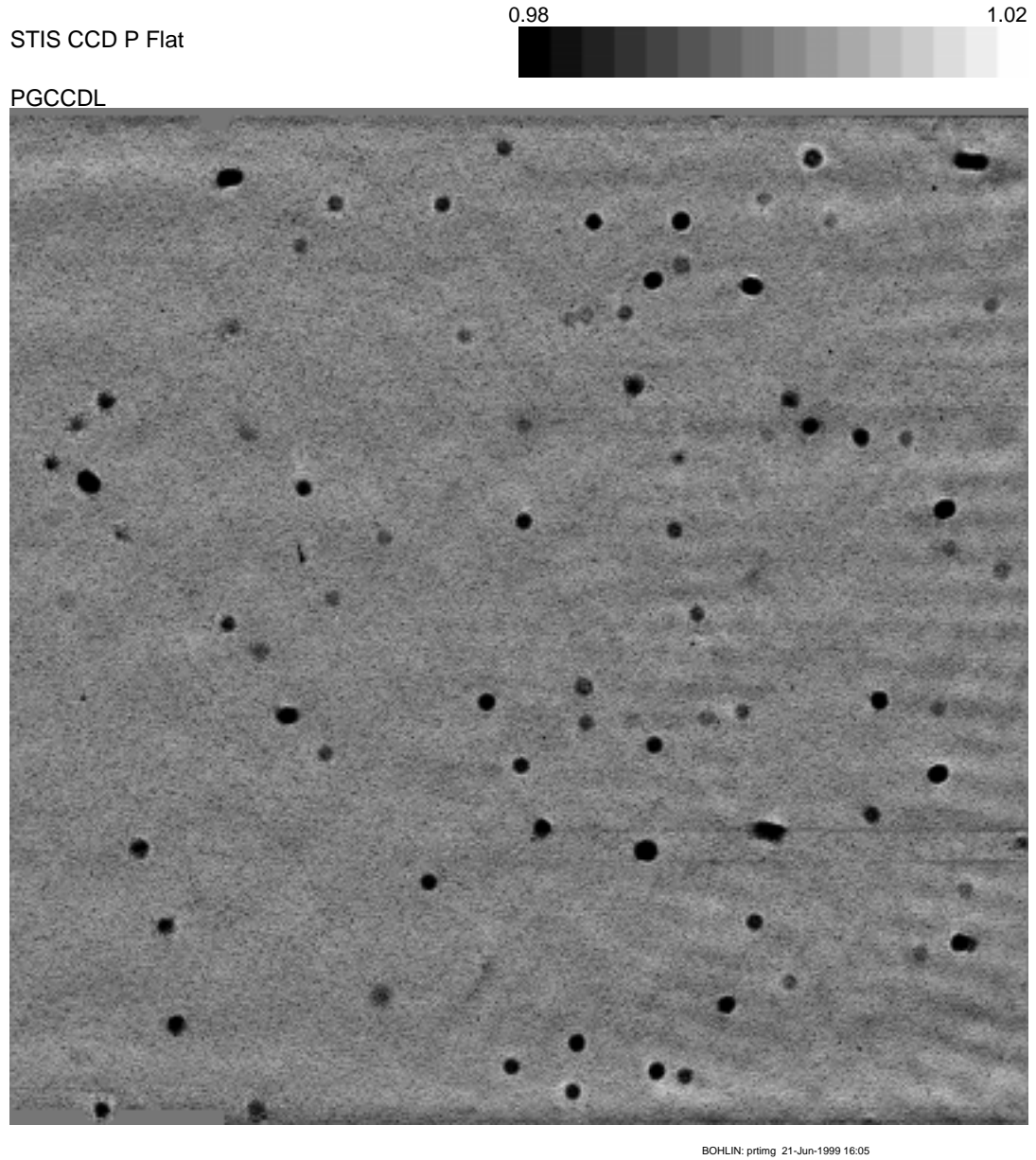


Figure 1: Flat field for low dispersion STIS CCD modes scaled from 0.98 to 1.02

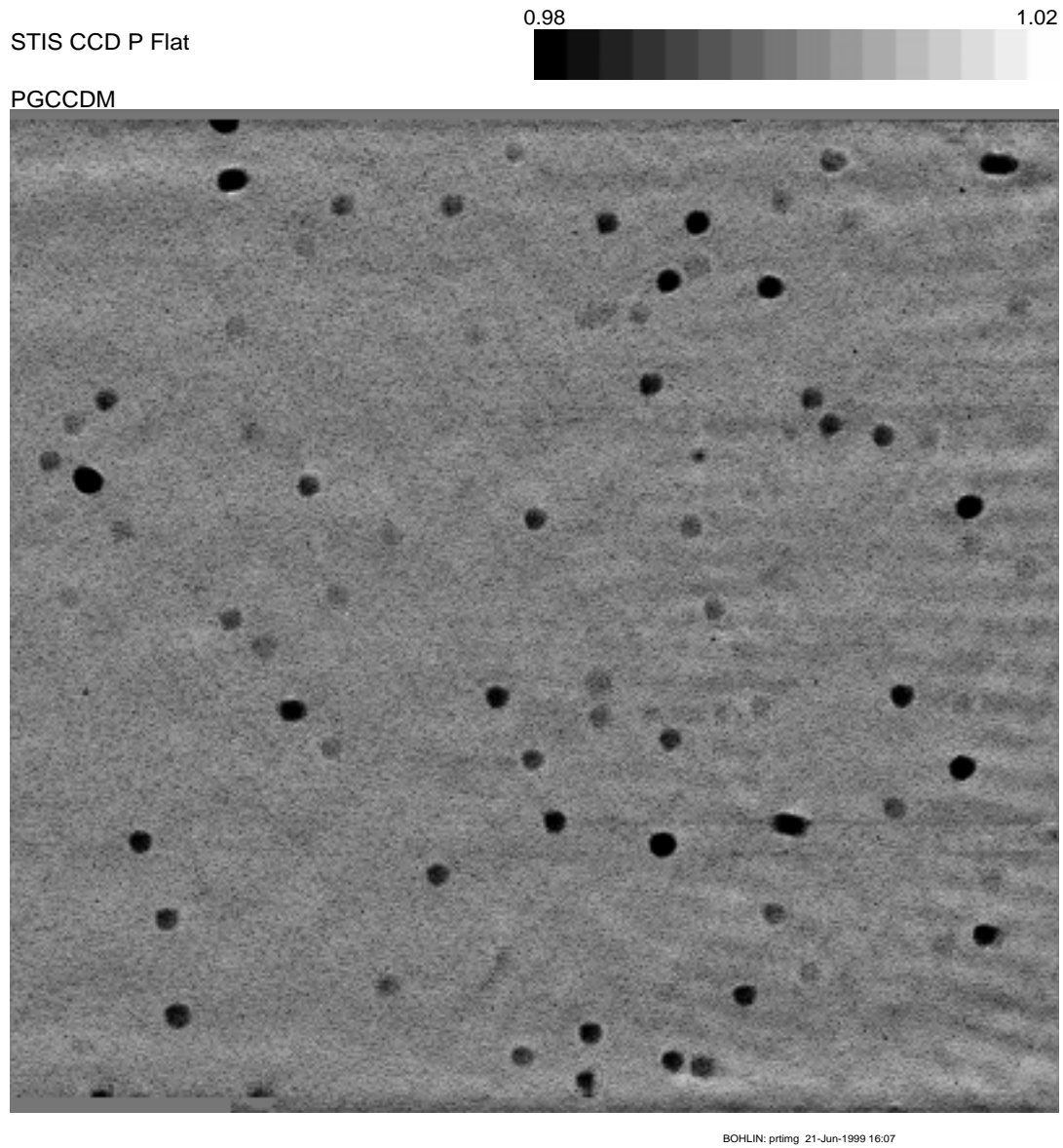


Figure 2: As in Figure 1 for the medium dispersion spectral modes. The dust motes are larger and shallower than in low dispersion.

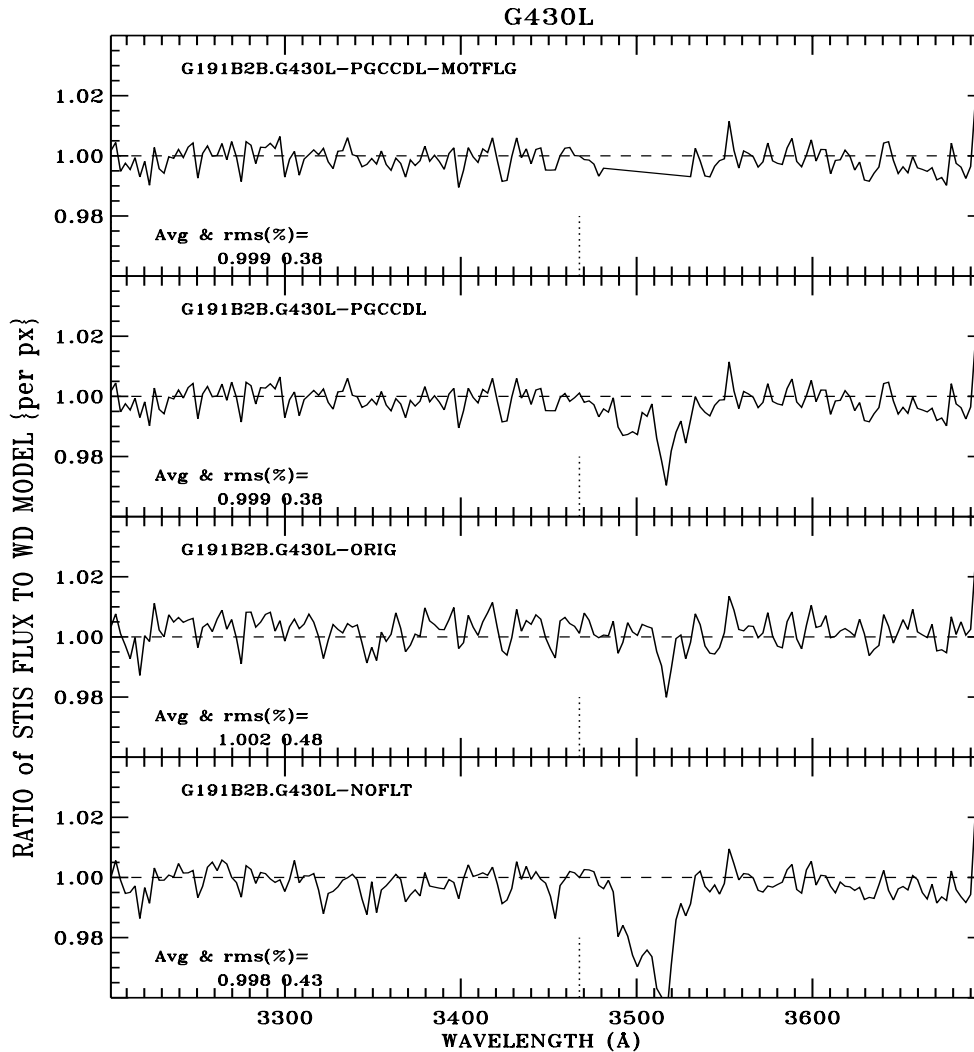


Figure 3: Effect of the CCD dust mote at (220,505) on the sum of two G430L spectra of G191B2B. Plotted as a function of wavelength is the ratio of the STIS data to the noiseless model spectrum for that standard star. There are no features in the standard spectrum, while the dip in the 3515Å region of the lower panels is the dust mote in the data. The lowest panel (G191B2B.G430L-NOFLT) used no flat field; G191B2B.G430L-ORIG is with the original current pipeline flat from prelaunch data; G191B2B.G430L-PGCCDL is the new flight flat; and G191B2B.G430L-MOTFLG is the same flight flat with the mote region flagged, so that the region of the mote can be automatically ignored. The two numbers at the lower left of each panel are the mean level and rms scatter in percent of the data points in the 3200-3467Å region delimited by the left hand axis and the short vertical dotted line. The new flat produces the best signal-to-noise ratio with a $\sigma=0.38\%$ that approaches the quantum statistical limit of 0.3%.

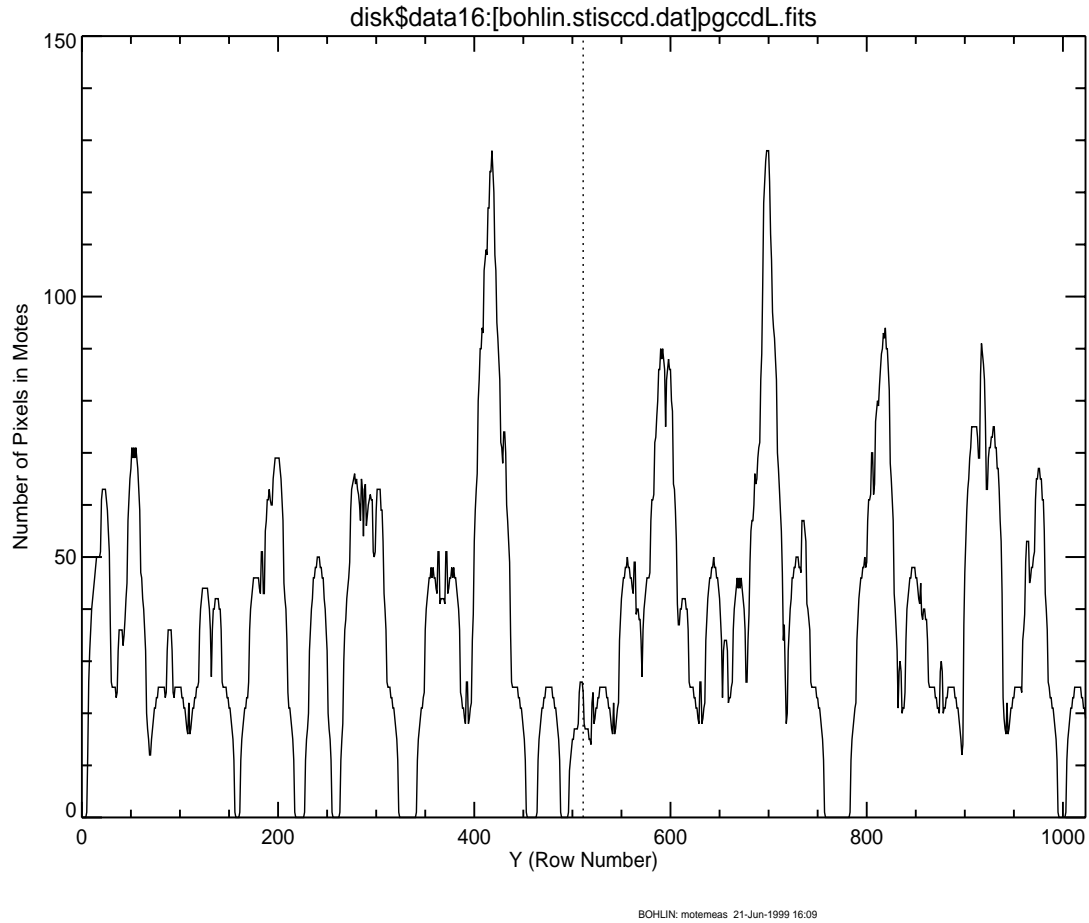


Figure 4: Number of pixels that lie in mote regions as a function of row number in the STIS CCD low dispersion modes. The vertical dotted line is the nominal location of the spectra at row 512 in the 1024x1024 CCD image.

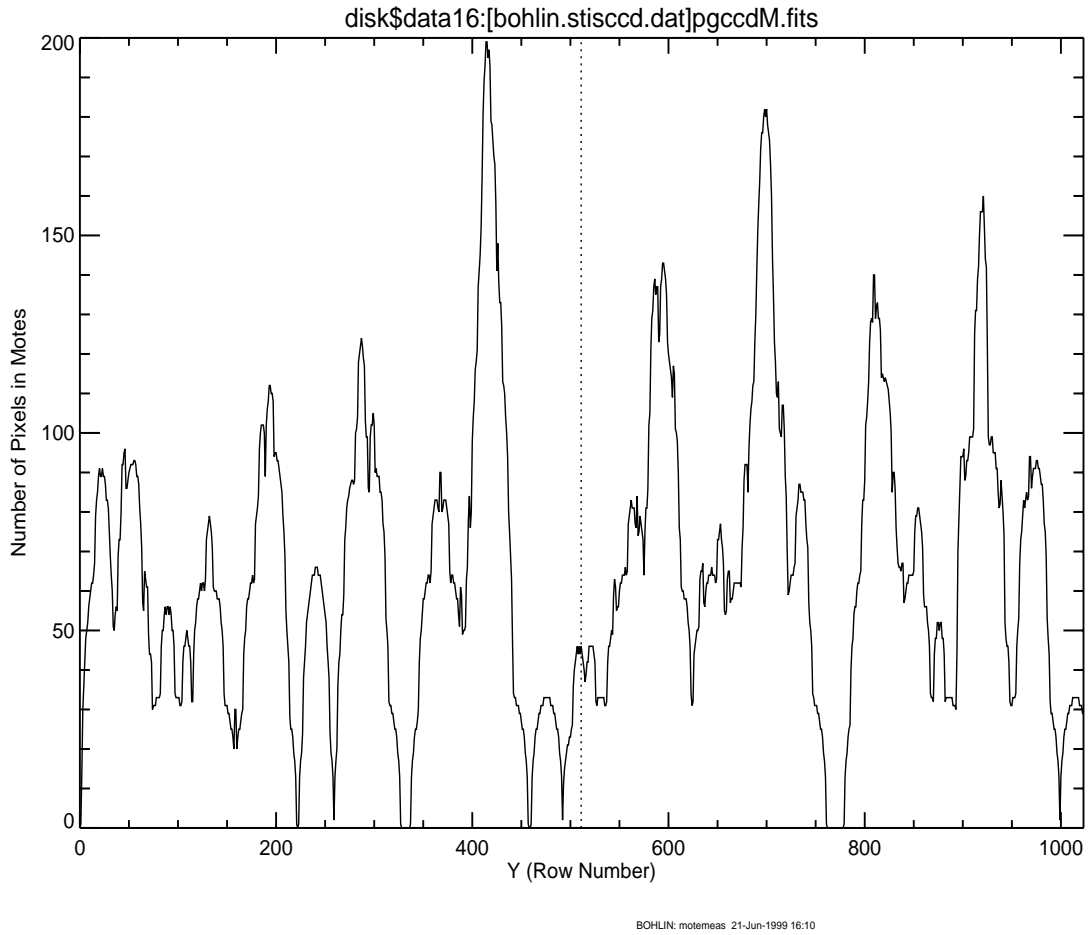


Figure 5: As in Figure 4 for the medium dispersion modes.

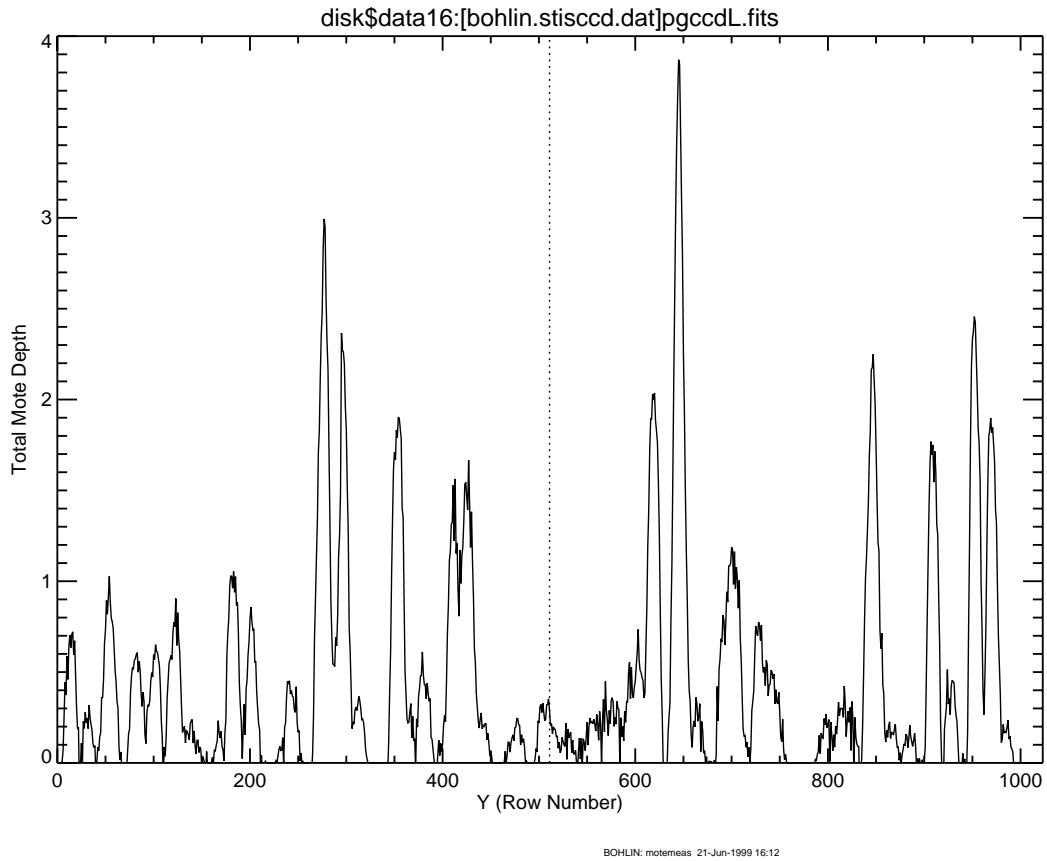


Figure 6: Cumulative depth below unity in motes for each row in low dispersion.

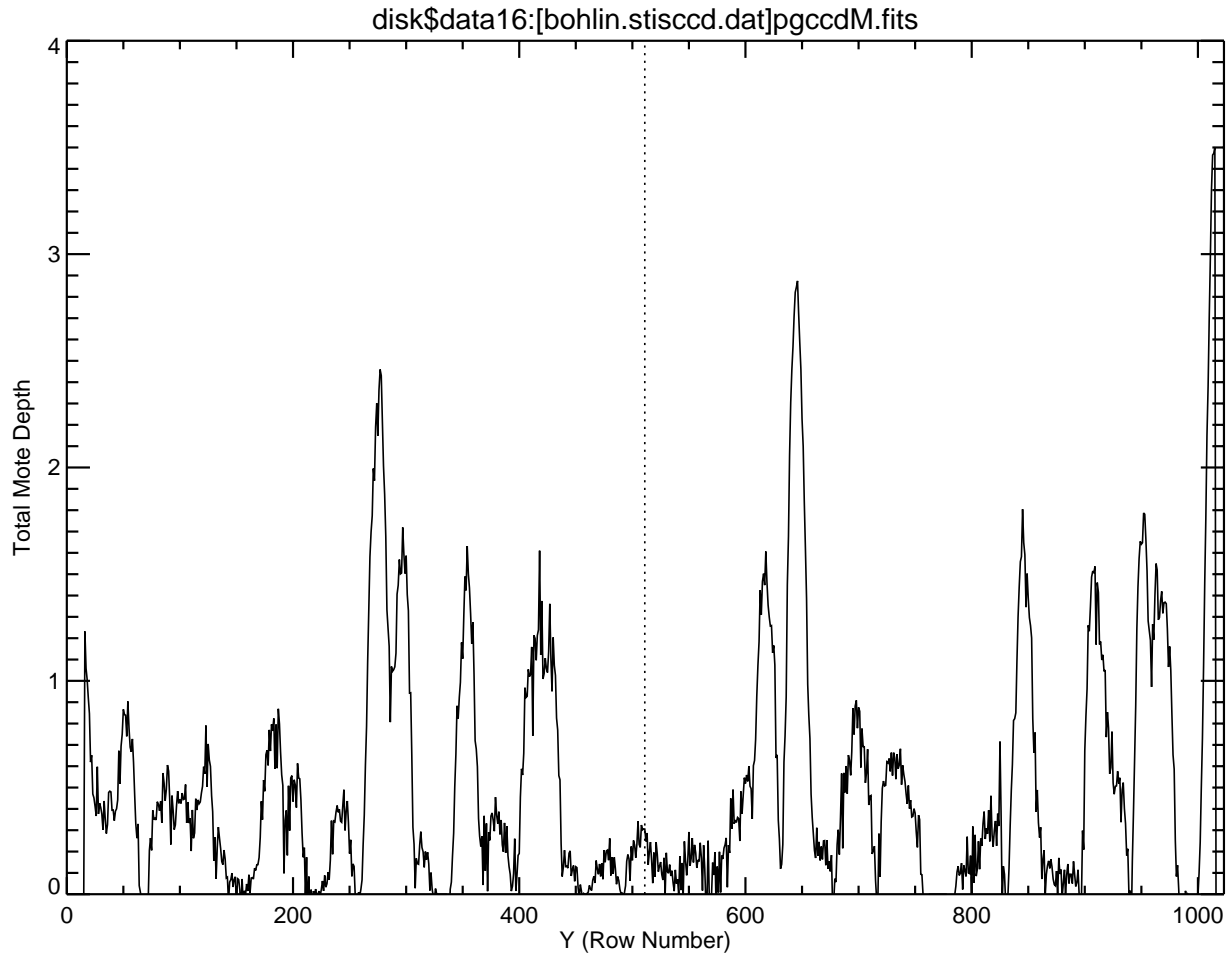


Figure 7: As in Figure 6 for the medium dispersion modes.