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Instrument Science Report STIS 2001-01R

Sensitivity Monitor Report for the STIS First-Order Modes-III

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May 2, 2001

ABSTRACT

This analysis of the STIS Sensitivity Monitor observations from 1997 through October 1, 2000, shows continuing sensitivity trends correlated with time for all first-order low and medium resolution modes as well as a temperature dependence in the FUV. The mean wavelength-averaged rate of sensitivity loss for the L-modes is ~1%/yr, with individual losses ranging from ~0%/yr (G430L,G750L) to ~1.5%/yr(G140L,G230L,G230LB). Selected wavelength settings of the M-modes have an average sensitivity loss of almost 2%/yr, with individual losses ranging from ~1%/yr (G230M,G430M,G750M) to ~3.5%/yr (G230MB). This report closes out the Cycle 8 first-order monitoring programs (Proposal ID: 8418, 8428).

Introduction

This is an update to the analyses of the sensitivity monitoring observations of the STIS first-order modes. The first data since the 1999 gyro failure and Servicing Mission 3A are presented, as well as all available data from Cycle 7,Cycle 8, and Cycle 9. Prior reports of sensitivity trends are given by Walborn and Bohlin in ISR STIS 98-27(WB1998), by Bohlin in ISR STIS 99-07 (B1999), and by Ed Smith, David Stys, Nolan Walborn, and Ralph Bohlin in ISR STIS 2000-03 (SSWB2000).

Observations

Observations analyzed in this report are from the STIS Sensitivity Monitor calibration program. The data are from Cycle 7, Cycle 8, and Cycle 9 programs through October 1, 2000. Each dataset has been processed by OTFC. Tables 1 and 2 show the data obtained since SSWB2000. To view spectra representative of those produced by each mode in this program refer to Figures 1-10 of WB1998. The data reduction and analysis procedures used to generate this report are described in SSWB2000.

Table 1. MAMA Observations

Rootname	Mode	Central-λ (Å)	Date	Time (UT)	Propid	Exptime (sec)	Targname
			G140L (1300-1500Å)				
o5jj07010	G140L	1425	1/19/00	8:37:36	8424	201	GRW+70D5824
o5jj08010	G140L	1425	2/7/00	2:02:33	8424	201	GRW+70D5824
o5jj09010	G140L	1425	3/10/00	2:20:13	8424	201	GRW+70D5824
o5jj10010	G140L	1425	4/12/00	12:46:34	8424	201	GRW+70D5824
o5jj11010	G140L	1425	5/12/00	19:14:33	8424	201	GRW+70D5824
o5jj12010	G140L	1425	6/6/00	10:07:45	8424	201	GRW+70D5824
o5jj13010	G140L	1425	7/3/00	2:01:13	8424	201	GRW+70D5824
o5jj14010	G140L	1425	8/23/00	16:25:50	8424	204	GRW+70D5824
o5jj99010	G140L	1425	10/1/99	18:14:28	8424	204	GRW+70D5824
o5jj99030	G140L	1425	10/1/99	18:35:41	8424	204	GRW+70D5824
o69s01010	G140L	1425	9/17/00	4:00:07	8857	201	GRW+70D5824
o69s02010	G140L	1425	10/1/00	7:00:41	8857	204	GRW+70D5824
			G140M (1150-1190Å)				
o5jj18020	G140M	1173	2/4/00	22:18:22	8424	210	AGK+81D266
o5jj19020	G140M	1173	3/11/00	2:12:36	8424	210	AGK+81D266
o5jj20020	G140M	1173	5/10/00	4:09:15	8424	210	AGK+81D266
o5jj21020	G140M	1173	7/7/00	14:56:16	8424	210	AGK+81D266
o69s13030	G140M	1173	9/1/00	12:28:06	8857	210	AGK+81D266
			G140M (1542-1592Å)				
o5jj18010	G140M	1567	2/4/00	22:05:17	8424	300	AGK+81D266
o5jj19010	G140M	1567	3/11/00	1:59:31	8424	300	AGK+81D266
o5jj20010	G140M	1567	5/10/00	3:56:10	8424	300	AGK+81D266
o5jj21010	G140M	1567	7/7/00	14:43:11	8424	300	AGK+81D266
o69s13020	G140M	1567	9/1/00	12:15:01	8857	300	AGK+81D266

Rootname	Mode	Central-λ (Å)	Date	Time (UT)	Propid	Exptime (sec)	Targname
G230L (2200-2600Å)							
o5jj07020	G230L	2376	1/19/00	8:47:52	8424	204	GRW+70D5824
o5jj08020	G230L	2376	2/7/00	2:12:49	8424	204	GRW+70D5824
o5jj09020	G230L	2376	3/10/00	2:30:29	8424	204	GRW+70D5824
o5jj10020	G230L	2376	4/12/00	12:56:50	8424	204	GRW+70D5824
o5jj11020	G230L	2376	5/12/00	19:24:49	8424	204	GRW+70D5824
o5jj12020	G230L	2376	6/6/00	10:18:01	8424	204	GRW+70D5824
o5jj13020	G230L	2376	7/3/00	2:11:29	8424	204	GRW+70D5824
o5jj14020	G230L	2376	8/23/00	16:36:09	8424	204	GRW+70D5824
o5jj99020	G230L	2376	10/1/99	18:24:47	8424	204	GRW+70D5824
o69s01020	G230L	2376	9/17/00	4:10:23	8857	204	GRW+70D5824
o69s02020	G230L	2376	10/1/00	7:11:00	8857	204	GRW+70D5824
G230M (2775-2860Å)							
o5jj18030	G230M	2818	2/4/00	22:29:37	8424	480	AGK+81D266
o5jj19030	G230M	2818	3/11/00	2:23:51	8424	480	AGK+81D266
o5jj20030	G230M	2818	5/10/00	4:20:30	8424	480	AGK+81D266
o5jj21030	G230M	2818	7/7/00	15:07:31	8424	480	AGK+81D266
o69s13040	G230M	2818	9/1/00	12:39:21	8857	480	AGK+81D266

Table 2. CCD Observations

Rootname	Mode	Central-λ (Å)	Date	Time (UT)	Propid	Exptime (sec)	Targname	GAIN
G230LB (2000-3000Å)								
o5ig03010	G230LB	2375	1/11/00	22:04:19	8418	172	AGK+81D266	1
o5ig04010	G230LB	2375	2/1/00	15:14:27	8418	172	AGK+81D266	1
o5ig05010	G230LB	2375	4/2/00	4:51:29	8418	172	AGK+81D266	1
o5ig06010	G230LB	2375	6/4/00	17:59:18	8418	172	AGK+81D266	1
o5ig07010	G230LB	2375	8/1/00	15:58:46	8418	172	AGK+81D266	1
G230MB (1920-2070Å)								
o5ig09010	G230MB	1995	1/15/00	17:47:25	8418	240	AGK+81D266	1
o5ig10010	G230MB	1995	5/14/00	5:59:26	8418	240	AGK+81D266	1
G230MB (2340-2490Å)								
o5ig09020	G230MB	2416	1/15/00	17:57:46	8418	180	AGK+81D266	1
o5ig10020	G230MB	2416	5/14/00	6:09:47	8418	180	AGK+81D266	1
G430L (3100-5500Å)								
o5ig03020	G430L	4300	1/11/00	22:13:34	8418	172	AGK+81D266	1
o5ig04020	G430L	4300	2/1/00	15:23:42	8418	172	AGK+81D266	1
o5ig05020	G430L	4300	4/2/00	5:00:44	8418	172	AGK+81D266	1
o5ig06020	G430L	4300	6/4/00	18:08:33	8418	172	AGK+81D266	1
o5ig07020	G430L	4300	8/1/00	16:08:01	8418	172	AGK+81D266	1
G430M (3050-3300Å)								
o5ig09030	G430M	3165	1/15/00	18:07:37	8418	120	AGK+81D266	1
o5ig10030	G430M	3165	5/14/00	6:19:38	8418	120	AGK+81D266	1
G430M (4060-4320Å, gain=1)								
o5ig09040	G430M	4194	1/15/00	18:15:38	8418	120	AGK+81D266	1
o5ig10040	G430M	4194	5/14/00	6:27:39	8418	120	AGK+81D266	1
G430M (4060-4320Å, gain=4)								
o5ig09050	G430M	4194	1/15/00	18:19:06	8418	120	AGK+81D266	4
o5ig10050	G430M	4194	5/14/00	6:31:07	8418	120	AGK+81D266	4
G750L (5600-7000Å)								
o5ig03030	G750L	7751	1/11/00	22:22:49	8418	432	AGK+81D266	1
o5ig04030	G750L	7751	2/1/00	15:32:57	8418	432	AGK+81D266	1
o5ig05030	G750L	7751	4/2/00	5:09:59	8418	432	AGK+81D266	1
o5ig06030	G750L	7751	6/4/00	18:17:48	8418	432	AGK+81D266	1

Rootname	Mode	Central-λ (Å)	Date	Time (UT)	Propid	Exptime (sec)	Targname	GAIN
o5ig07030	G750L	7751	8/1/00	16:17:16	8418	432	AGK+81D266	1
			G750M (7000-7500Å)					
o5ig09060	G750M	7283	1/15/00	18:27:57	8418	120	AGK+81D266	1
o5ig10060	G750M	7283	5/14/00	6:39:58	8418	120	AGK+81D266	1

Results

Figures 1 through 19 present the relative sensitivity vs. time for each observing mode, plus the linear fits to those points. The slope, i.e., percent change in sensitivity per year, and its 1 sigma uncertainty in the fits are given at the bottom of each figure. The 1-sigma rms(%) of the data residuals from the linear fit is given by the SIGMA value also at the bottom of each figure. A summary of those values for each mode is contained in Table 3. These tables also compare our results to those presented by SSWB2000. On average, the percent per year changes in sensitivities measured in this report are in agreement with SSWB2000 to within 1 sigma.

The biggest differences with respect to SSWB2000 are for the modes that appear to have a bimodal trend in time for the sensitivity. Using single, linear fits, the difference of the slopes exceed 1-2 sigma in each case. When split at 1998.7, the trends seen by SSWB2000 agree with those seen now.

The two-epoch fits of both MAMA *and* CCD modes covering 1900-3000Å continue to exhibit a bimodal time variation. The sensitivity increases prior to ~1998.7 and decreases thereafter. Single fits to these data indicate, with a large uncertainty, no or little change with time, while the two epoch fits show significant trends with a significantly reduced scatter about the fits. Linear fits which begin at 1998.7 show rates of change in sensitivity ranging from -0.9%/yr (G230M) to -3. 6%/yr (G230MB).

Table 3.

Observing Mode			SSWB 2000			STIS ISR 2001-01			Difference		
Mode	**Epoch**	**λ– Range(Å)**	**%/yr**	**+/-**	**SIGMA**	**%/yr**	**+/-**	**SIGMA**	**%/yr**	**+/-**	**Ratio**
MAMA Modes											
G140L		1300-1500	-1.36	0.15	0.53	-1.54	0.11	0.63	-0.18	0.19	0.97
G140M		1150-1190	-3.51	0.48	0.69	-2.55	0.28	0.74	0.96	0.56	1.73
G140M		1542-1592	-2.19	0.24	0.49	-2.1	0.14	0.47	0.09	0.28	0.32
G230L		2200-2600	-0.12	0.16	0.55	-0.74	0.12	0.65	-0.62	0.20	3.10
G230L	<1998.7	2200-2600	1.49	0.37	0.36	1.42	0.36	0.36	-0.07	0.52	0.14
G230L	>1998.7	2200-2600	-1.36	0.15	0.2	-1.51	0.07	0.23	-0.15	0.17	0.91
G230M		2775-2860	0.02	0.16	0.33	-0.42	0.13	0.46	-0.44	0.21	2.13
G230M	<1998.7	2775-2860	1.13	0.22	0.11	1.33	0.26	0.13	0.2	0.34	0.59
G230M	>1998.7	2775-2860	-0.58	0.18	0.18	-0.9	0.1	0.21	-0.32	0.21	1.55
CCD Modes											
G230LB		2000-3000	-0.14	0.1	0.39	-0.64	0.13	0.52	-0.5	0.16	3.05
G230LB	<1998.7	2000-3000	0.72	0.21	0.16	0.78	0.21	0.17	0.06	0.30	0.20
G230LB	>1998.7	2000-3000	-1.25	0.31	0.24	-1.4	0.12	0.23	-0.15	0.33	0.45
G230MB		1920-2070	-0.11	0.43	0.7	-1.16	0.45	1.12	-1.05	0.62	1.69
G230MB	<1998.7	1920-2070	0.84	0.64	0.38	0.67	0.72	0.42	-0.17	0.96	0.18
G230MB	>1998.7	1920-2070	-3.06	0.8	0.27	-3.6	0.3	0.27	-0.54	0.85	0.63
G230MB		2340-2490	-0.67	0.27	0.45	-1.11	0.24	0.59	-0.44	0.36	1.22
G230MB	<1998.7	2340-2490	0.35	0.53	0.32	0.21	0.63	0.37	-0.14	0.82	0.17
G230MB	>1998.7	2340-2490	-1.91	0.01	0.01	-2.11	0.31	0.29	-0.2	0.31	0.64
G430L		3100-5500	-0.26	0.26	0.63	-0.29	0.14	0.55	-0.03	0.30	0.10
G430M		3050-3300	-0.87	0.11	0.18	-0.98	0.09	0.22	-0.11	0.14	0.77
G430M	Gain=1	4060-4320	-1.07	0.08	0.12	-1.0	0.04	0.11	0.07	0.09	0.78
G430M	Gain=4	4060-4320	-1.31	0.12	0.12	-1.15	0.07	0.12	0.16	0.14	1.15
G750L		5600-7000	0.07	0.16	0.39	-0.1	0.1	0.4	-0.17	0.19	0.90
G750M		7000-7500	-1.21	0.13	0.21	-1.12	0.08	0.21	0.09	0.15	0.59

Conclusions

The MAMA first-order trends are now sufficiently well established to incorporate into the data reduction pipeline. The available M-mode wavelengths appear to track the wavelength-dependent trends in the L-modes as presented by B1999; hence, the latter can be applied to both L and M-modes. On the other hand, the situation for the CCD is unclear. There is no evident relationship between the L and M-mode trends (although B1999 did not perform a bimodal analysis for G230LB). The G430L and G750L trends observed here are not significantly different from zero; for G230LB, a wavelength-dependent bimodal analysis is required. Very significant declines in sensitivity are seen in all the observed CCD M-modes, but since only a few wavelength settings are available, there is no basis for pipeline corrections (with the possible exception of G230MB if the wavelength-dependent bimodal analysis of G230LB indicates a relationship).

References:

Walborn, N., & Bohlin, R. 1998, Instrument Science Report, STIS 98-27, (Baltimore: STScI). (WB1998).

Bohlin, R. 1999, Instrument Science Report, STIS 99-07, (Baltimore:STScI). (B1999).

Ed Smith, David Stys, Nolan Walborn, Ralph, 2000, Instrument Science Report, STIS 2000-03, (Baltimore: STScI). (SSWB2000).

Addendum:

Causes of the Observed Sensitivity Declines.

An analysis of the CCD sensitivity trends with respect to the recently derived CTE loss rates (Cycle 10 Phase II STIS Update) has revealed some clear relationships. A key point is that the present CCD L observations have substantially higher counts (maxima of 36E3 for G230LB, 60E3 for G430L, and 79E3 for G750L) than the M (3E3 for G230MB and G750M, 5E3 for G430M). For a minimal sky background of 3 e- and transfer across 512 rows, as appropriate for the Monitor observations, the CTE loss increased from 0.03 to 0.04 at 5E3 counts between September 1999 and October 2000, but only from 0.013 to 0.018 at 30E3 counts. The former rate of ~1%/yr is exactly the rate of sensitivity loss found here for G430M and G750M, while the much smaller or null losses for G430L and G750L are consistent with the much higher counts in those data.

G230LB and G230MB show higher rates of decline than the other CCD configurations, but the former can be understood as the SUM of the CTE losses and a different effect seen also in the MAMA NUV configurations. The behavior of both MAMA and CCD NUV sensitivities showed an initial increase until 1998.7, and thereafter a decline. Note that the G230LB decline rate is essentially identical to that of G230L, consistent with a negligible CTE contribution at the high counts, but that the G230MB rate at 2416 A equals the sum of the G230M rate and the CTE loss observed for the other CCD M configurations.

In summary, three distinct mechanisms of sensitivity loss can be identified in these Monitor data. (1) A wavelength-dependent FUV decline is tracked consistently by G140L and G140M, pointing to an origin in the FUV-MAMA. (2) Both MAMA and CCD NUV configurations showed similar initial increases in sensitivity, followed by declines after 1998.7. The only obvious elements in common among these configurations are the correction and collimator mirrors. (3) All CCD configurations are consistent with the independently measured CTE loss, which in the case of the NUV configurations is additive with mechanism 2. A more refined analysis of the CTE effects will take into account the wavelength dependence of the total counts in the CR-SPLIT Monitor data.

Thanks to Paul Goudfrooij for suggesting a comparison between the Monitor and CTE data.

Figures

Figure 1:

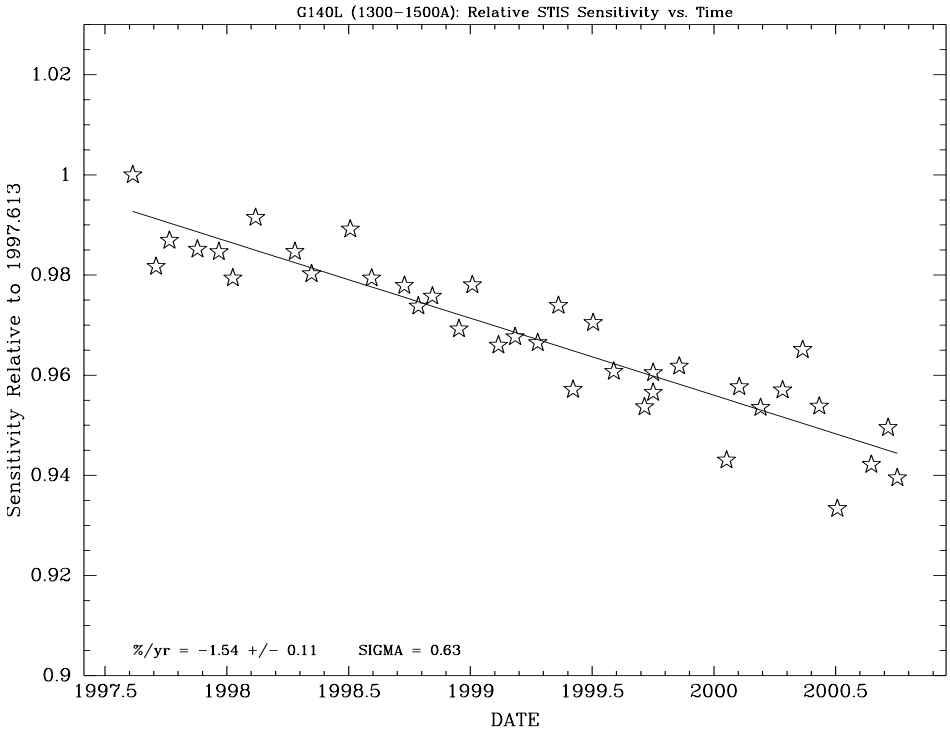


Figure 2:

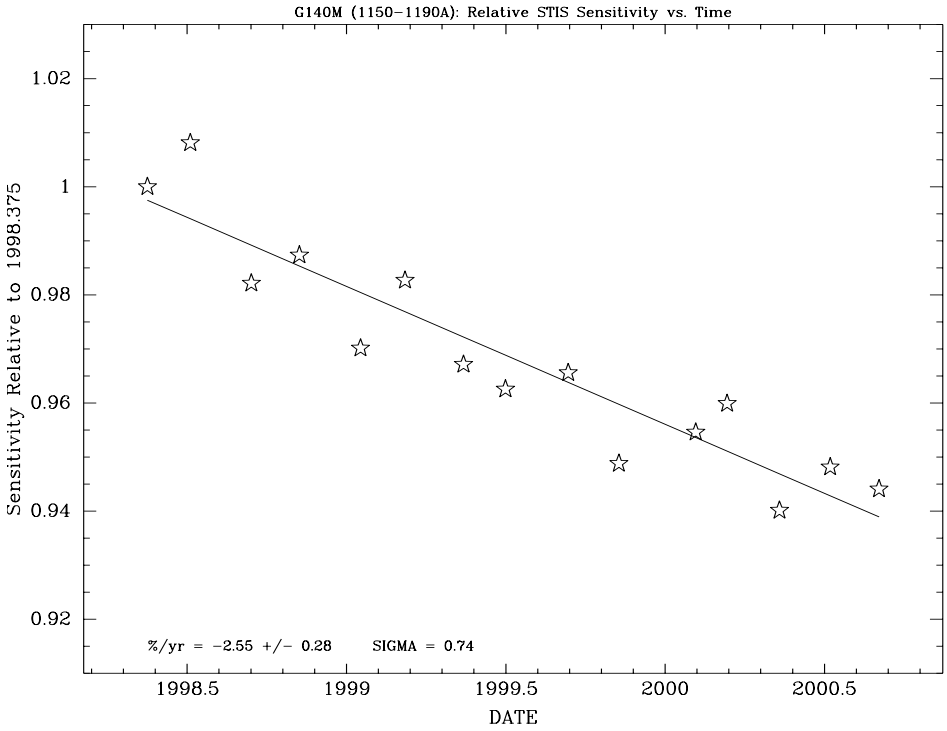
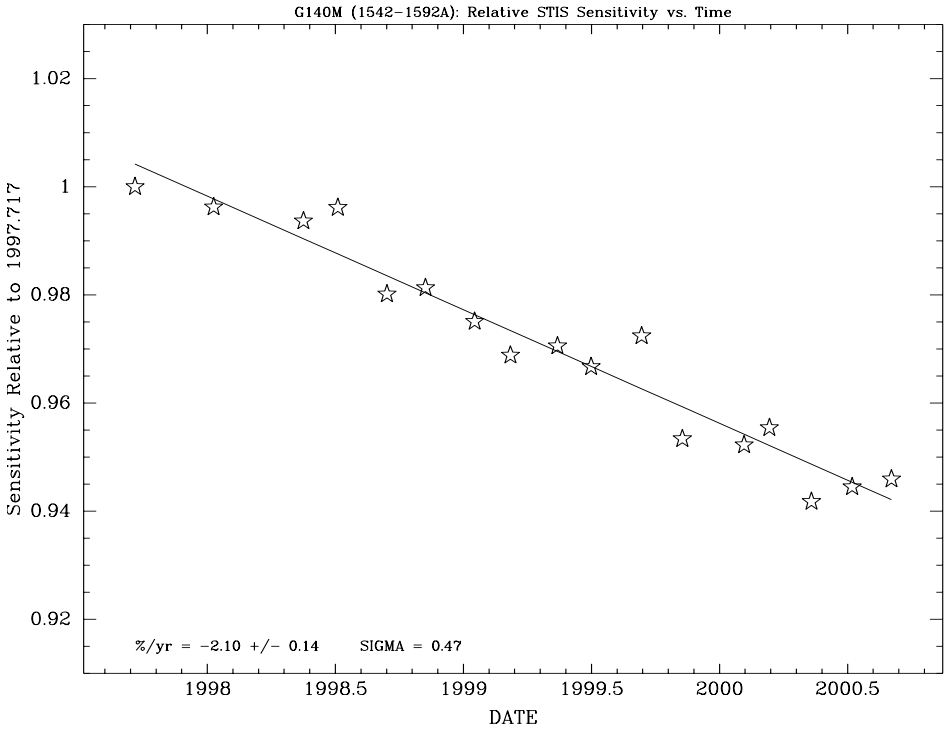


Figure 3:



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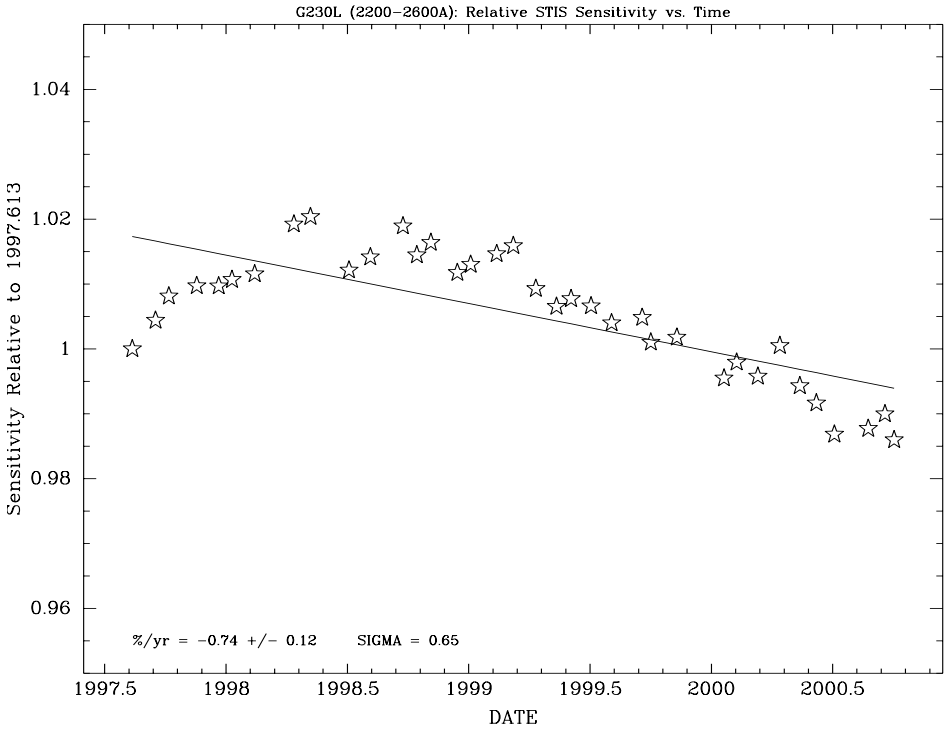

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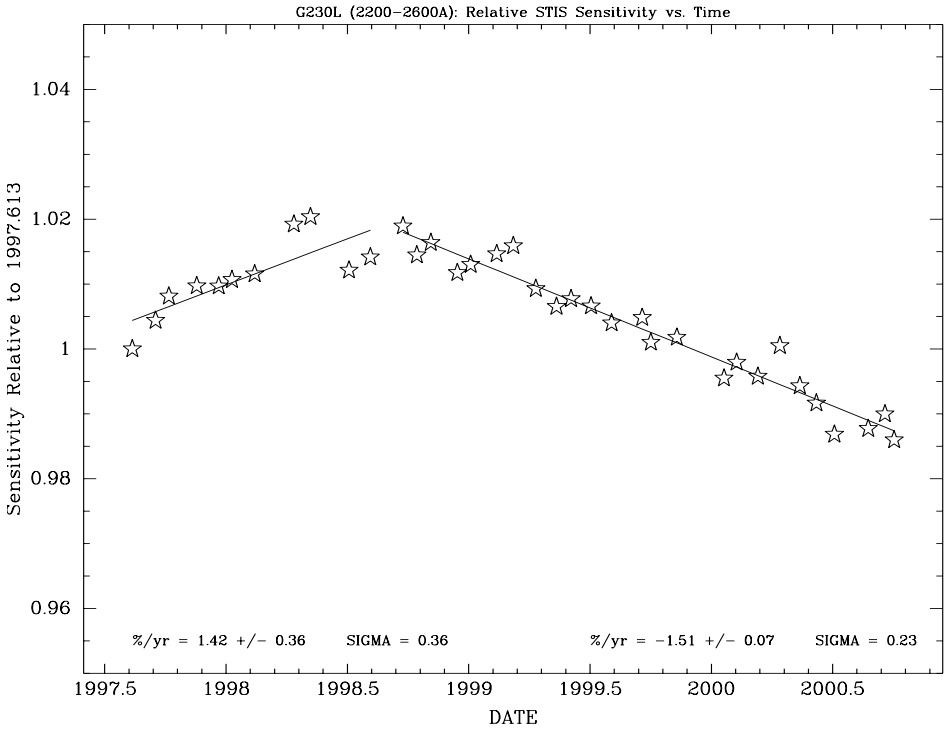

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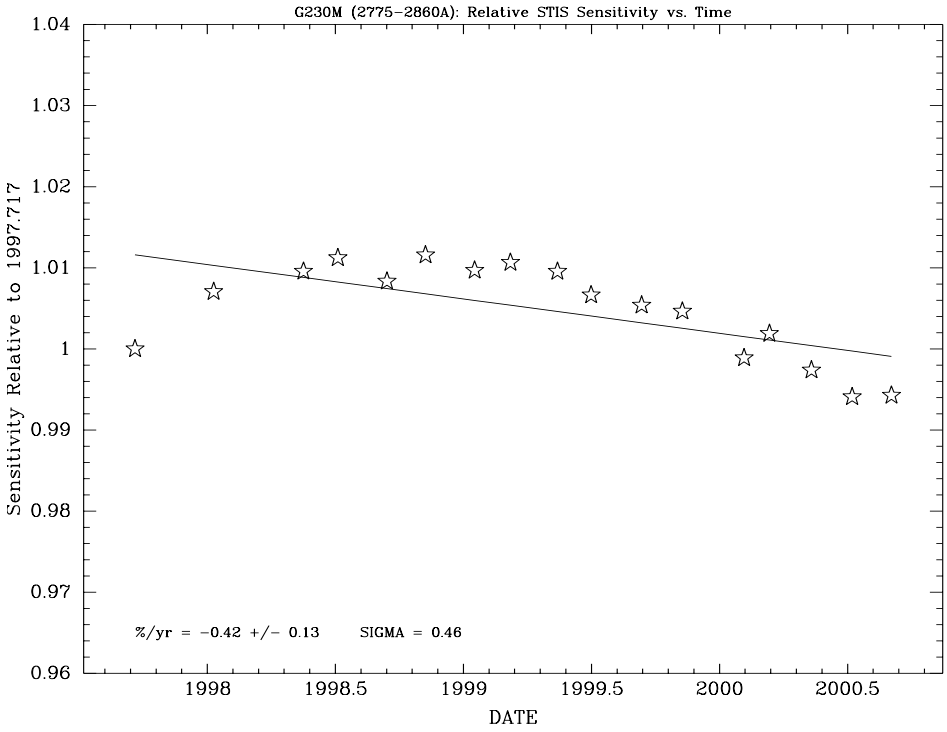

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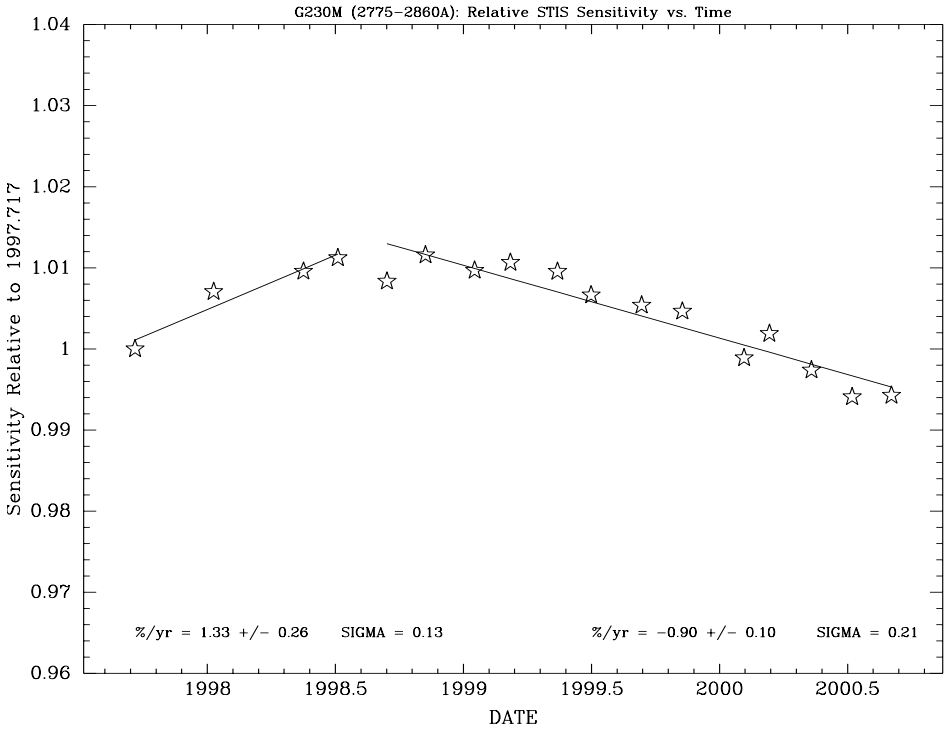

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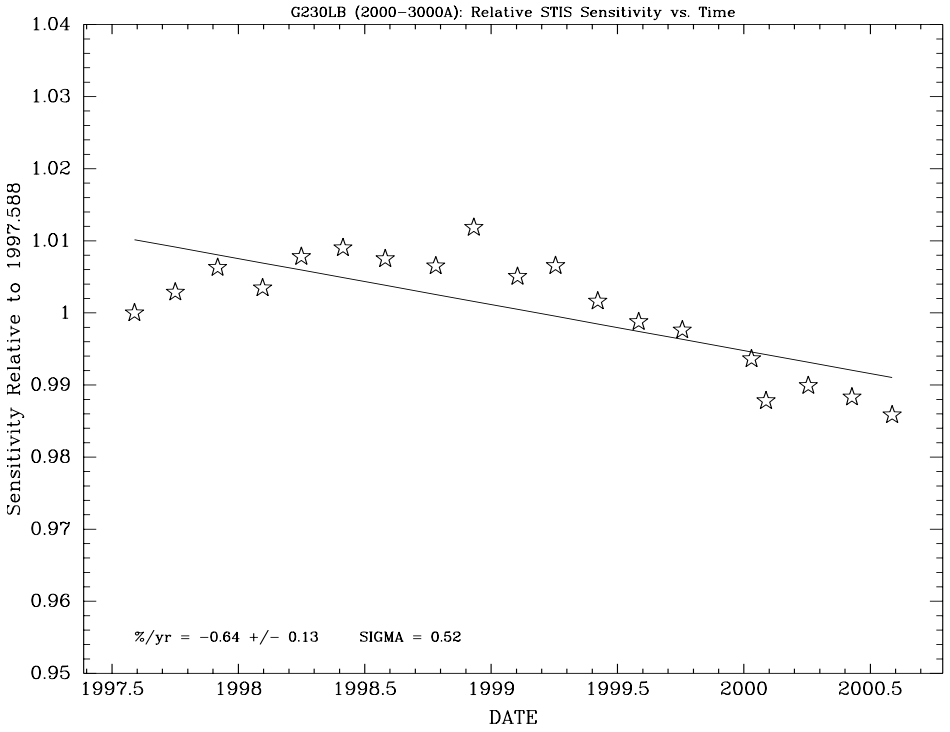

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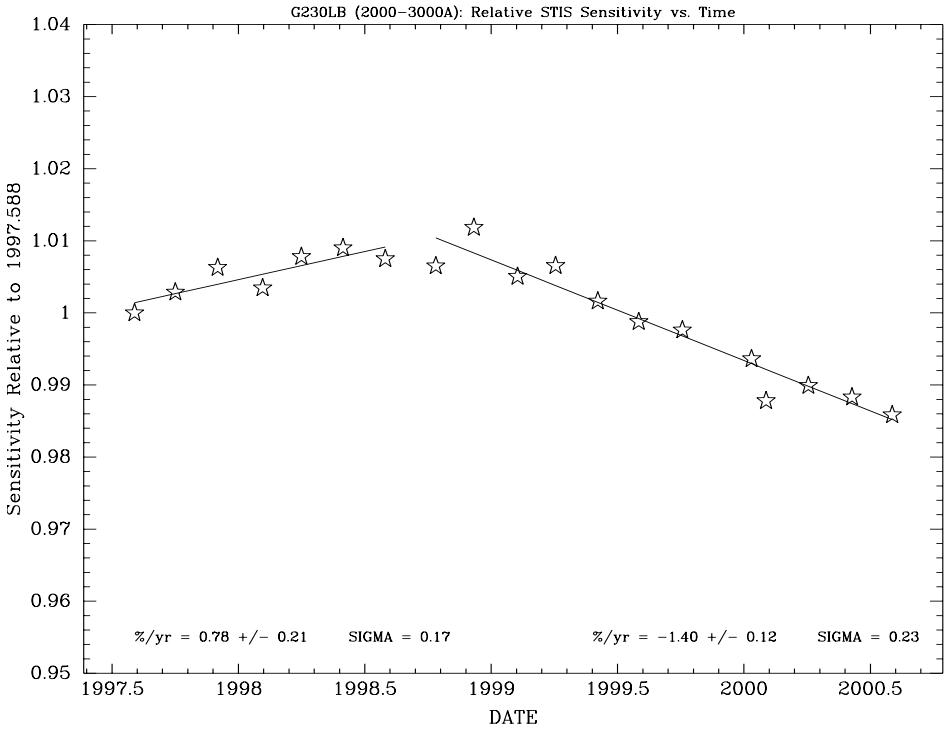

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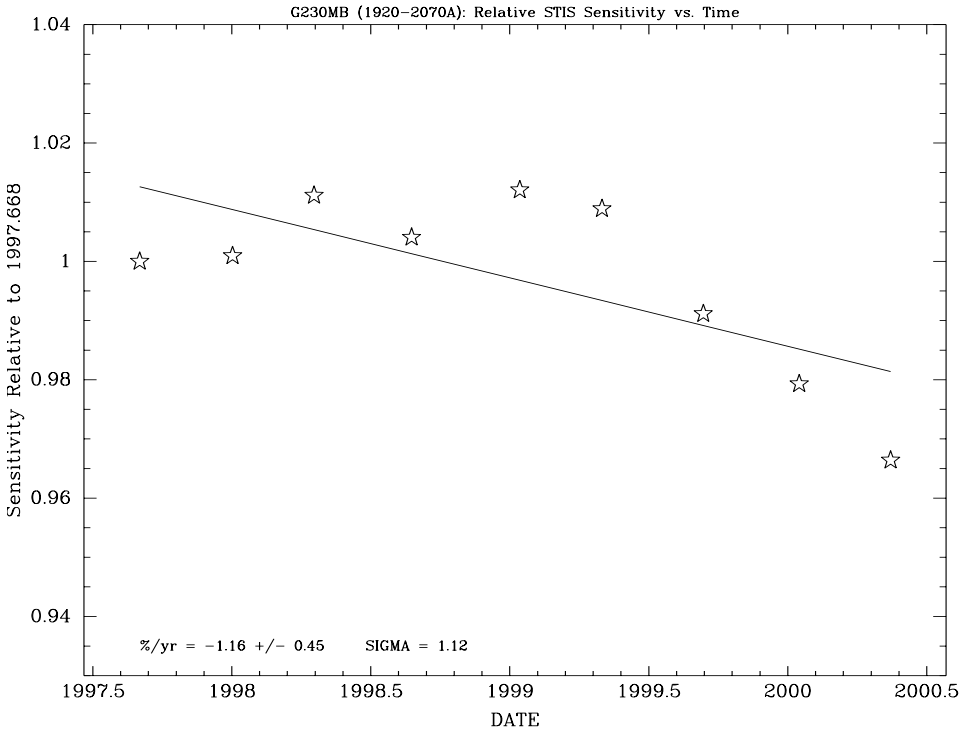

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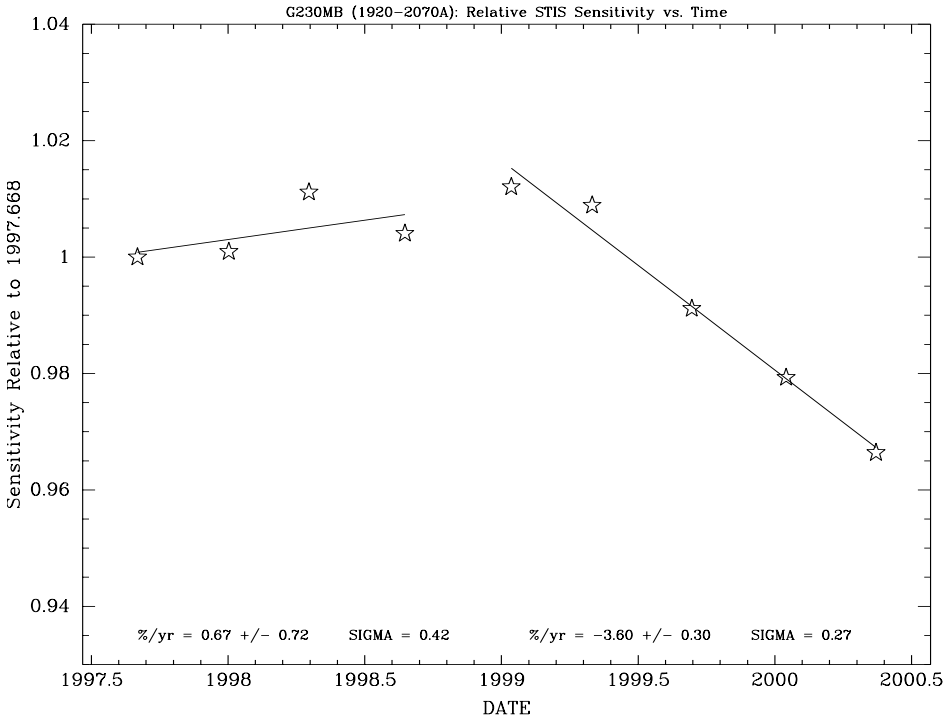

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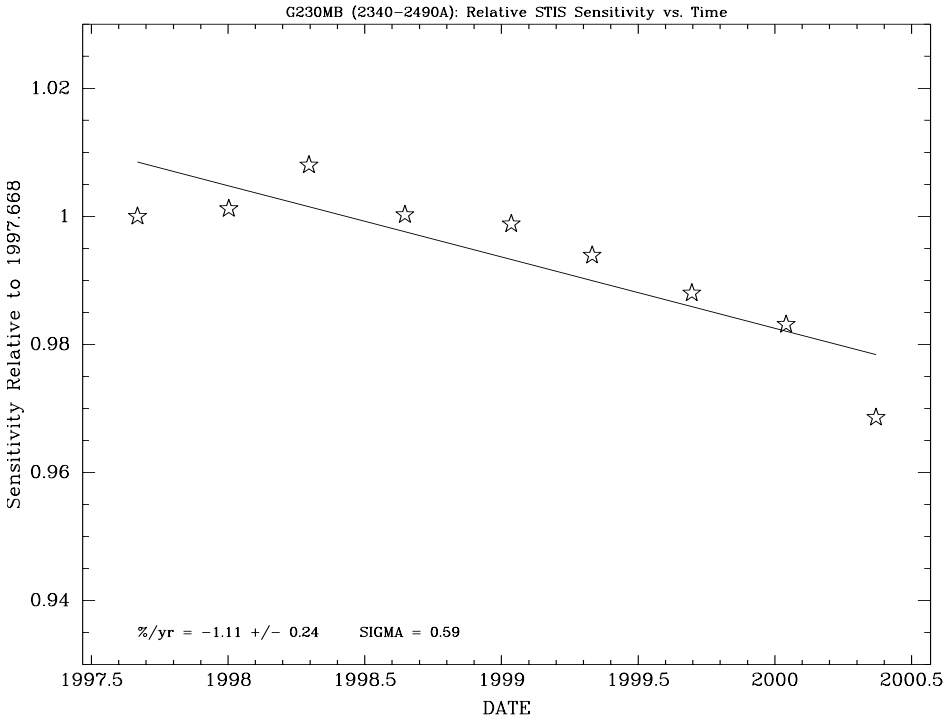

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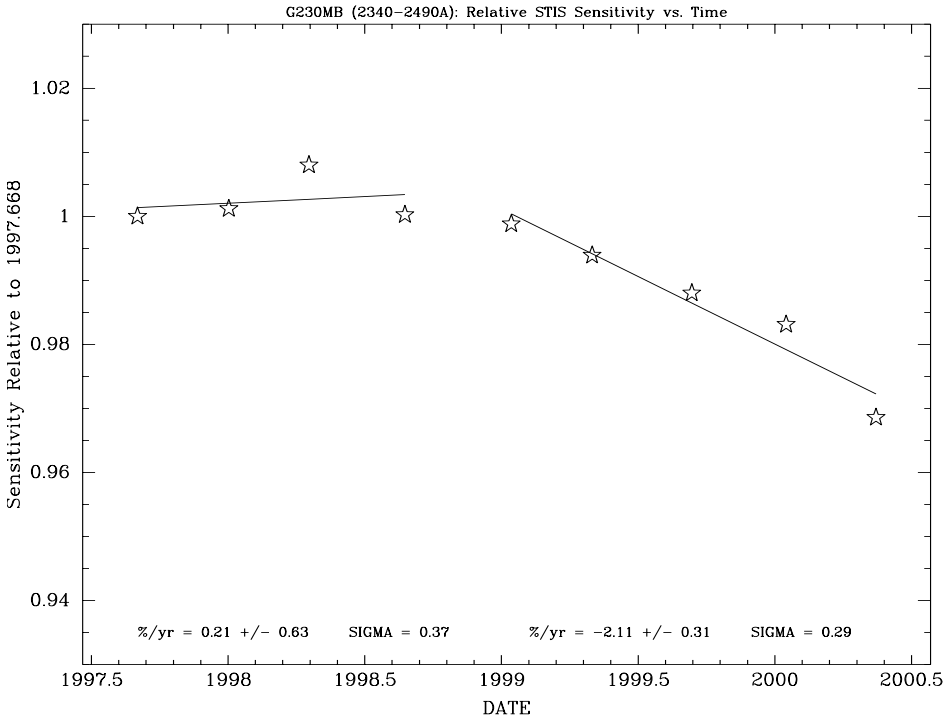

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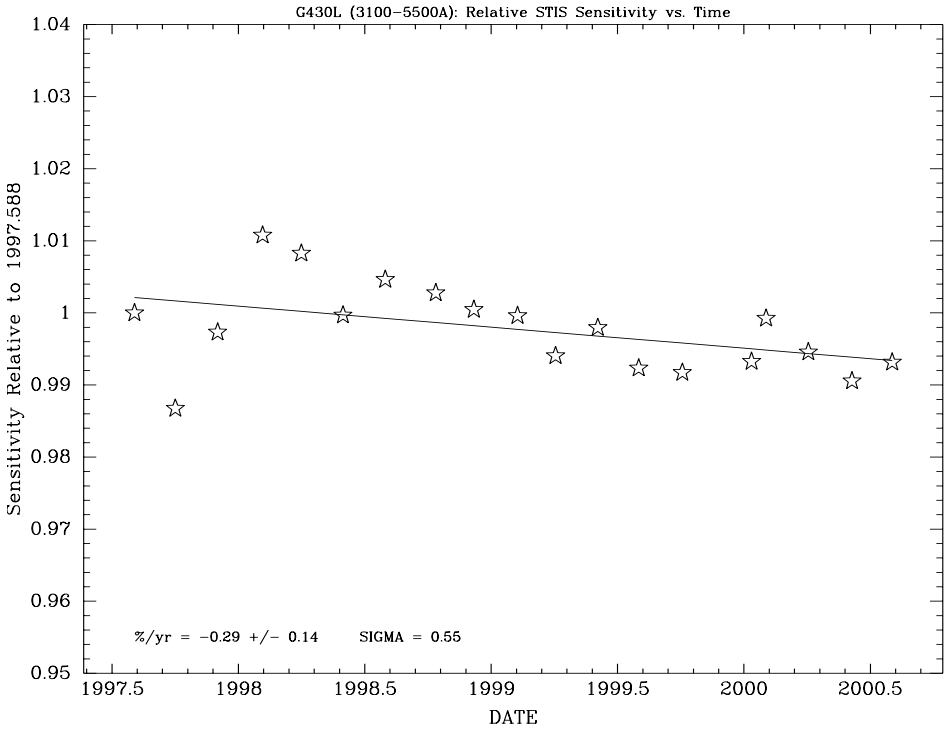

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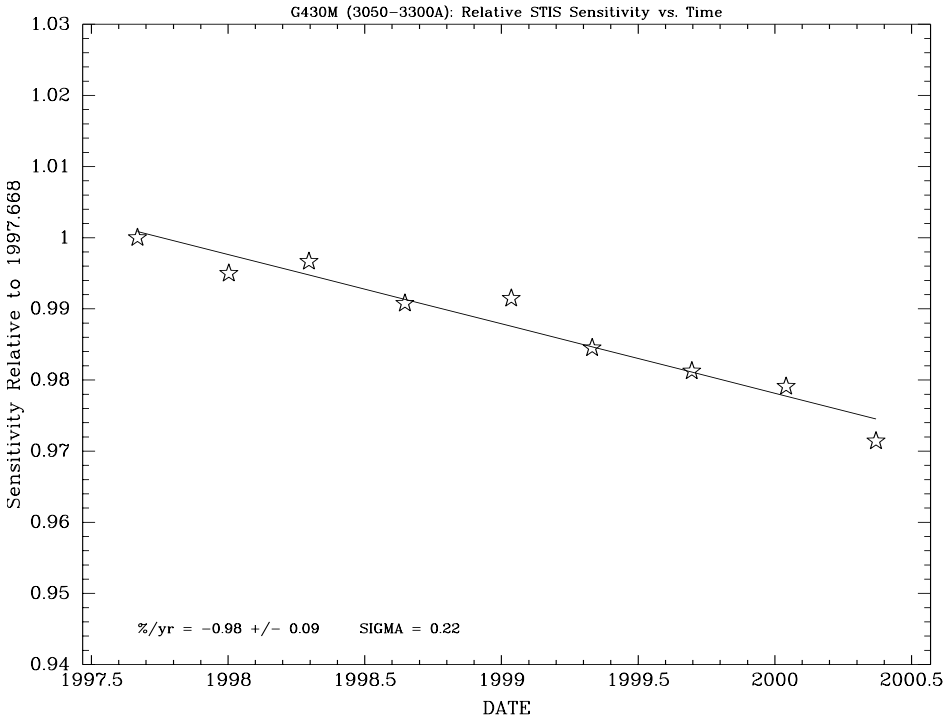

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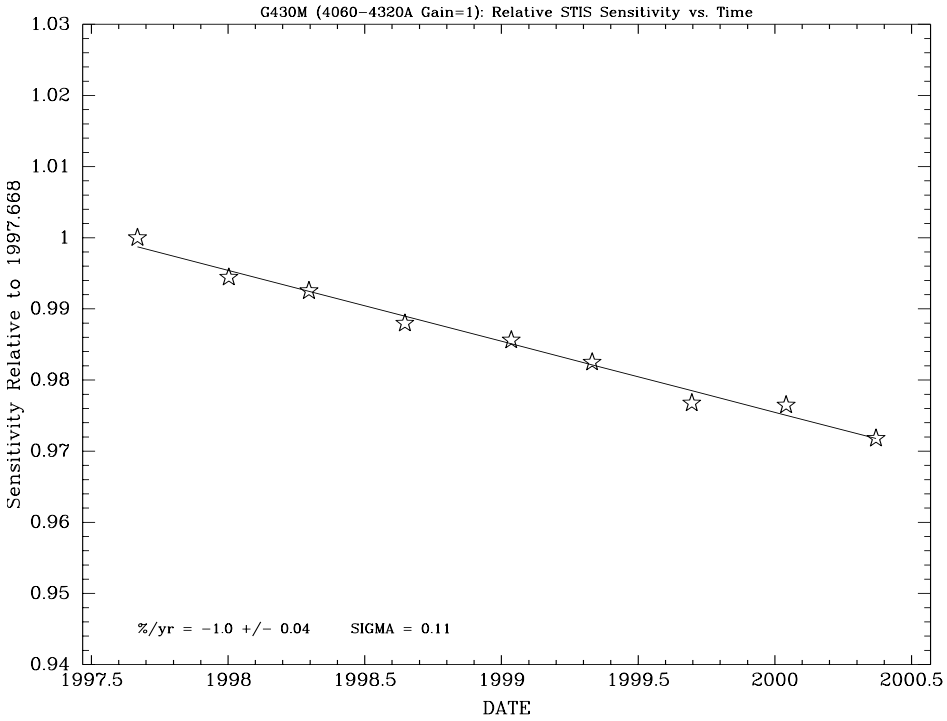

Figure 17:

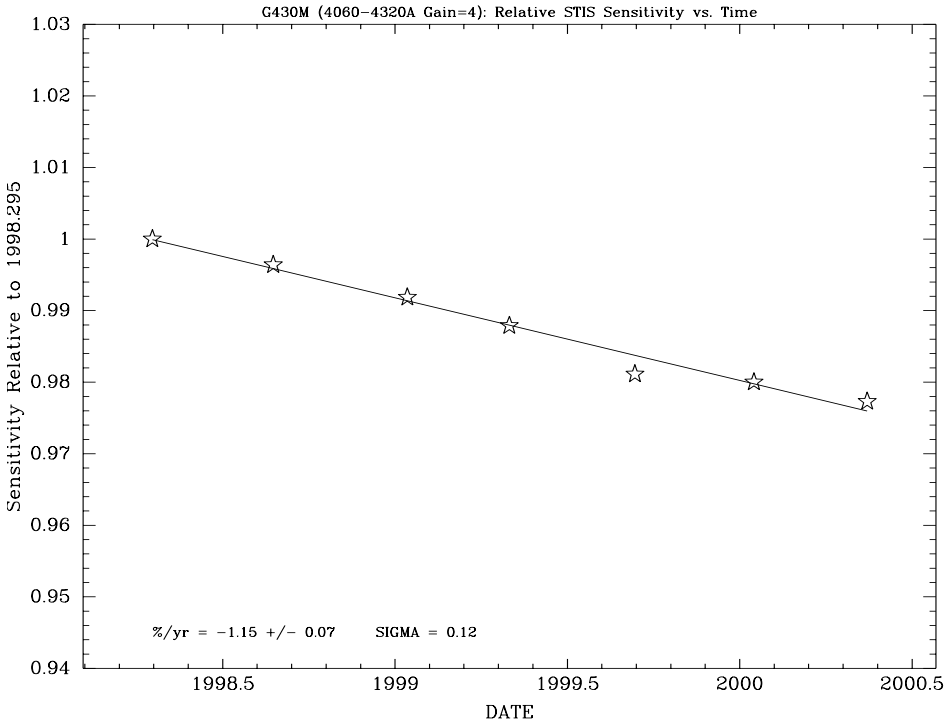

Figure 18:

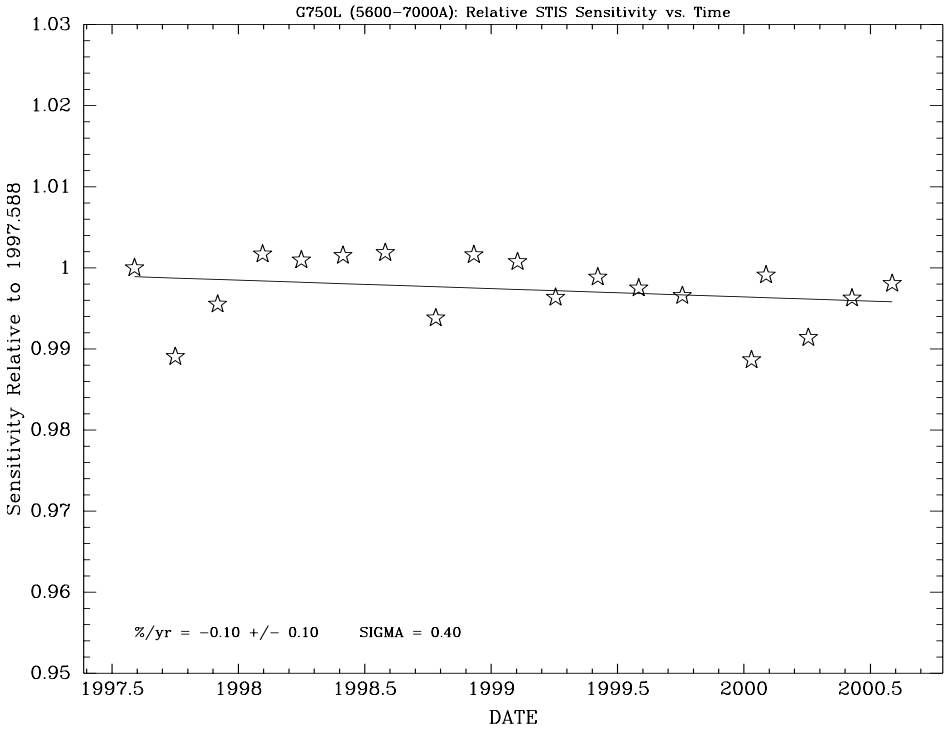

Figure 19: