LWR LOW DISPERSION NOISE MODEL FOR USE IN NEWSIPS PROCESSING

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Presented is the LWR low dispersion noise model for use in Newsips processing with the 1983 ITF. The noise model is an empirically derived measurement of the scatter in flux numbers (FN) about the mean FN in the background extraction area. The mean and standard deviation of the flux was measured in twenty equal bins of 84 Å for each image. The wavelength dependance is represented by a third order polynomial. The result is an estimate of the standard deviation for any wavelength and exposure level. 161 LWR low dispersion images, spanning the entire dynamic range of the detector, are included. Only science images were used. A list of all the images used is provided in Table 1. A good description of the use of the noise model and its role in the final NEWSIPS product is presented in the NEWSIPS Processing Information Manual (version 1.0). Those interested, are strongly encouraged to consult this document. It should also be pointed out that a second LWR low dispersion noise model will be constructed for the LWR *hybrid* ITF, which will also be used in NEWSIPS production processing.

As mentioned above, only science images were used in constructing the noise model. Lamp exposures obtained as part of the LWR ITF are convenient images for the highest exposure levels. Figure 1 shows a plot of the standard deviation in FN as a function of FN for two different 84 Å bins, the open diamonds are science images and the asterisks are lamp exposures. One can see in Fig. 1 the lamp images are different from the science images. Although the lamp exposures show a very tight well-defined relationship it was felt that the different noise characteristics of the lamp exposures do not realistically model the noise one may encounter on a science image. The noise present on a science image is the result of contributions from several sources such as particles trapped in the Earth's magnetic field (both protons and electrons), radioactive decays in the detector, and scattered light (from both the source and/or the Sun, Earth or Moon). The noise on the Lamp exposures is a result of noise intrinsic to the detector and photon statistics. All UV lamp exposures were excluded from the list of images used. High background science images to replace the UV Lamp exposures were drawn from a search of the IUE merged log.

To compute the noise model the images listed in table 1 were divided into 20 equal 84 Å bins. The mean FN and standard deviation are computed for each bin. pixels flagged as bad are discarded. Figure 2 shows plots for the 20 bins. the solid line is a third order polynomial fit to the data in that bin. The results of the polynomial fit are presented in Table 2, which lists the mean wavelength, sigma and the coefficients of the fit.

The wavelength dependance of the coefficients was determined by a third order polynomial fit of the coefficients as a function of wavelength. Plots of the fits are presented in Fig. 3. The plots include the central wavelength, the third order fit and the standard deviation of the fit. Table 3 lists all relevant information and is self explanatory.

The IDL routines used in this noise model are the exact same routines used in constructing low dispersion noise models for the other cameras (LWP and SWP). Changes to the analysis only dealt with reading and writing data, and plotting. It was however necessary to relax some criteria in order to get meaningful results at the longest wavelength bin. The data centered at 3385 Å did not contain enough pixels (according to the code). The cause of this

problem was simply that many of the pixels to be used fell off the faceplate of the camera. To get around this, only pixels which were good (as judged by the error flags) were used. So this bin contained much less data, but is handled no differently.

References

Nichols, J., et al., **International Ultraviolet Explorer New Spectral Image Processing System Information Manual: Low Dispersion Data Version 1.0.**

Table 1. LWR IMAGE LIST

LWR01582	LWR03090	LWR06472	LWR12078	LWR15352
LWR01637	LWR03124	LWR06473	LWR12177	LWR15353
LWR01638	LWR03124	LWR06632	LWR12219	LWR15355
LWR01639	LWR03127	LWR06878	LWR12496	LWR15365
LWR01640	LWR03598	LWR07165	LWR12508	LWR15366
LWR01747	LWR03617	LWR07779	LWR12640	LWR15367
LWR01748	LWR03618	LWR07813	LWR13008	LWR15377
LWR01773	LWR03974	LWR08046	LWR13015	LWR15426
LWR01775	LWR04133	LWR08877	LWR13025	LWR15480
LWR01782	LWR04351	LWR08890	LWR13026	LWR15486
LWR01785	LWR04354	LWR08896	LWR13501	LWR15496
LWR01786	LWR04410	LWR08966	LWR13509	LWR15520
LWR01787	LWR04509	LWR08980	LWR13510	LWR15640
LWR01803	LWR04511	LWR08981	LWR13516	LWR15757
LWR02050	LWR04527	LWR09083	LWR13517	LWR15796
LWR02115	LWR04530	LWR09122	LWR13519	LWR15817
LWR02213	LWR04613	LWR09134	LWR13595	LWR15900
LWR02214	LWR04616	LWR09361	LWR13851	LWR16290
LWR02230	LWR04634	LWR09398	LWR13868	LWR16291
LWR02231	LWR04635	LWR09445	LWR13869	LWR16432
LWR02258	LWR04678	LWR09458	LWR14090	LWR16647
LWR02363	LWR04680	LWR09478	LWR14091	LWR16679
LWR02534	LWR04764	LWR09519	LWR14324	LWR16680
LWR02535	LWR04766	LWR10138	LWR14436	LWR16943
LWR02539	LWR04853	LWR10153	LWR14452	LWR16969
LWR02745	LWR04948	LWR10154	LWR14726	LWR16975
LWR02745	LWR05164	LWR10366	LWR14812	LWR16978
LWR02752	LWR05263	LWR10724	LWR15201	LWR17029
LWR02815	LWR06135	LWR11111	LWR15270	LWR17161
LWR02842	LWR06136	LWR11216	LWR15348	LWR17433
LWR02960	LWR06164	LWR11637	LWR15349	LWR17661
LWR02982	LWR06242	LWR11647	LWR15350	LWR 3089
LWR03052				

Figure 1. Lamp + Null vs Science images

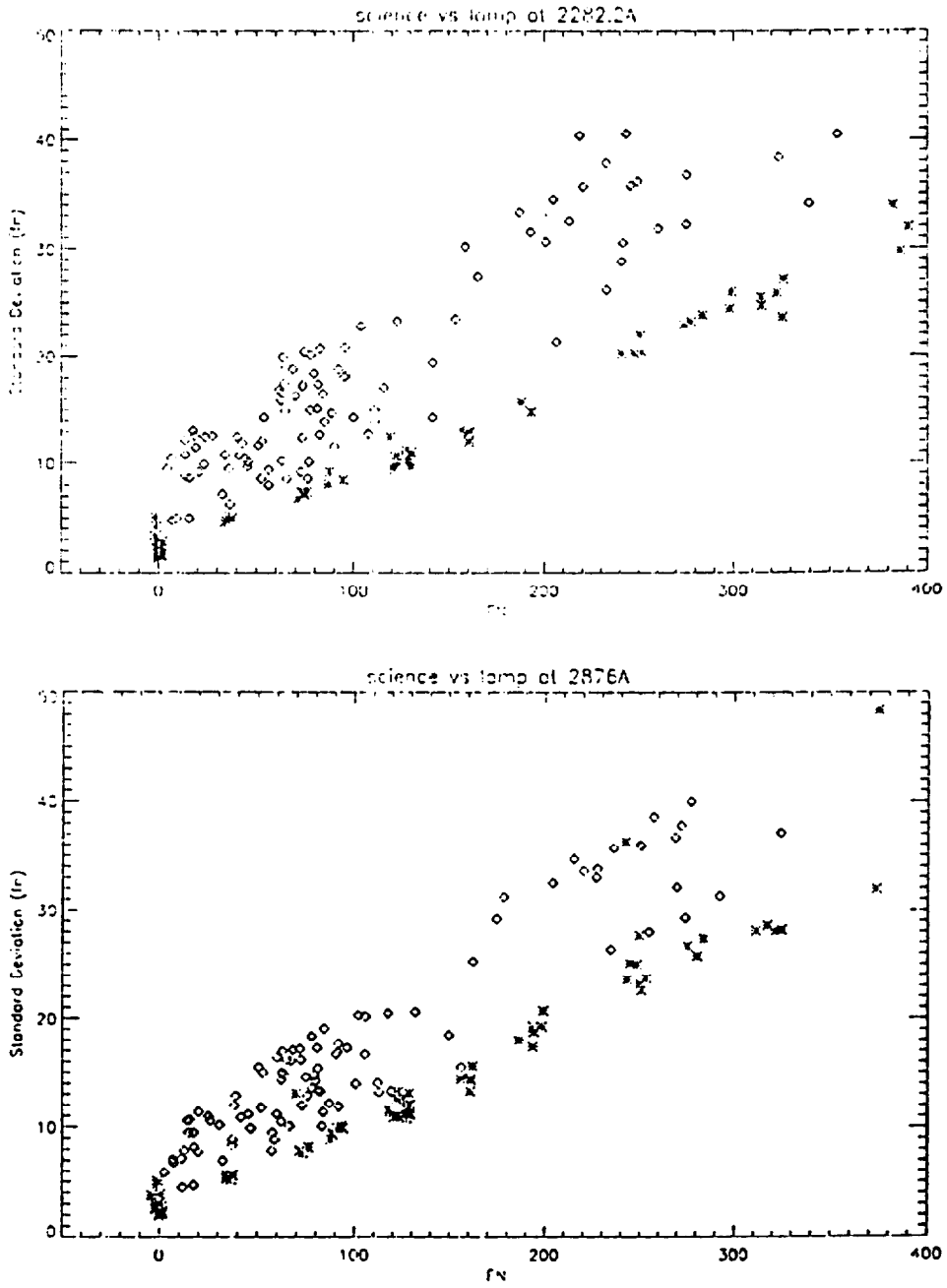
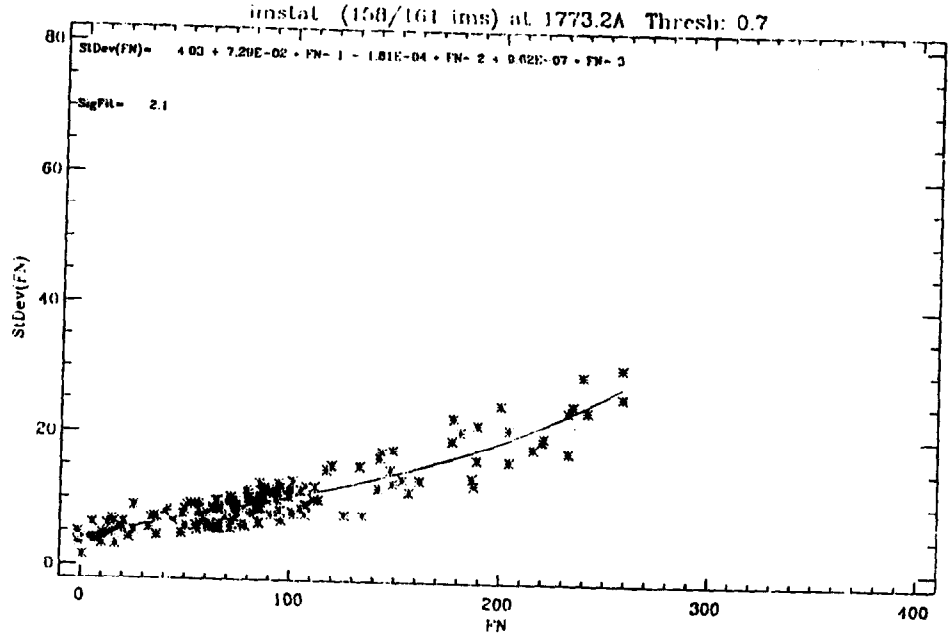
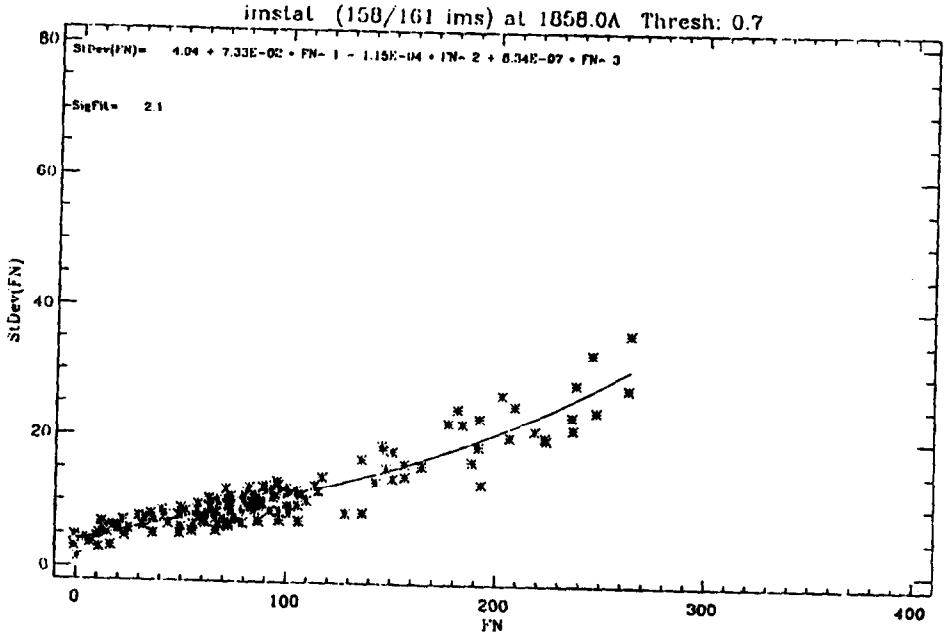


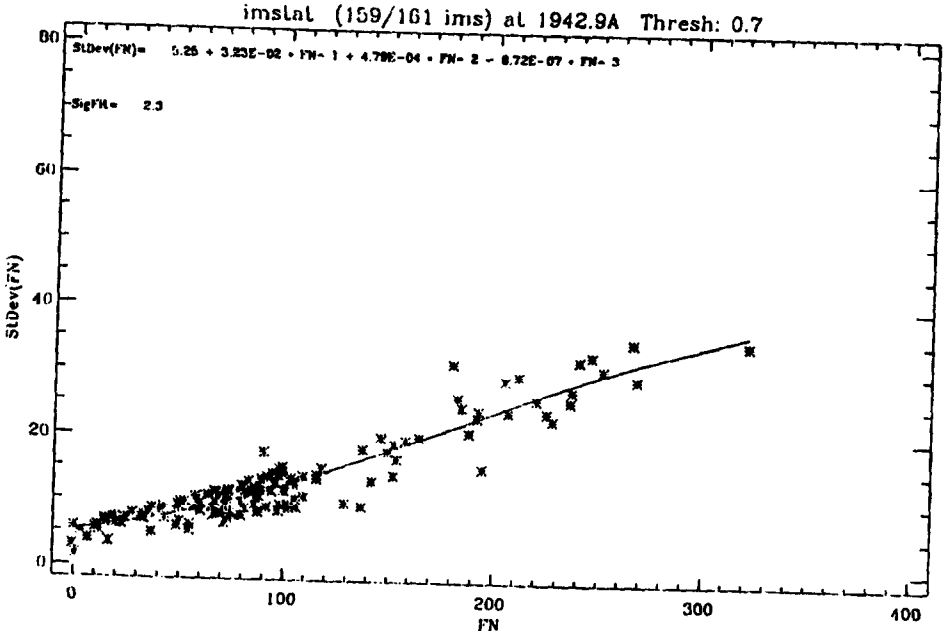
Fig. 1 Shows a plot of lamp and null images (asterisks) vs Science images (open diamonds) at two selected wavelengths. The differences between the two sets leads to an exclusion of the lamp exposures from the rest of this analysis. Plotted is FN vs standard deviation (in FN).

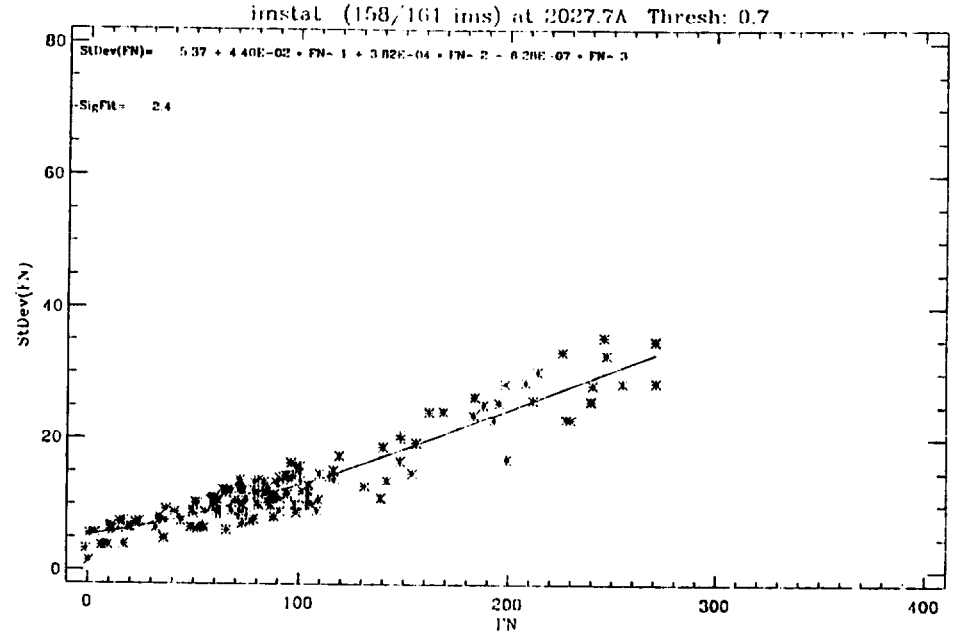
Table 2. RESULTS FOR EACH OF THE 20 WAVELENGTH BINS. SHOWING THE CENTRAL WAVELENGTH, SIGMA OF 3rd DEGREE FIT OF STANDARD DEVIATION (IN FN) VERSUS FN, AND THE COEFFICIENTS FOR THE POLYNOMIAL.

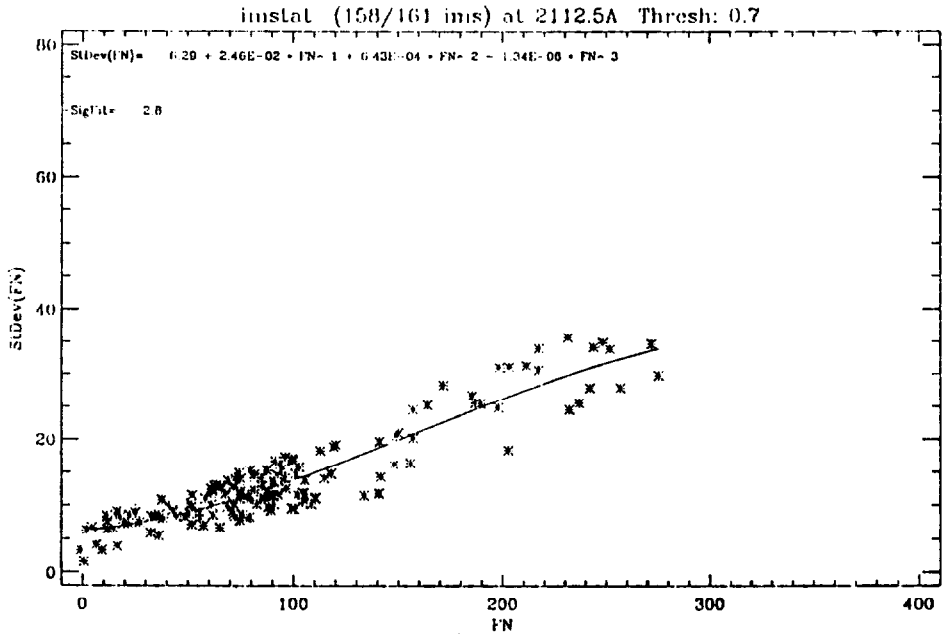
MEAN WAVE	SIGMA	C(0)	C(1)	C(2)	C(3)
1773.20	2.07730	4.03010	7.294470e-02	-1.807820e-04	9.618742e-07
1858.00	2.11411	4.04326	7.331502e-02	-1.148057e-04	8.338769e-07
1942.90	2.28824	5.24796	3.230239e-02	4.788022e-04	-8.720740e-07
2027.70	2.35394	5.37186	4.400852e-02	3.820295e-04	-6.280783e-07
2112.50	2.77208	6.28643	2.461471e-02	6.431108e-04	-1.336182e-06
2197.40	3.17414	6.85407	1.680827e-02	8.121408e-04	-1.781780e-06
2282.20	3.67348	8.43479	1.705761e-02	9.118957e-04	-2.238280e-06
2367.00	3.65609	9.31519	-7.960448e-03	1.105816e-03	-2.581025e-06
2451.90	3.61882	8.80627	9.898687e-03	9.232844e-04	-2.096989e-06
2536.70	3.09587	8.69200	-1.553127e-03	9.974535e-04	-2.260134e-06
2621.50	2.94398	7.92353	9.304627e-03	1.086645e-03	-2.763238e-06
2706.40	3.12202	8.16330	2.188651e-02	9.044706e-04	-2.187468e-06
2791.20	3.05043	7.62905	3.542082e-02	7.124708e-04	-1.650525e-06
2876.00	2.95022	7.38981	4.027950e-02	6.626614e-04	-1.622623e-06
2960.90	3.13827	7.64327	3.931385e-02	5.982997e-04	-1.513839e-06
3045.70	3.10714	7.49939	3.493364e-02	6.083059e-04	-1.516741e-06
3130.50	2.66419	6.48126	4.346974e-02	4.931357e-04	-1.251079e-06
3215.40	2.66266	6.27167	2.240771e-02	5.244956e-04	-1.157040e-06
3300.19	2.44839	5.90194	1.059789e-02	5.514030e-04	-1.178394e-06
3385.00	2.18000	5.11698	2.984796e-02	3.545440e-04	-8.054480e-07

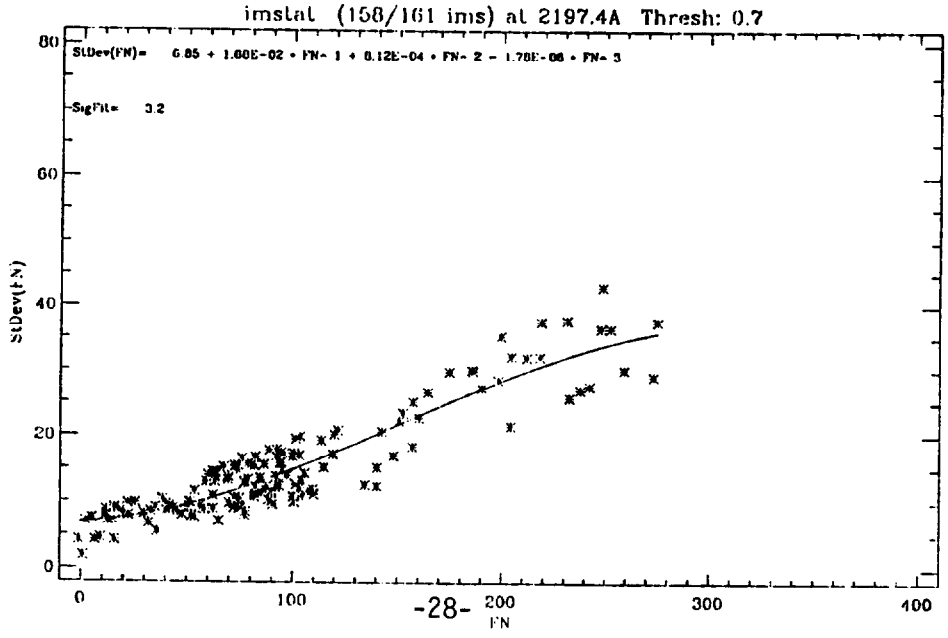

imstat (158/161 ims) at 1773.2A Thresh: 0.7
StDev(FN)= 4.03 + 7.20E-02 * FN- 1 - 1.81E-04 * FN- 2 + 9.02E-07 * FN- 3
SigFN= 2.1
StDev(FN)
FN
0
20
40
60
80
100
200
300
400

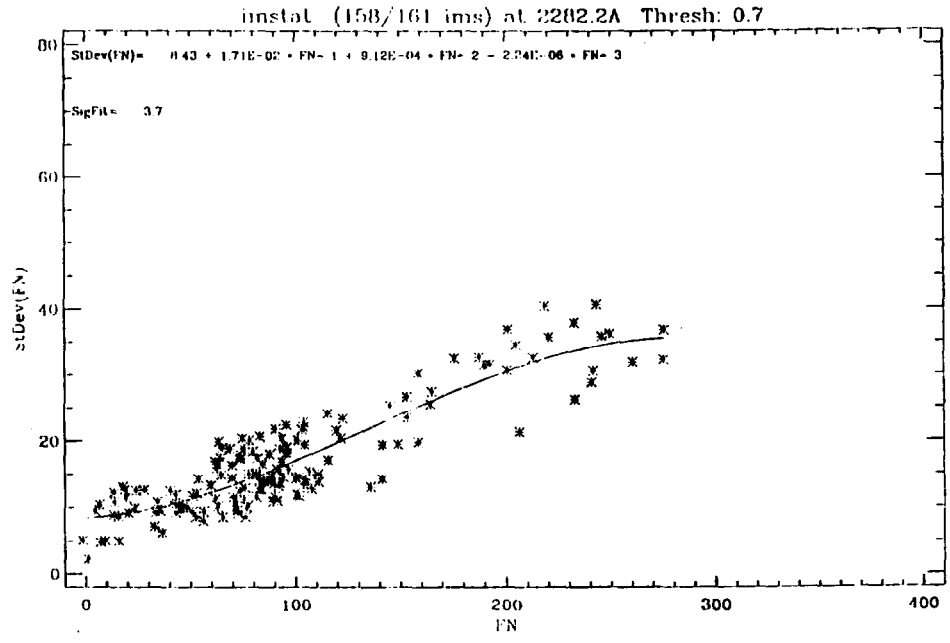

imstat (158/161 ims) at 1858.0A Thresh: 0.7
StDev(FN)= 4.04 + 7.33E-02 * FN- 1 - 1.15E-04 * FN- 2 + 8.34E-07 * FN- 3
SigFN= 2.1
StDev(FN)
FN
0
20
40
60
80
100
200
300
400

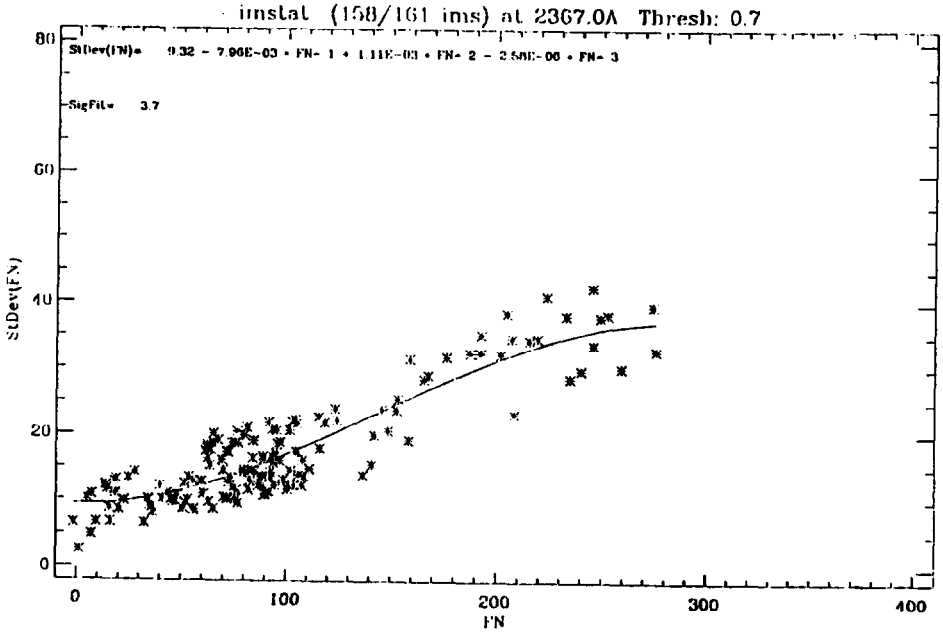

imstat (159/161 ims) at 1942.9A Thresh: 0.7
StDev(FN)= 5.25 + 3.23E-02 * FN- 1 + 4.79E-04 * FN- 2 - 8.72E-07 * FN- 3
SigFN= 2.3
StDev(FN)
FN
0
20
40
60
80
100
200
300
400

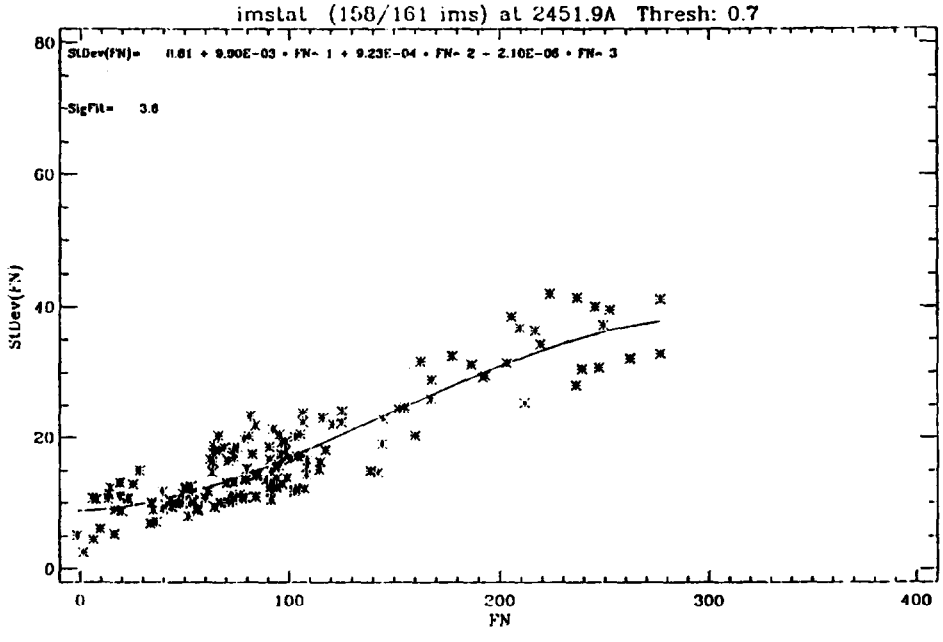

imstat (158/161 ims) at 2027.7A Thresh: 0.7
StDev(FN)= 5.37 + 4.40E-02 * FN^ 1 + 3.82E-04 * FN^ 2 - 6.20E-07 * FN^ 3
SigFit= 2.4
StDev(FN)
FN
0
20
40
60
80
100
200
300
400

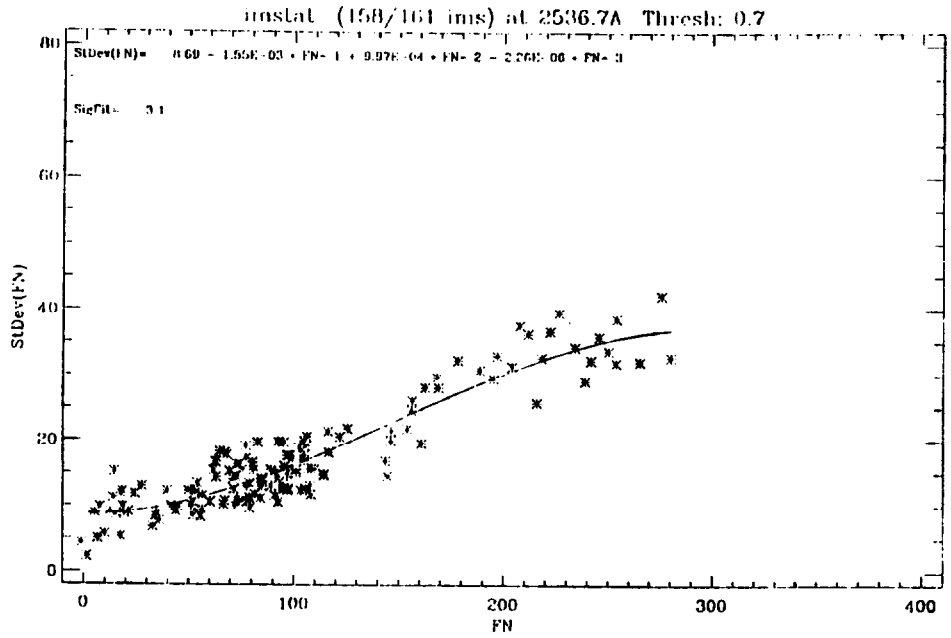

imstat (158/161 ims) at 2112.5A Thresh: 0.7
StDev(FN)= 6.20 + 2.46E-02 * FN^ 1 + 6.43E-04 * FN^ 2 - 1.34E-06 * FN^ 3
SigFit= 2.8
StDev(FN)
FN
0
20
40
60
80
100
200
300
400

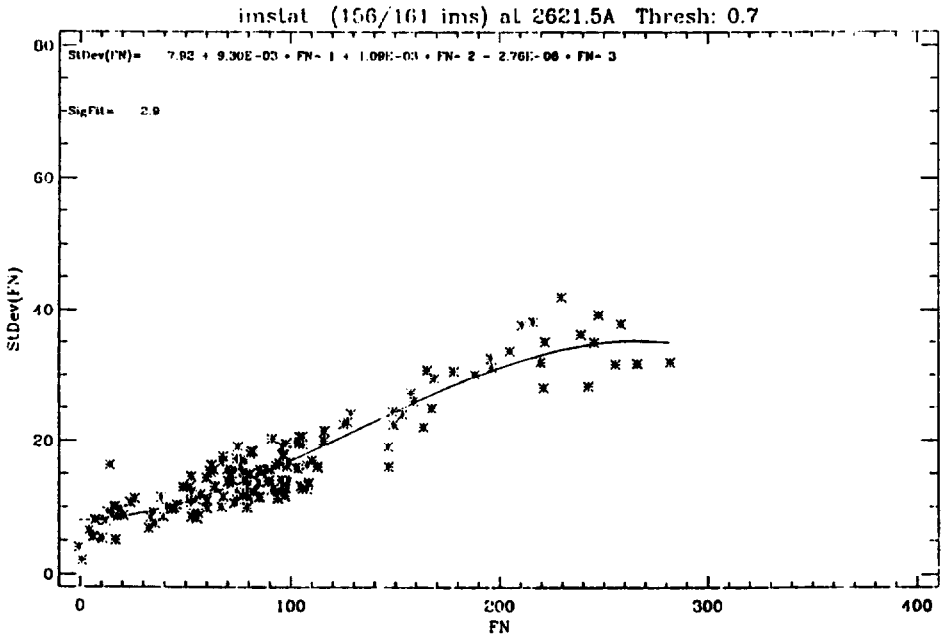

imstat (158/161 ims) at 2197.4A Thresh: 0.7
StDev(FN)= 6.85 + 1.60E-02 * FN^ 1 + 8.12E-04 * FN^ 2 - 1.78E-06 * FN^ 3
SigFit= 3.2
StDev(FN)
FN
0
20
40
60
80
100
200
300
400

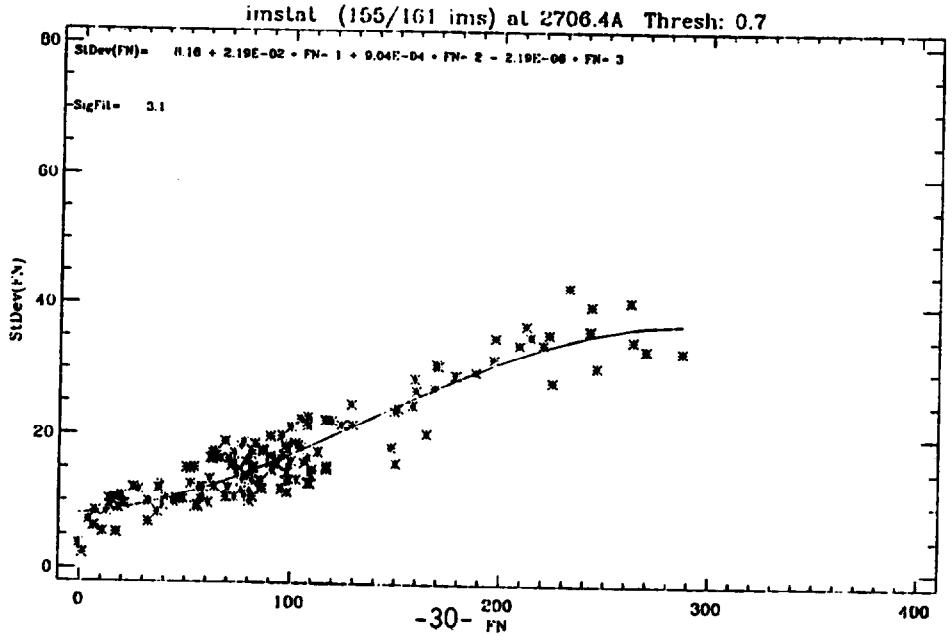

imstat (158/161 ims) at 2282.2A Thresh: 0.7
StDev(FN)= 0.43 + 1.71E-02 * FN- 1 + 9.12E-04 * FN- 2 - 2.24E-06 * FN- 3
SigFit= 3.7
StDev(FN)
FN
0
20
40
60
80
0
100
200
300
400

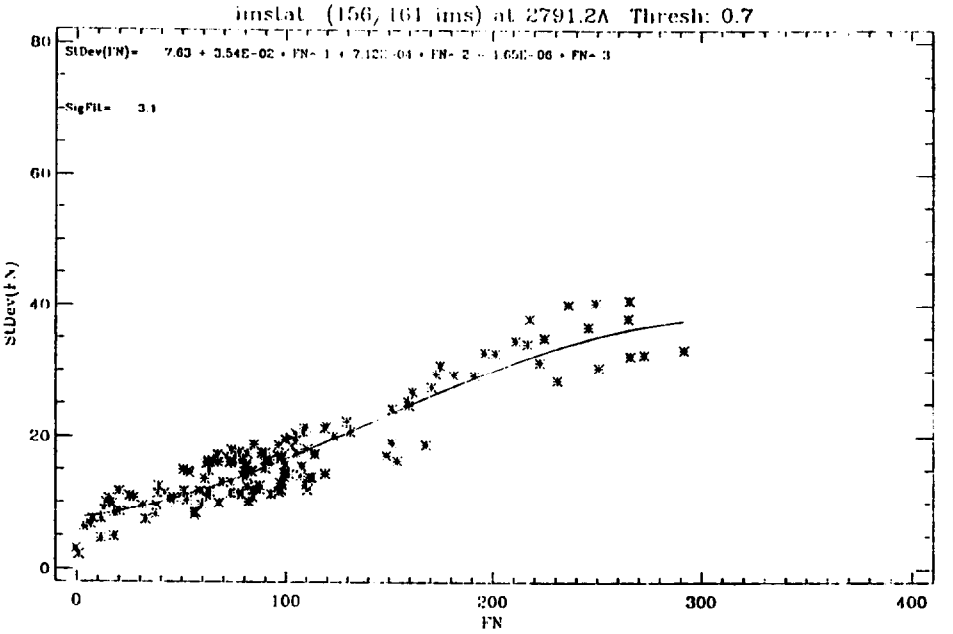

imstat (158/161 ims) at 2367.0A Thresh: 0.7
StDev(FN)= 9.32 - 7.90E-03 * FN- 1 + 1.11E-03 * FN- 2 - 2.58E-06 * FN- 3
SigFit= 3.7
StDev(FN)
FN
0
20
40
60
80
0
100
200
300
400

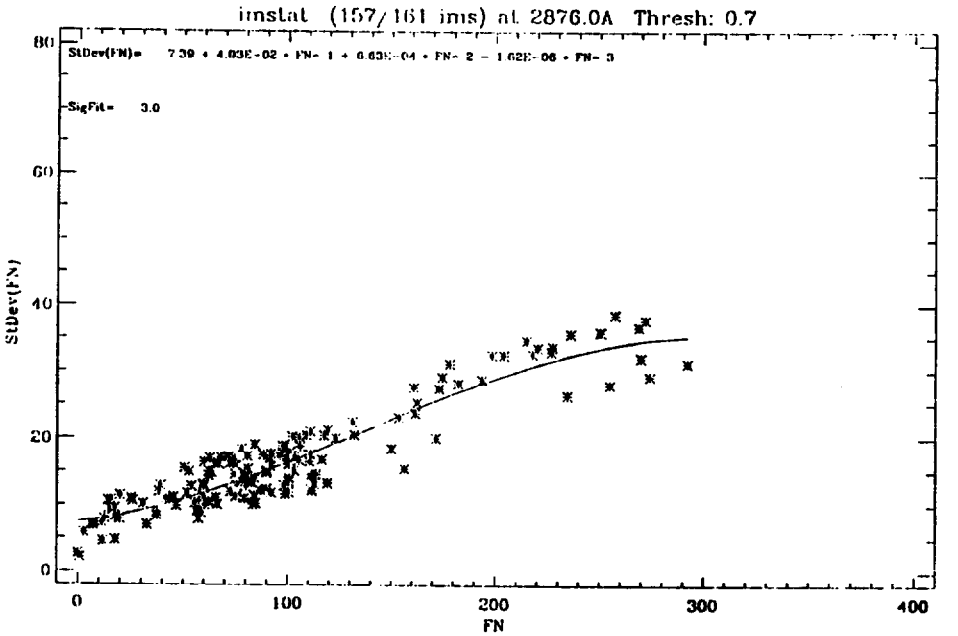

imstat (158/161 ims) at 2451.9A Thresh: 0.7
StDev(FN)= 0.61 + 9.90E-03 * FN- 1 + 9.23E-04 * FN- 2 - 2.10E-06 * FN- 3
SigFit= 3.6
StDev(FN)
FN
0
20
40
60
80
0
100
200
300
400

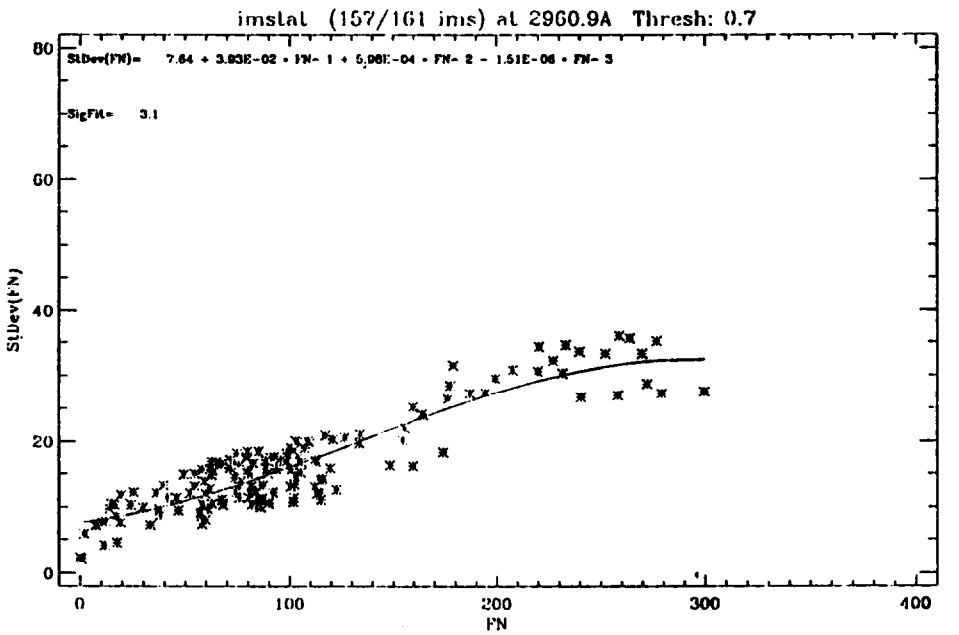

imstat (158/161 ims) at 2536.7A Thresh: 0.7
StDev(FN)= 0.69 - 1.55E-03 * FN- 1 + 9.97E-04 * FN- 2 - 2.26E-06 * FN- 3
SigFit= 3.1
StDev(FN)
FN
0
20
40
60
80
100
200
300
400

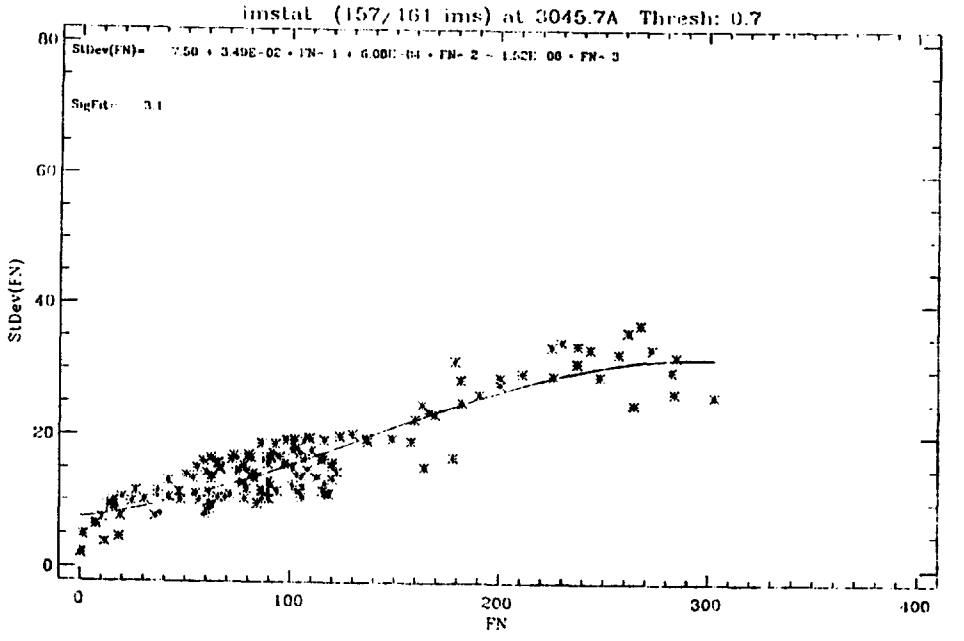

imstat (156/161 ims) at 2621.5A Thresh: 0.7
StDev(FN)= 7.92 + 9.30E-03 * FN- 1 + 1.09E-03 * FN- 2 - 2.76E-06 * FN- 3
SigFit= 2.9
StDev(FN)
FN
0
20
40
60
80
100
200
300
400

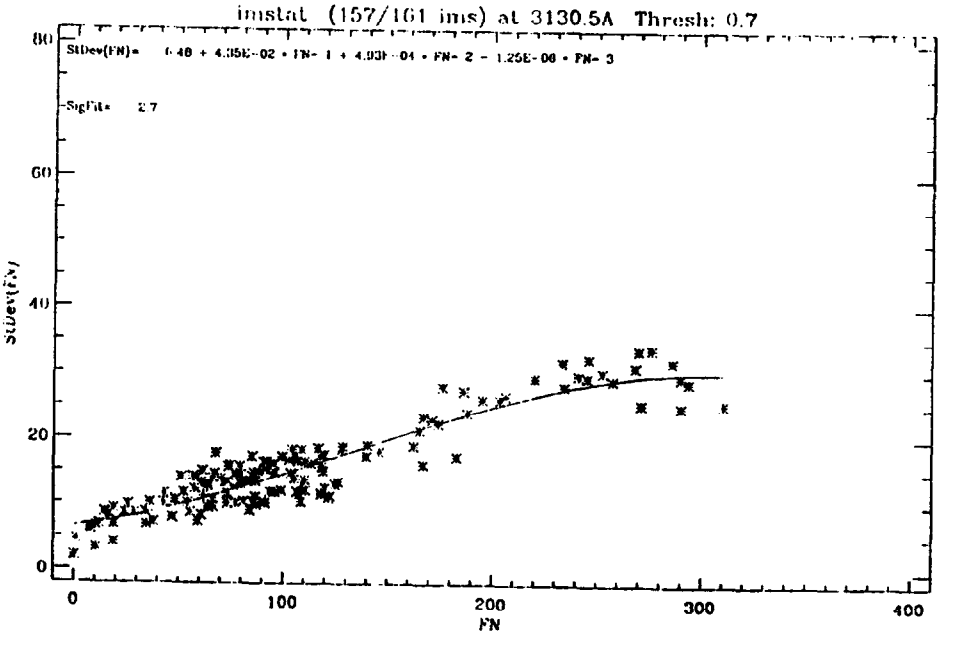

imstat (155/161 ims) at 2706.4A Thresh: 0.7
StDev(FN)= 8.18 + 2.19E-02 * FN- 1 + 9.04E-04 * FN- 2 - 2.19E-06 * FN- 3
SigFit= 3.1
StDev(FN)
FN
0
20
40
60
80
100
200
300
400

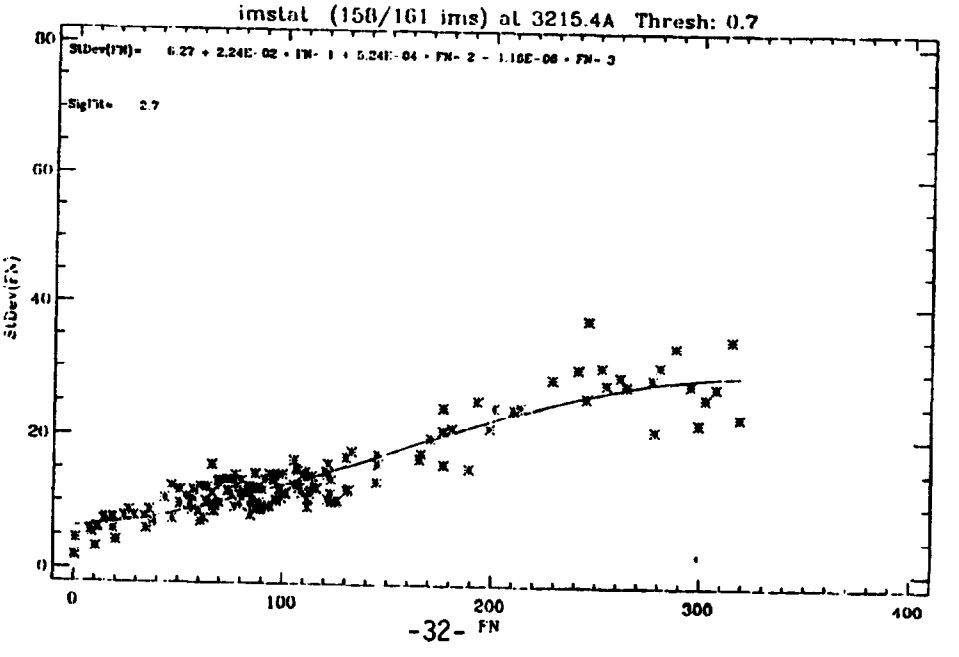

imstat (156/161 ims) at 2791.2A Thresh: 0.7
StDev(FN)= 7.63 + 3.54E-02 * FN- 1 + 7.12E-04 * FN- 2 - 1.65E-06 * FN- 3
SigFit= 3.1
StDev(FN)
FN
0
20
40
60
80
0
100
200
300
400

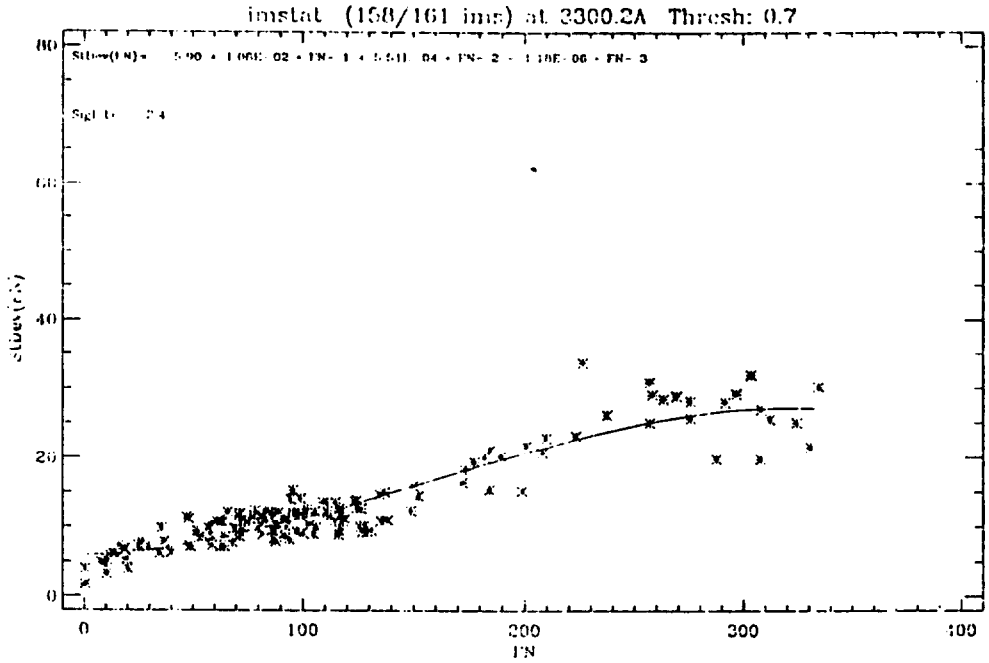

imstat (157/161 ims) at 2876.0A Thresh: 0.7
StDev(FN)= 7.39 + 4.03E-02 * FN- 1 + 6.63E-04 * FN- 2 - 1.62E-06 * FN- 3
SigFit= 3.0
StDev(FN)
FN
0
20
40
60
80
0
100
200
300
400


imstat (157/161 ims) at 2960.9A Thresh: 0.7
StDev(FN)= 7.64 + 3.93E-02 * FN- 1 + 5.98E-04 * FN- 2 - 1.51E-06 * FN- 3
SigFit= 3.1
StDev(FN)
FN
0
20
40
60
80
0
100
200
300
400


imstat (157/161 ims) at 3045.7A Thresh: 0.7
StDev(FN)= 7.50 + 3.49E-02 * FN- 1 + 6.08E-04 * FN- 2 - 1.52E-06 * FN- 3
SigFit= 3.1
StDev(FN)
FN
0
20
40
60
80
0
100
200
300
400


imstat (157/161 ims) at 3130.5A Thresh: 0.7
StDev(FN)= 6.48 + 4.35E-02 * FN- 1 + 4.93E-04 * FN- 2 - 1.25E-06 * FN- 3
SigFit= 2.7
StDev(FN)
FN
0
20
40
60
80
0
100
200
300
400


imstat (158/161 ims) at 3215.4A Thresh: 0.7
StDev(FN)= 6.27 + 2.24E-02 * FN- 1 + 5.24E-04 * FN- 2 - 1.16E-06 * FN- 3
SigFit= 2.7
StDev(FN)
FN
0
20
40
60
80
0
100
200
300
400


imstat (158/161 ims) at 3300.2A Thresh: 0.7
0
20
40
60
80
0
100
200
300
400
FN

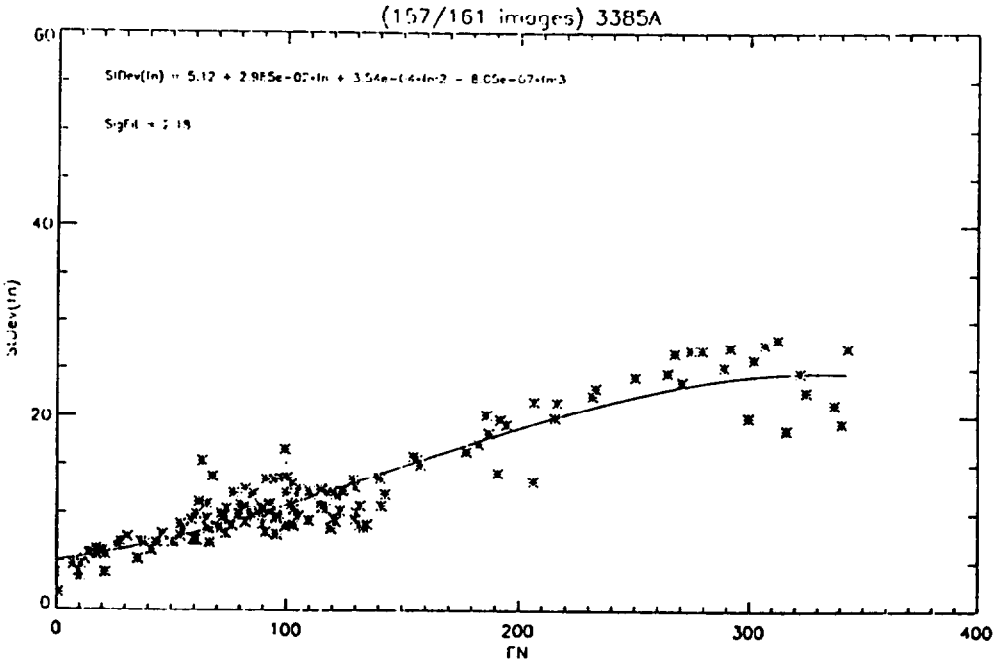

(157/161 images) 3385A
0
20
40
60
0
100
200
300
400
FN

FIGURE 3. Plots of the coefficients vs wavelength

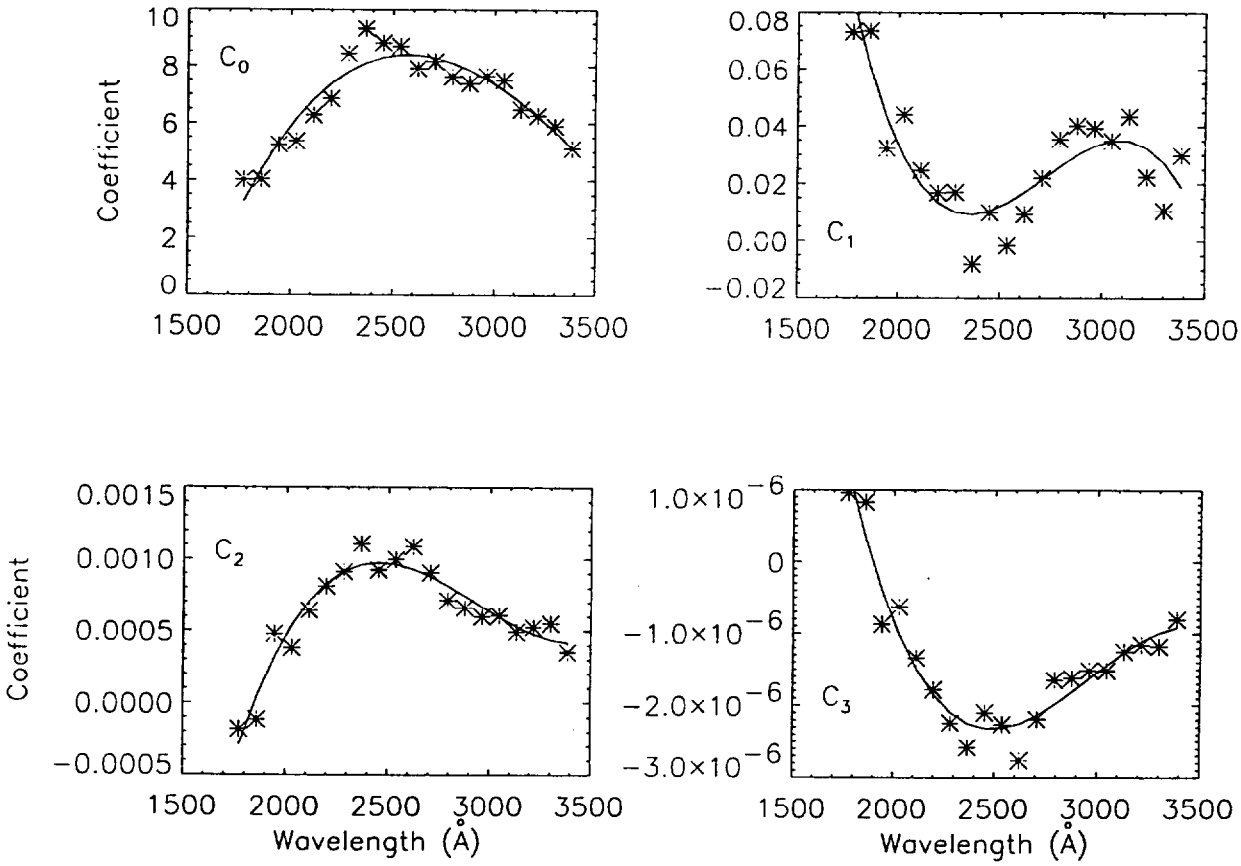


Fig. 3 Plots of the coefficients of the third order polynomial vs wavelength. Solid line is a third order polynomial fit to the data using the results presented in table 3 below.

Table 3. WAVELENGTH-DEPENDENCE OF THE 4 COEFFICIENTS FIT USING A 3rd ORDER POLYNOMIAL

SIGMA(FIT)	C(0)	C(1)	C(2)	C(3)
0.559855	-66.3124	7.041480e-02	-2.088836e-05	1.867906e-09
1.139935e-02	2.53779	-2.880286e-03	1.078247e-06	-1.321115e-10
1.076776e-04	-2.933076e-02	3.251477e-05	-1.140258e-08	1.297965e-12
2.942100e-07	7.650966e-05	-8.342830e-08	2.886433e-11	-3.242354e-15