

IUE Data Reduction

XXXIV. Implementation of New Dispersion Constants and Second-order Time Corrections

On June 20, 1984 (GMT 112:13:51) updated dispersion constants were implemented in production processing for the LWP, LWR, and SWP cameras. These files replace those implemented for the LWR and SWP on September 21, 1982 and for the LWP on April 12, 1983.

The chief distinction of the new calibration files is the introduction of correlation coefficients to facilitate second-order time (and linear THDA) corrections for the LWR and SWP constants. Studies have shown that the second-order time correction more closely models the dispersion relations for both recent and early LWR and SWP spectra than the previous linear time correction. For the LWP camera only a THDA correction is currently implemented. (See IUE Data Reduction Memos XXX and XXXII in NASA IUE Newsletters No. 20 and 21, respectively.)

Table 1 shows statistics for the dispersion constants and the standard deviations before and after the corrections are applied. Table 2 lists the actual dispersion constants and correlation coefficients as implemented on June 20. The notation used in the latter table is defined in terms of the line (L) and sample (S) position for a given wavelength as calculated for high dispersion via the equations

$$S = A_1 + A_2 m \lambda + A_3 (m \lambda)^2 + A_4 m + A_5 \lambda + A_6 m^2 \lambda + A_7 m \lambda^2 \quad (1)$$

$$L = B_1 + B_2 m \lambda + B_3 (m \lambda)^2 + B_4 m + B_5 \lambda + B_6 m^2 \lambda + B_7 m \lambda^2 \quad (2)$$

where

m = order number and
 λ = wavelength in Å.

For low dispersion ($m = 1$) only the first two terms are required.

For SWP and LWR the temperature and time corrections are terms $W(S)$ and $W(L)$ which are added to (1) and (2) above respectively. These are computed from the relations

$$W = W_1 + W_2 T + W_3 t + W_4 t^2 \quad (3)$$

where

T = head amplifier temperature (°C) and
t = number of days since January 1, 1978.

The correlation coefficients, W , are defined such that the mean time and temperature correspond to a correction of zero. For the LWP camera $W_3 = 0$ and $W_4 = 0$, since no time correction is applied. The figures show graphically both the corrected and uncorrected spectral format shifts plotted as a function of time.

In addition to the new dispersion relations, a new version of the applications program TCCAL has been implemented which allows a correction for time independent of a correction for THDA. In the past, if the THDA value could not be extracted from the image header label, TCCAL would default to mean dispersion constants. The new version will allow images taken prior to March 1979, as well as History Replay images*, to be processed with time-corrected dispersion relations. Note that this should be particularly useful for SWP images, for which the time corrections are more significant (i.e. produce smaller residual scatter) than the corrections for THDA.

Images for which a time correction was applied without any correction for THDA can be identified by checking the history portion of the image header label. Look for the entry '(MEAN)' on the line which lists the THDA value used to correct for spectrum motion. This implies that the THDA was not located in the header label, and, instead, the appropriate mean value was used.

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* History Replay images generally do not have THDA information in the header label.

Table 1

Dispersion Constant Statistics

	LWP		LWR		SWP	
	Low	High	Low	High	Low	High
No. of D.C.	51	50	105	103	107	109
Mean time	12/31/83	12/31/83	6/ 4/81	6/15/81	7/22/81	7/10/81
Start	6/17/80	6/17/80	7/15/78	9/30/78	9/30/78	9/11/78
End	3/11/84	3/11/84	3/ 7/84	3/ 7/84	3/11/84	3/11/84
Mean THDA(°C)	8.9	9.3	13.4	13.6	8.7	8.7
Lowest	6.2	6.5	8.8	9.5	5.1	5.1
Highest	12.2	12.2	18.3	18.3	13.2	12.8
Slope (DL/DS)	-.8599	1.20*	.7466	-1.38*	-.8063	1.28*
"Plate" Scale (pixel ⁻¹)	2.64 Å	7.22 km/s	2.65 Å	7.23 km/s	1.67 Å	7.70 km/s
Raw scatter (1σ in pixels)						
Parallel	.38	.64	.37	1.44	.84	1.07
Perpendicular	.63	.35	1.66	.31	1.03	.49
Scatter after correction						
	[THDA only]			[THDA & 2nd order time]		
Parallel	.30	.38	.29	.40	.19	.24
Perpendicular	.41	.19	.38	.24	.28	.15

* Order no. 100 used

Table 2. Coefficients Defining the Dispersion Relations For the Small Aperture (1 of 2)

	LWP HIGH	LWR HIGH	SWP HIGH
A1	5.873462158066862E 03	-4.568022566378104E 03	5.240320204548078E 02
A2	-1.722858383957817E-01	1.446262990785922E-01	-1.712441225166165E-01
A3	6.555369560052370E-07	-5.465497800144054E-07	1.270371733811783E-06
A4	1.595428893061642E 01	3.706365790765387E-02	2.400037009830254E-01
A5	3.593457426360678E-01	2.252782055000451E-01	-4.501831878764407E-01
A6	-6.872232913998719E-05	-1.128214756800759E-07	-1.710001924922418E-06
A7	-2.783347519836731E-06	1.178784019429775E-07	-1.229343742859447E-07
R1	1.722851374444825E 03	1.567990956548678E 04	-7.171777625701399E 03
R2	-1.525291559975196E-01	-2.798031396384101E-01	-1.180881485399540E-01
R3	6.234107147653889E-07	9.128413204610836E-07	1.221904605794151E-06
R4	2.195447834078006E-03	5.258053799093249E-02	-6.164813394499542E-02
R5	3.116702603413883E-01	2.249828862644492E-01	3.952920335125301E-01
R6	5.21952433350585E-08	2.913198089519675E-08	4.665040004845884E-07
R7	-2.825129628780807E-07	9.398635854889812E-09	-1.466678989324729E-07
CORRELATION COEFFICIENTS			
W1(S)	-7.430500388145447E-01	5.459306716918945E 00	-2.977794647216797E 00
W2(S)	8.040672540664673E-02	-2.795313000679016E-01	4.107570648193359E-02
W3(S)		-1.768400659784675E-03	2.857662504538894E-03
W4(S)		3.070972525165416E-07	-5.223851076152641E-07
W1(L)	-4.000792503356934E 00	-8.628579139709473E 00	-2.841607093811035E 00
W2(L)	4.322262406349182E-01	5.308601856231689E-01	2.274644970893860E-01
W3(L)		1.599742565304041E-03	7.730186916887760E-04
W4(L)		-3.199881462023768E-07	-6.993195711402223E-08

Table 2. Coefficients Defining the Dispersion Relations For the Small Aperture (2 of 2)

	LWP LOW	LWR LOW	SWP LOW
A1	1.046282942865237E 03	-2.992355784397701E 02	9.833223402481985E 02
A2	-2.867015866247448E-01	3.022840587387481E-01	-4.665747674619282E-01
A3			
A4			
A5			
A6			
A7			
R1	-2.722748512318324E 02	-2.647551045134080E 02	-2.633234804632572E 02
R2	2.465361695604904E-01	2.256895703788157E-01	3.762166817667614E-01
R3			
R4			
R5			
R6			
R7			
CORRELATION COEFFICIENTS			
W1(S)	-7.578814029693604E-01	5.142534255981445E 00	-3.452352523803711E 00
W2(S)	8.561676740646362E-02	-2.351302504539490E-01	-3.286504652351141E-03
W3(S)		-1.864231890067458E-03	3.721332177519798E-03
W4(S)		1.824748778744834E-07	-6.585678420378827E-07
W1(L)	-2.995339393615723E 00	-8.595767974853516E 00	-1.659444808959961E 00
W2(L)	3.379166126251221E-01	4.655143022537231E-01	1.674554347991943E-01
W3(L)		2.750693820416927E-03	2.752062573563308E-05
W4(L)		-5.675888132827822E-07	8.504440529577550E-08

Table 3.

Total* RMS Scatter (1σ in pixels) for Various
Corrections to the Mean Dispersion Constants

HIGH DISPERSION

	<u>LWP</u>	<u>LWR</u>	<u>SWP</u>
Raw Scatter	0.73	1.48	1.18
1st Order THDA	0.42	0.83	0.94
1st Order Time	0.72	1.07	0.47
THDA & Time	0.42	0.48	0.32
THDA & 2nd order Time	0.41	0.47	0.28
No. of Points	50	103	109
Mean Time (1 = 1/1/78)	1865	1281	1288

LOW DISPERSION

	<u>LWP</u>	<u>LWR</u>	<u>SWP</u>
Raw Scatter	0.73	1.70	1.33
1st Order THDA	0.51	1.20	1.19
1st Order Time	0.71	1.00	0.46
THDA & Time	0.50	0.51	0.39
THDA & 2nd order Time	0.48	0.48	0.34
No. of Points	51	105	107
Mean Time (1 = 1/1/78)	1857	1257	1300

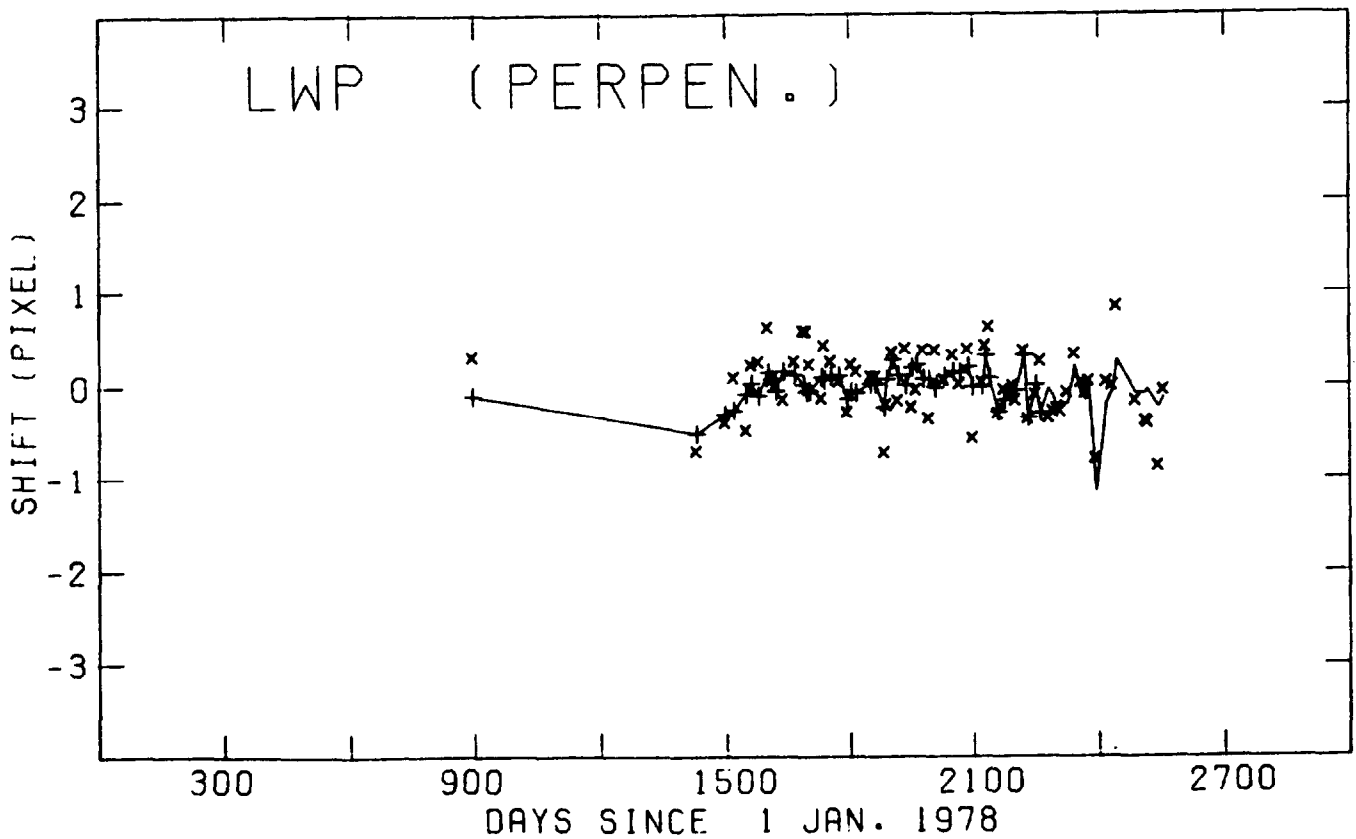
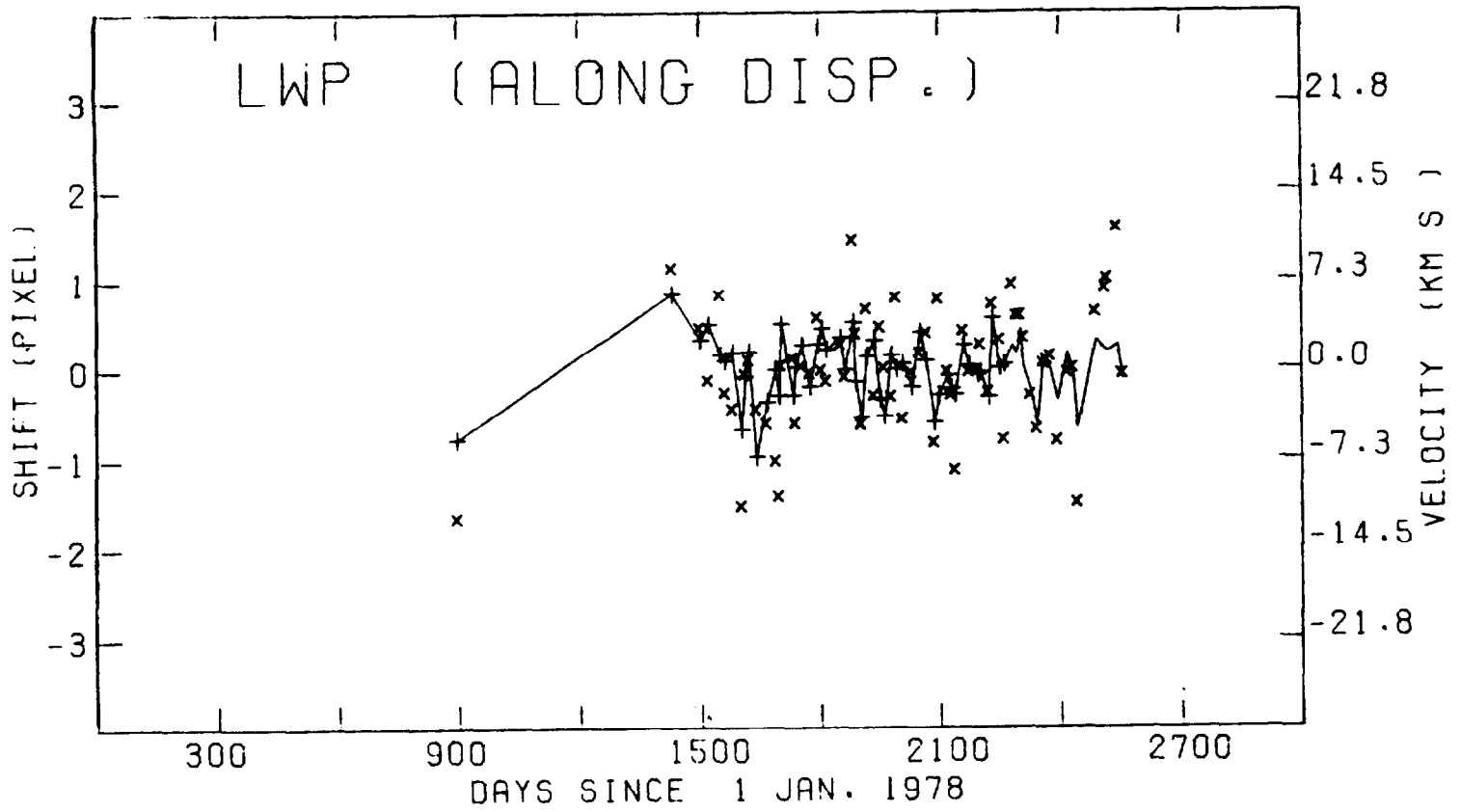
* Perpendicular and parallel components combined.

Figure Caption:

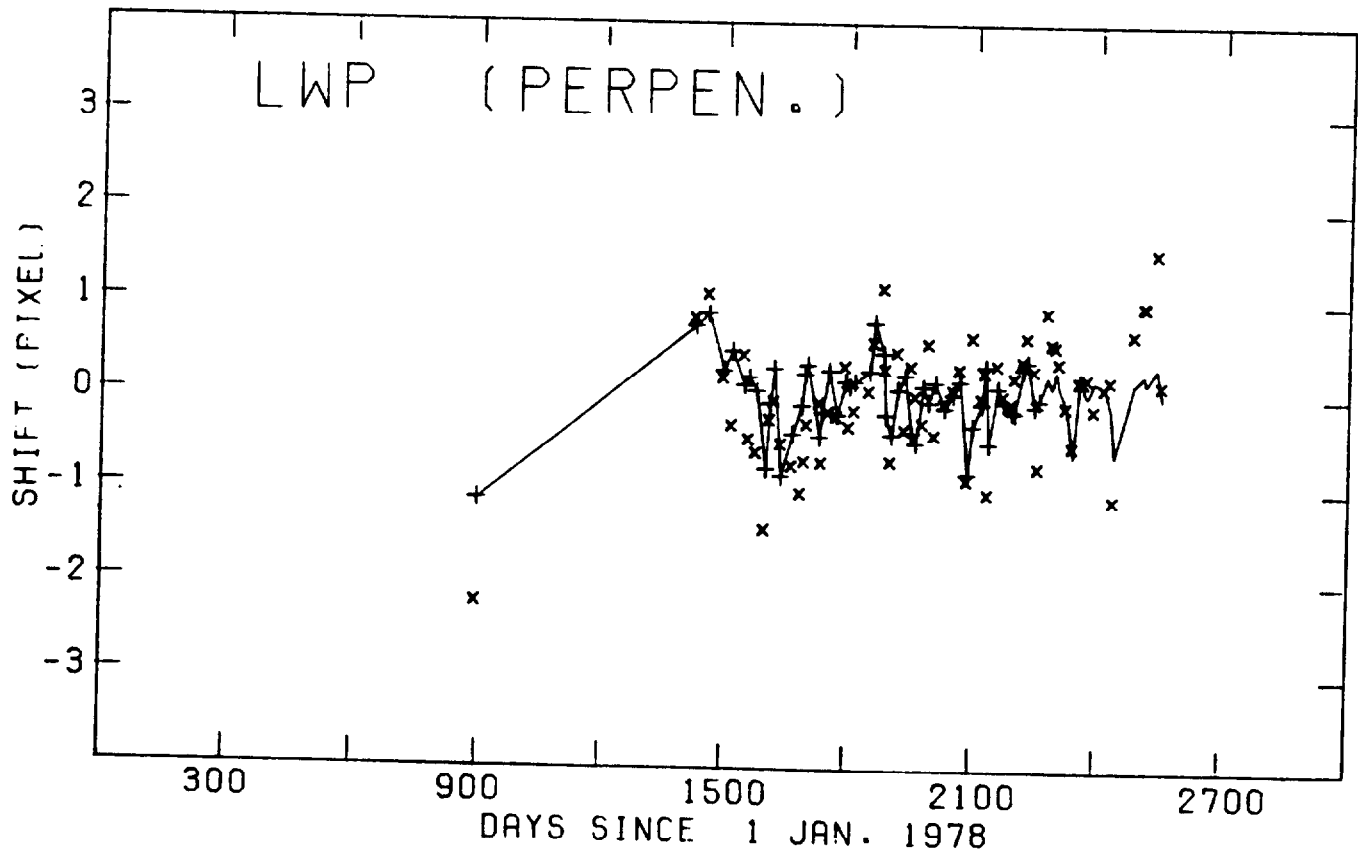
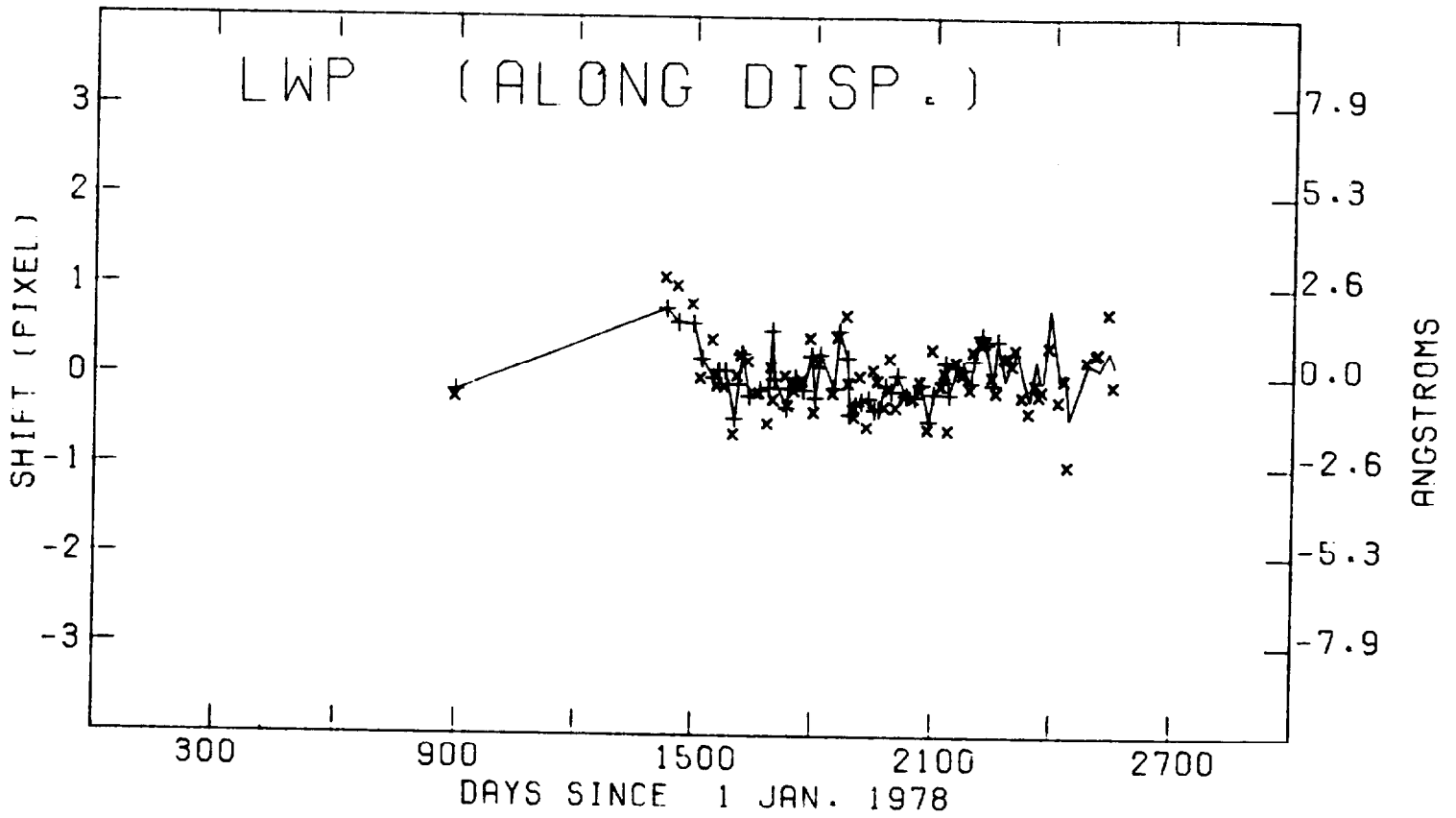
The plots in the following figures show, for an arbitrarily selected wavelength, the relative variation with time of the uncorrected spectral format shifts (indicated by the symbol "x") and the temperature and time corrected shifts (indicated by the symbol "+"). The corrected shifts shown in the figures for LWR and SWP have been generated using a linear THDA and second-order time relation. For the LWP only a linear temperature correction was performed.

The plots for LWR and SWP confirm that the linear temperature and second-order time corrections are effective in compensating for the format shifts. For the LWP camera no time dependence is apparent.

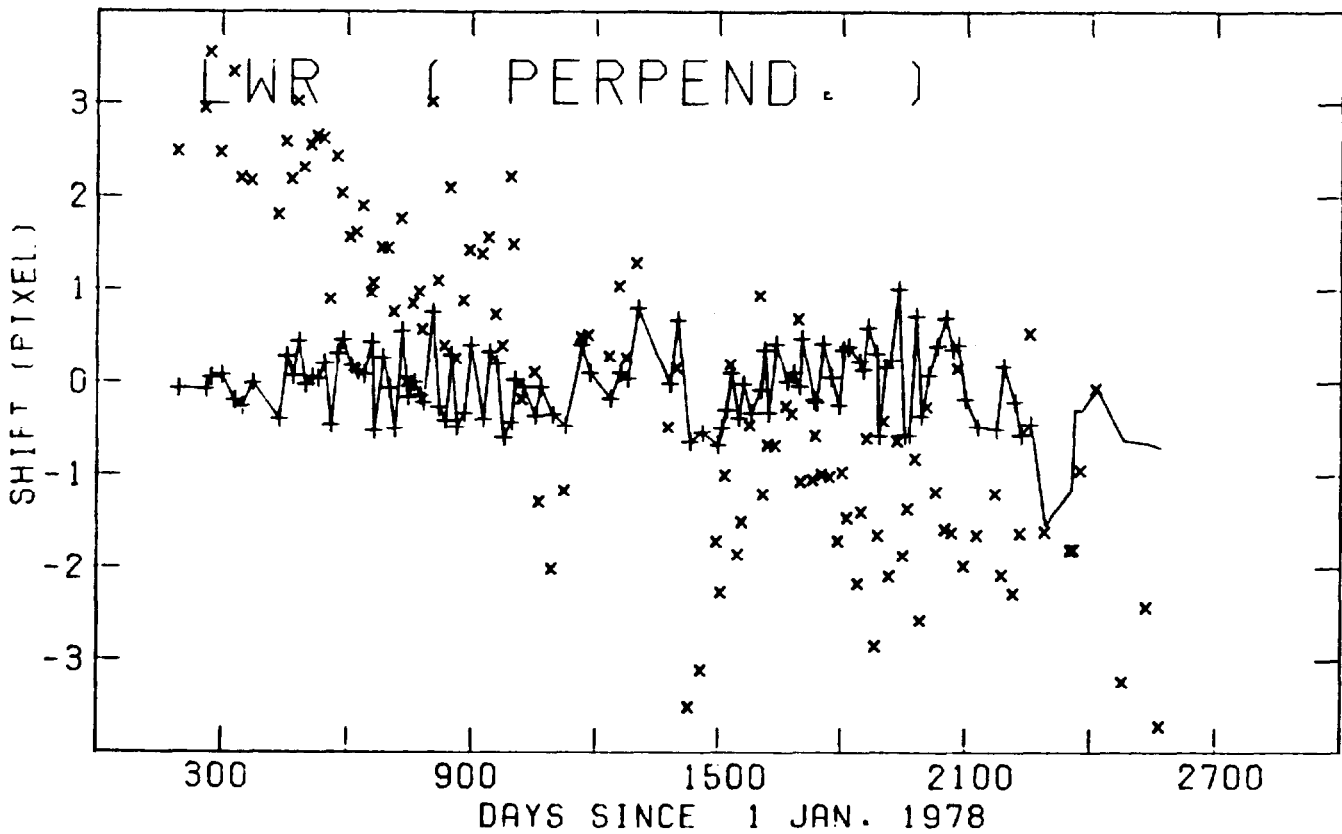
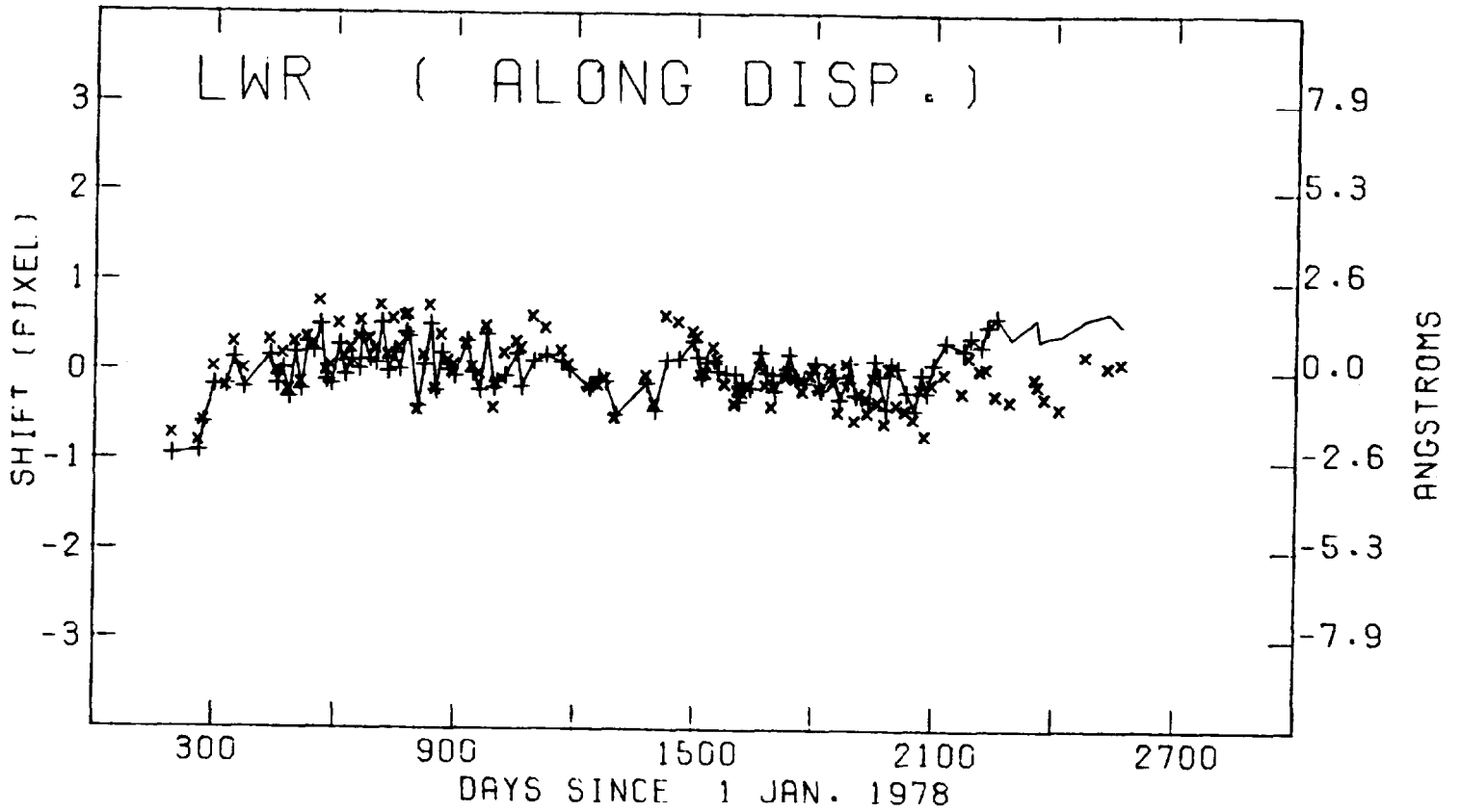
HIGH DISPERSION



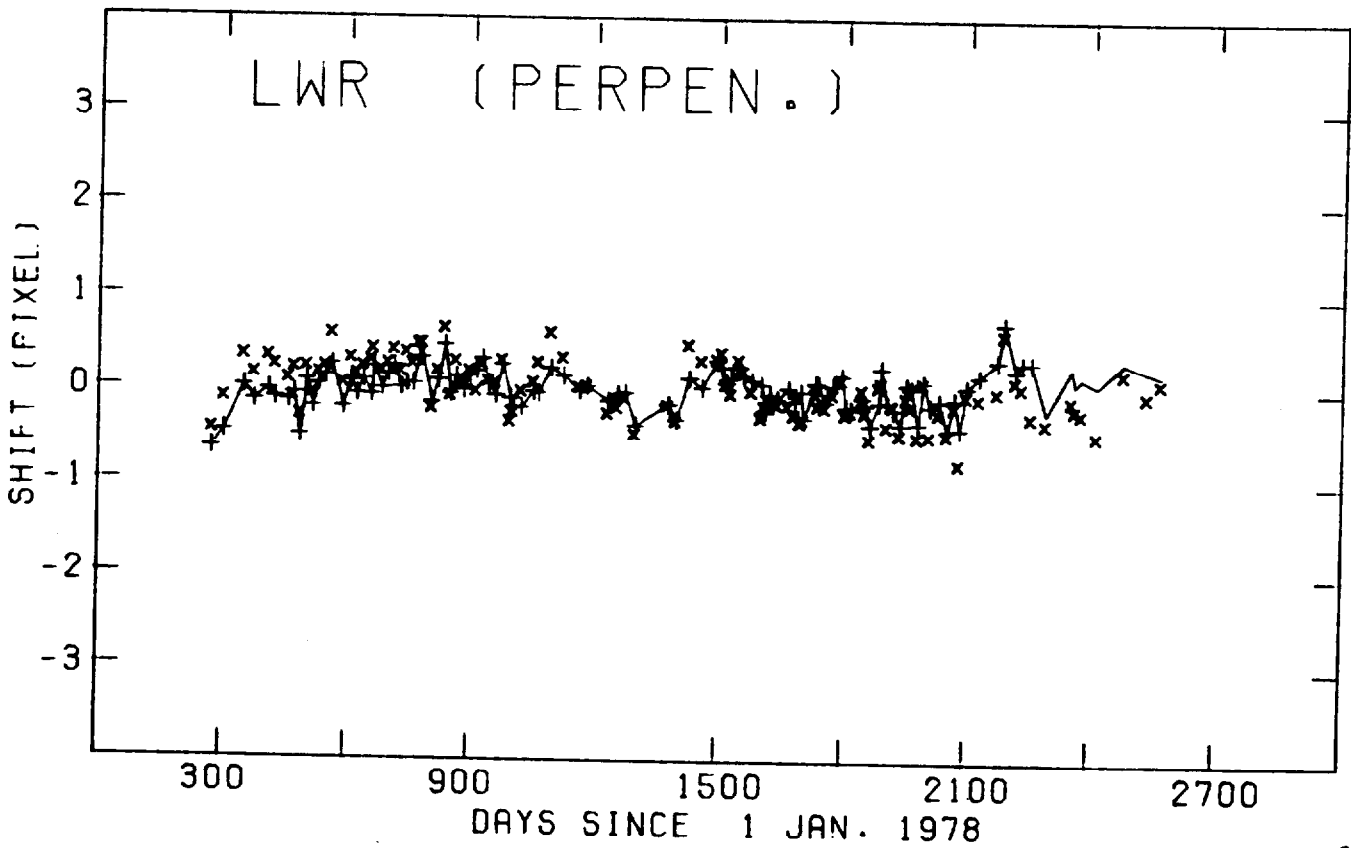
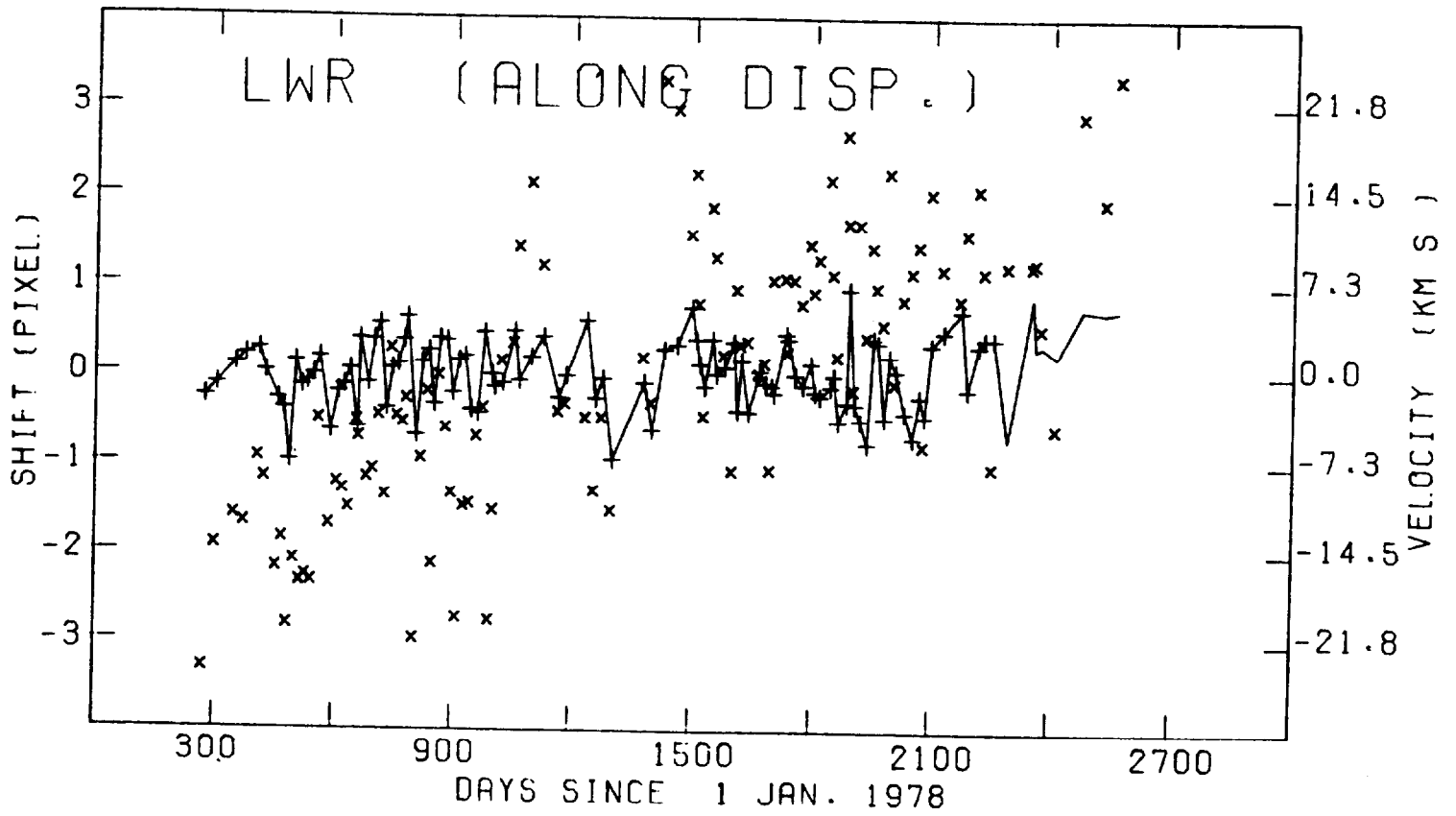
LOW DISPERSION



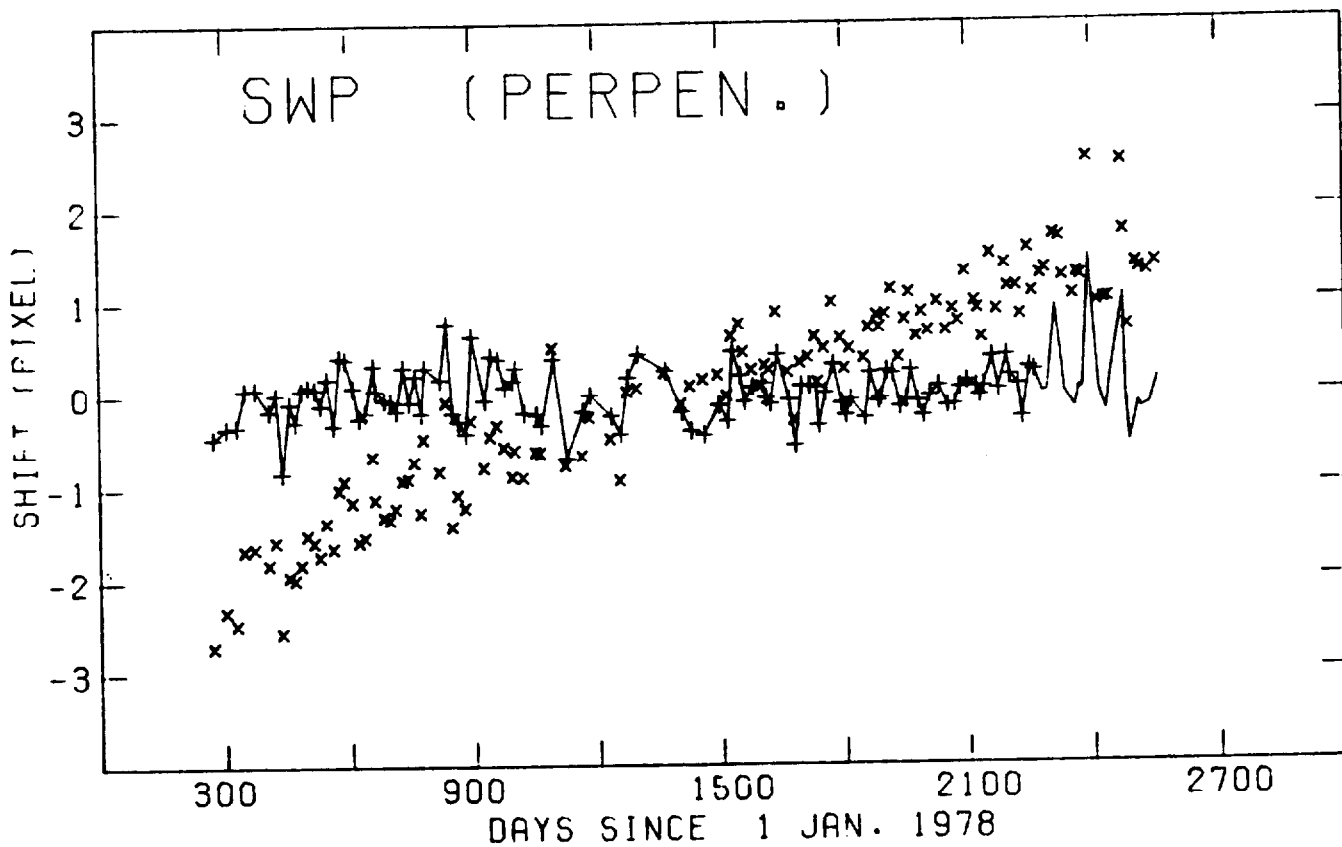
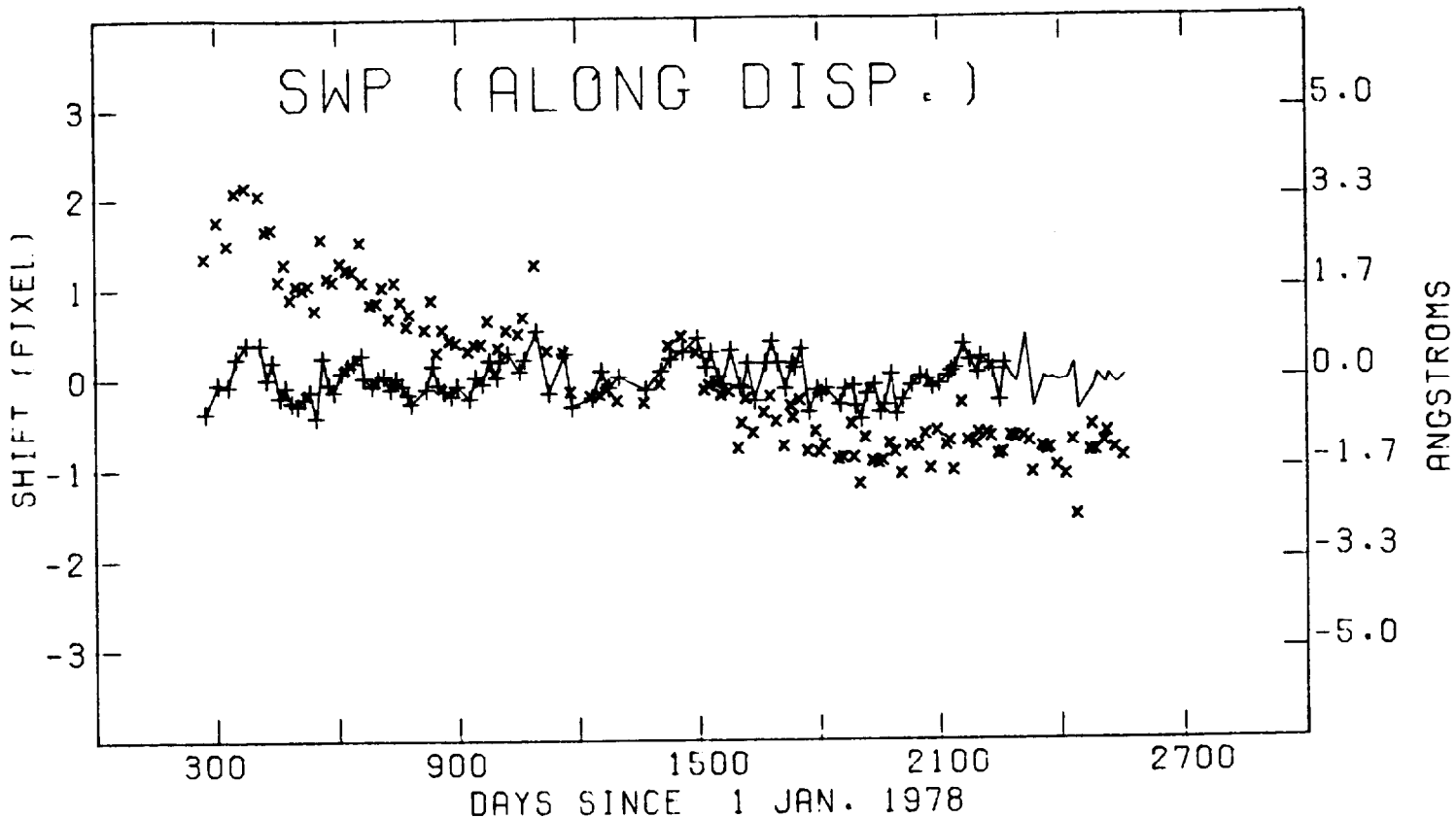
LOW DISPERSION



HIGH DISPERSION



LOW DISPERSION



HIGH DISPERSION

