Results From FGS Cycle 5 Calibration Program #6175 “3 Points of Light”

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September 25, 1995

ABSTRACT

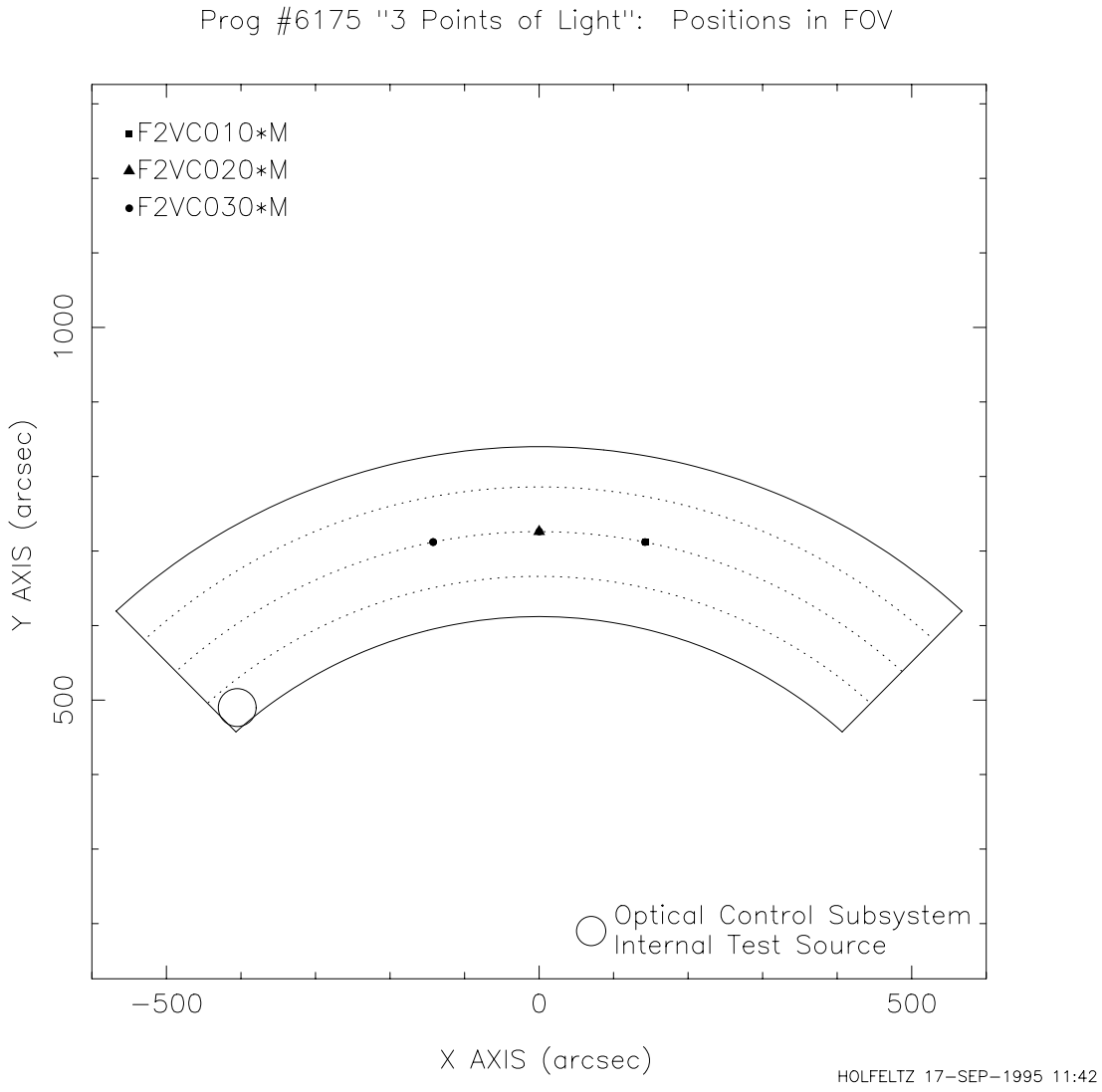
Results from the Cycle 5 FGS calibration program #6175, “3 Points of Light”, are discussed. This program obtained TRANSfer Mode observations of the standard FGS star Upgren 69 (B-V = +0.5) at 3 positions near the center of the field of view of FGS #3 through the Clear (F583W), PUPIL, and Neutral Density (F5ND) filters. The reference files so obtained serve to calibrate, for Cycle 5, the dependence of the Transfer Function on the filter used and the position in the field of view for targets of moderate color index.

1. Introduction

The morphology of the Transfer Function or S-curve (the interferometric fringe visibility pattern obtained during a TRANSfer Mode observation with a Fine Guidance Sensor) changes dramatically with the filter used, the position in the field of view, the date of observation, and even with the color index of the target. Appropriate reference data is thus required in order to reduce TRANSfer Mode science observations.

FGS Cycle 5 calibration program #6175, “3 Points of Light”, calibrates the dependence of the Transfer Function on the filter and position in the field of view. The program obtained reference Transfer Functions of the FGS standard star Upgren 69 (V = 9.6, B-V = +0.5) through three filters (Clear F583W, PUPIL, and Neutral Density F5ND) at 3 positions near the center of the field of view of FGS #3 (see Figure 1).

Figure 1: Positions in field of view at which reference Transfer Functions were obtained.



2. Observations and Data Reductions

The Observations

Nine scans at each position were obtained for the Clear and PUPIL filters; twelve scans were obtained for each of the Neutral Density filter observations. The observations occurred over 3 orbits between 11 Sept., 1995 and 16 Sept., 1995. Table 1 summarizes these observations.

Table 1. Summary of Observations

Filename	Filter	Date
F2VC0101M	PUPIL	11 Sept. 1995
F2VC0102M	F583W	11 Sept. 1995
F2VC0103M	F5ND	11 Sept. 1995
F2VC0201M	PUPIL	12 Sept. 1995
F2VC0202M	F583W	12 Sept. 1995
F2VC0203M	F5ND	12 Sept. 1995
F2VC0301M	PUPIL	16 Sept. 1995
F2VC0302M	F583W	16 Sept. 1995
F2VC0303M	F5ND	16 Sept. 1995

Data Smoothing and Merging

All scans for a given data set were co-added or merged together then averaged in 1 milli-arc second bins. The resulting S-curve was then fit with a continuous piece-wise polynomial. These polynomial fits to the data are the reference Transfer Functions to be used in the reduction of TRANSfer Mode science data. Table 2 relates information regarding the merging of the Transfer Functions. Column 1 lists the filename, column 2 gives the number of scans which were merged together. Columns 3 and 4 give, respectively, the average and maximum signal-to-noise ratio for the x-axis S-curve. The average signal-to-noise ratio is defined as the ratio of the average of the absolute value of the signal within ±300 milli-arc seconds of the primary null divided by the standard deviation about the mean of the Transfer Function far (> 300 milli-arc seconds) from the null. The maximum signal-to-noise ratio is defined as the peak-to-peak amplitude of the Transfer Function divided by the standard deviation of the Transfer Function far (> 300 milli-arc seconds) from the null.

Table 2. Summary of Merged Transfer Functions

Filename	# Scans Obtained	X-Axis		Y-Axis	
		Avg S/N	Max S/N	Avg S/N	Max S/N
F2VC0101M	9	8	171	6	101
F2VC0102M	9	7	163	4	90
F2VC0103M	12	2	34	2	32
F2VC0201M	9	8	168	6	106

Filename	# Scans Obtained	X-Axis		Y-Axis	
		Avg S/N	Max S/N	Avg S/N	Max S/N
F2VC0202M	9	8	146	5	117
F2VC0203M	12	2	28	2	37
F2VC0301M	9	7	126	6	113
F2VC0302M	9	7	102	5	121
F2VC0303M	12	1	20	2	33

The Transfer Functions

The merged Transfer Functions (prior to the polynomial fit) at each of three positions with the Clear (F583W), PUPIL, and Neutral Density (F5ND) filters are shown in Figure 2 through Figure 10, respectively.

Figure 2: Clear Filter (F583W) Calibration Transfer Function at (142”, 712”)

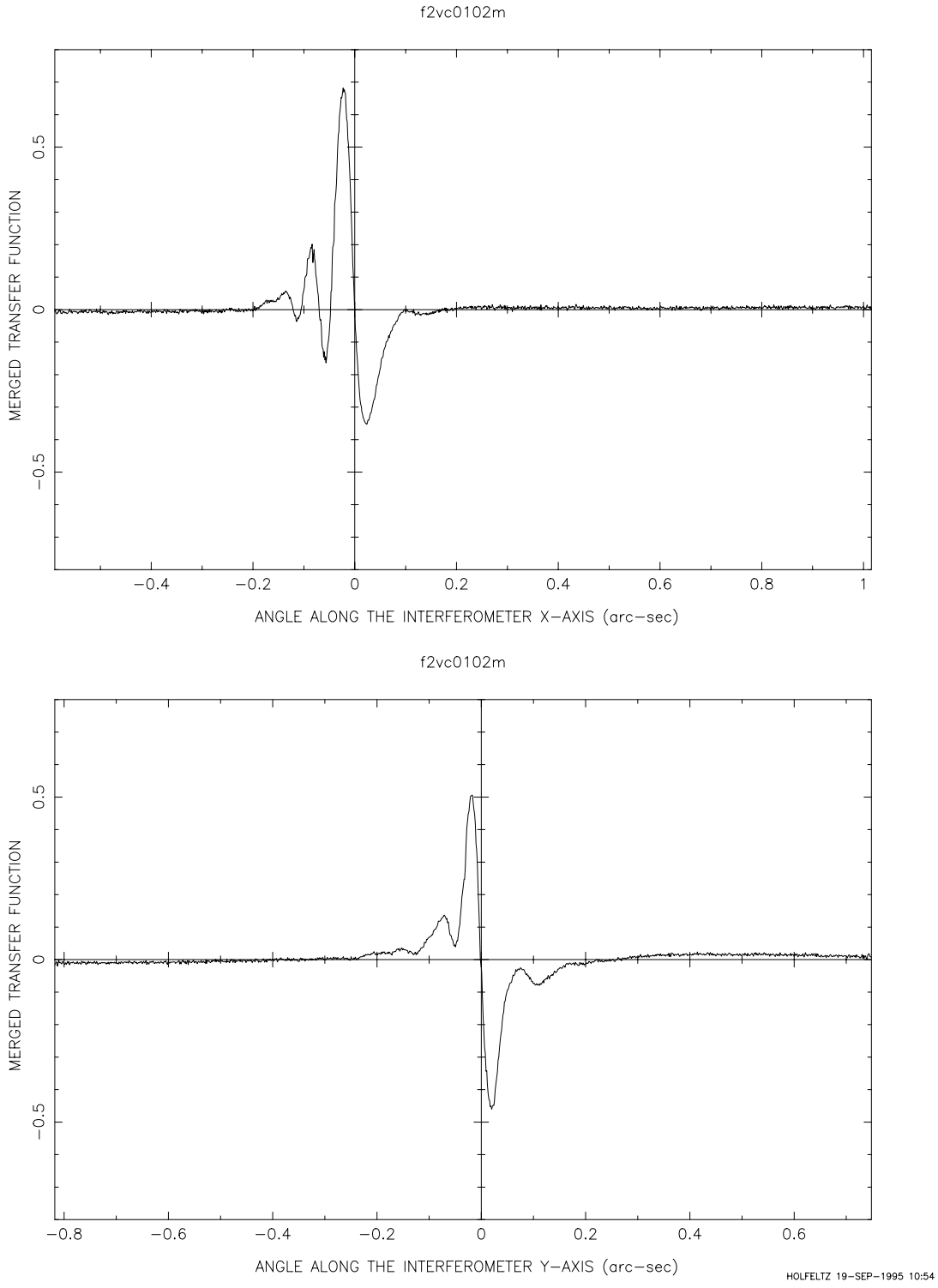


Figure 3: Clear Filter (F583W) Calibration Transfer Function at (0”, 726”)

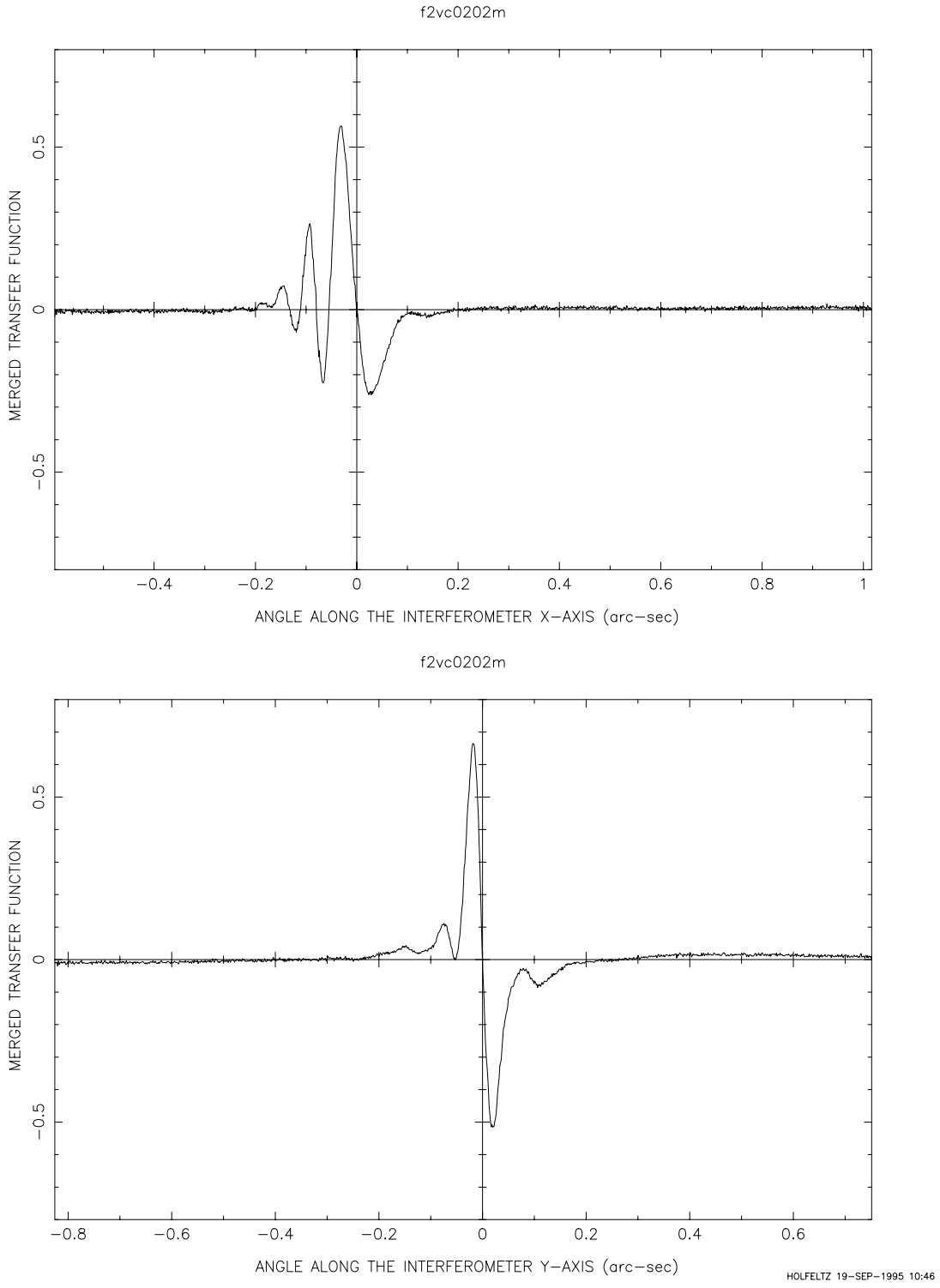


Figure 4: Clear Filter (F583W) Calibration Transfer Function at (-142”, 712”)

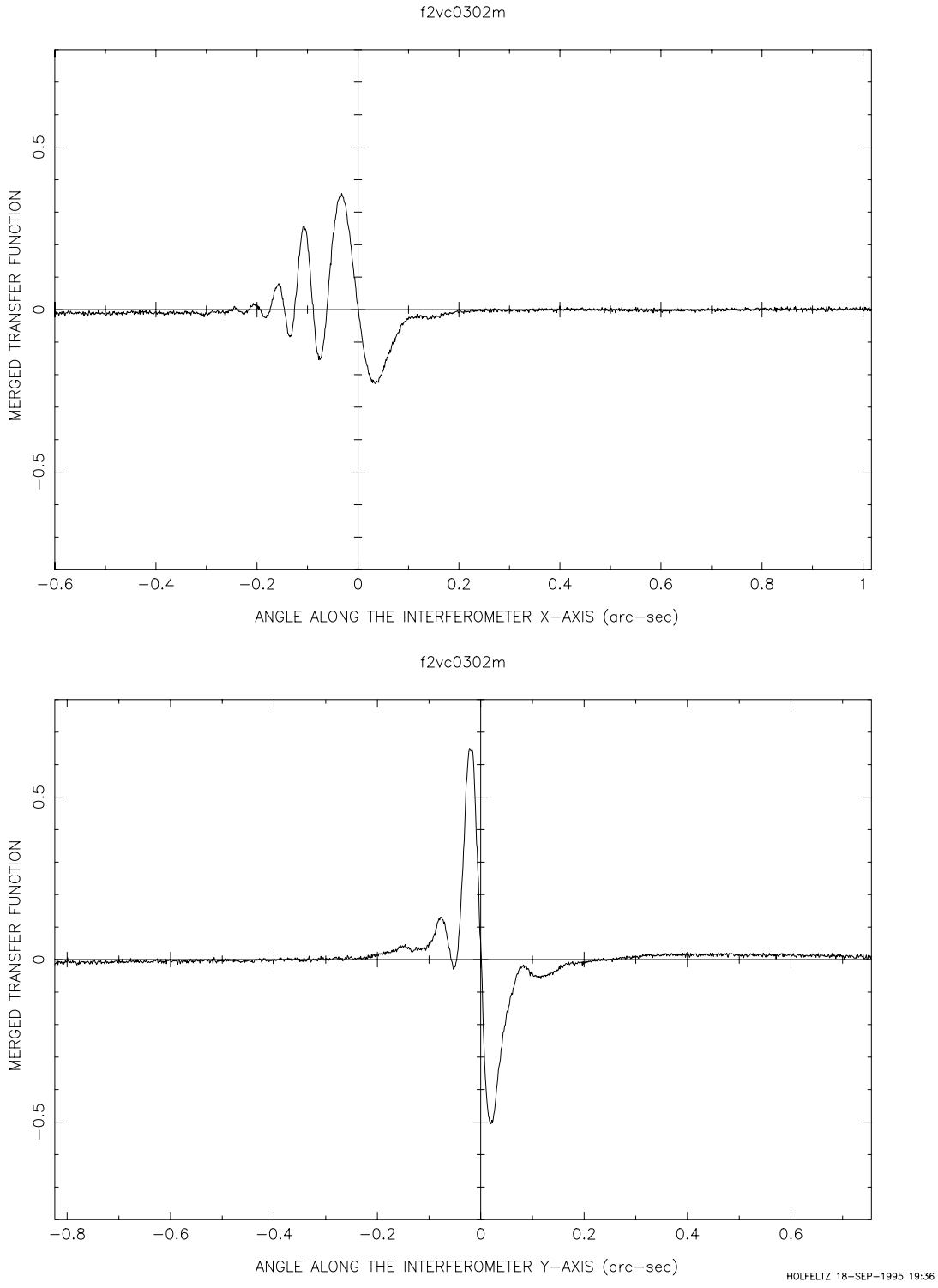


Figure 5: PUPIL Filter Calibration Transfer Function at (142”, 712”)

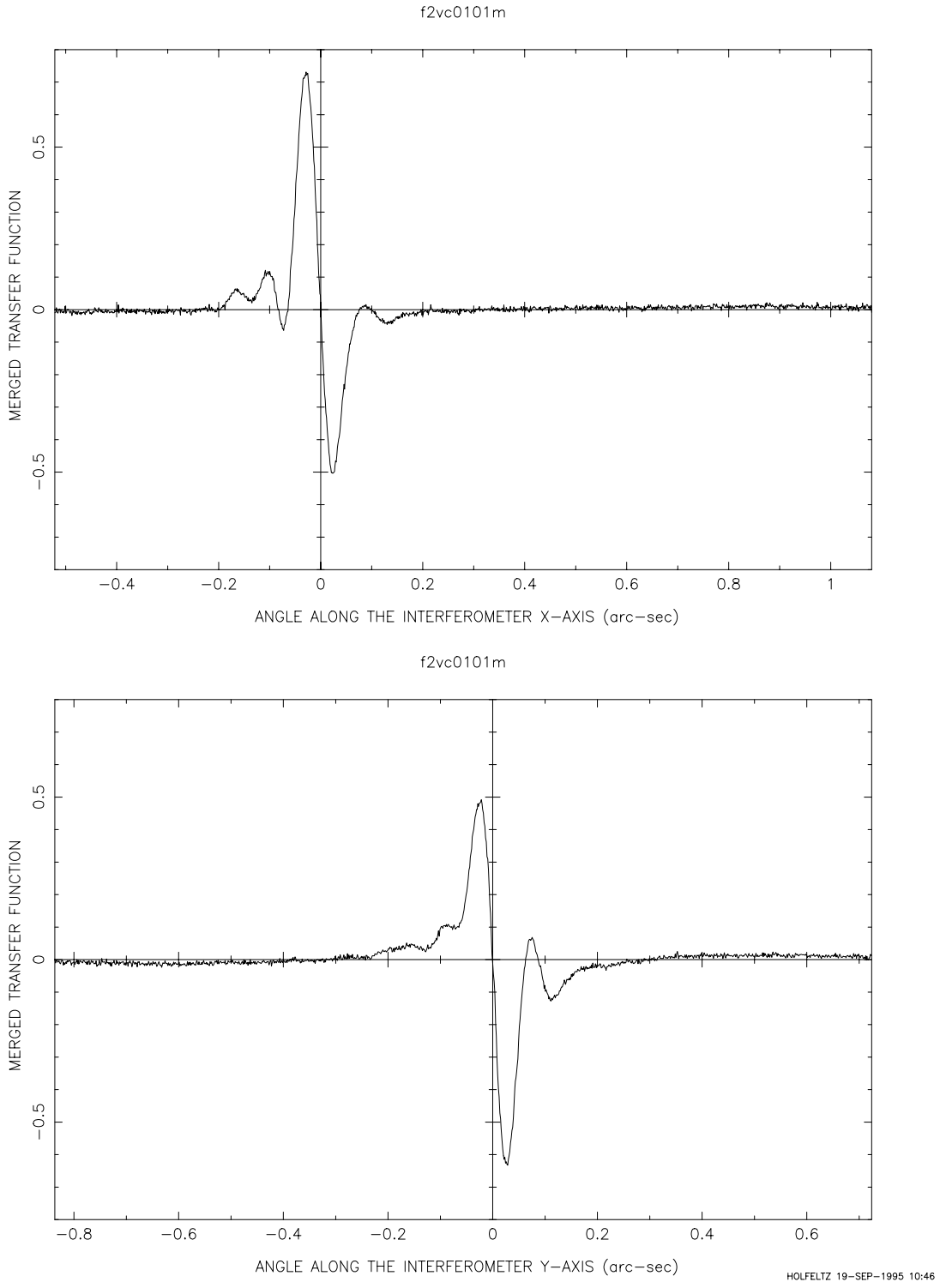


Figure 6: PUPIL Filter Calibration Transfer Function at (0”, 726”)

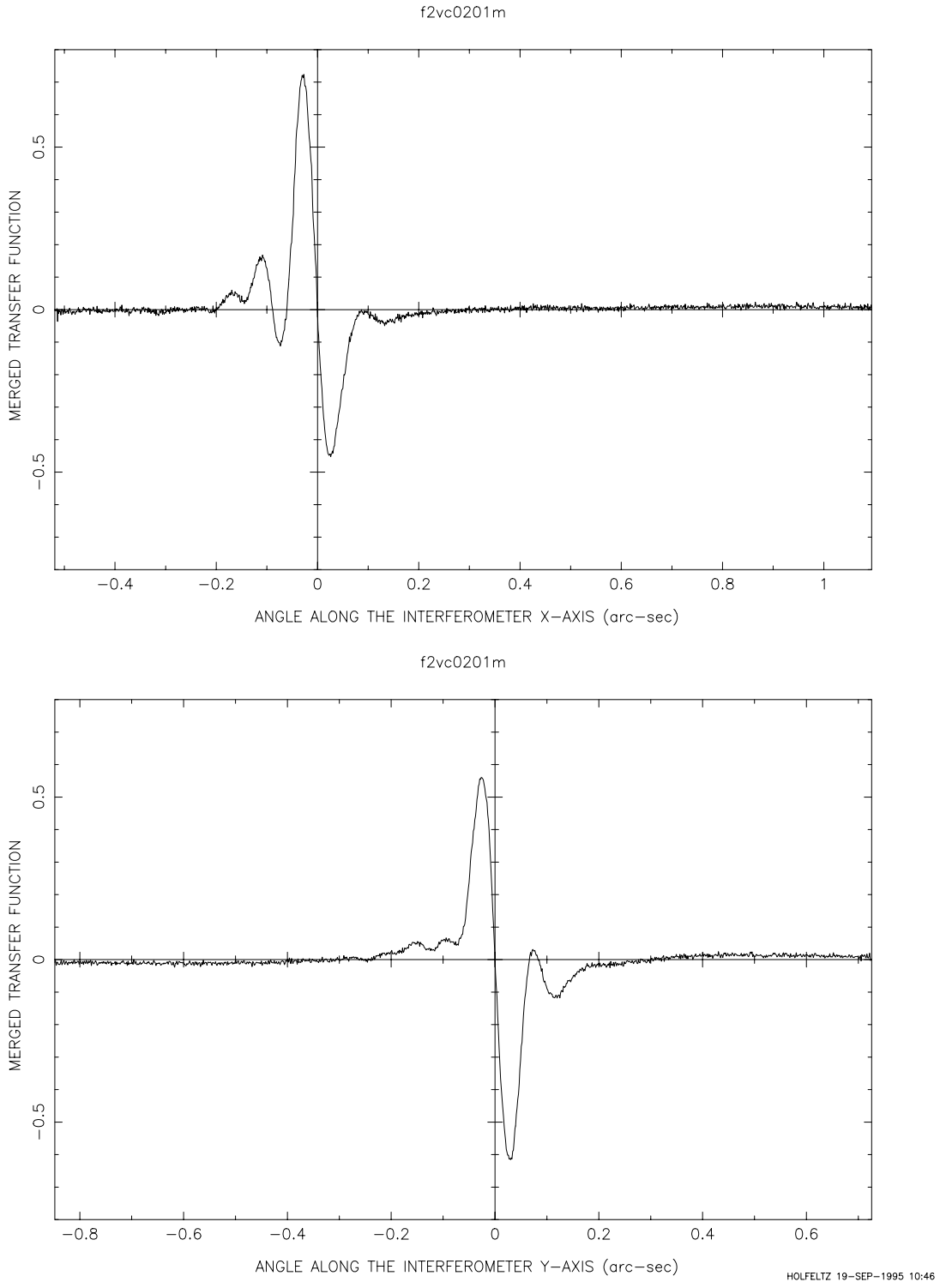


Figure 7: PUPIL Filter Calibration Transfer Function at (-142”, 712”)

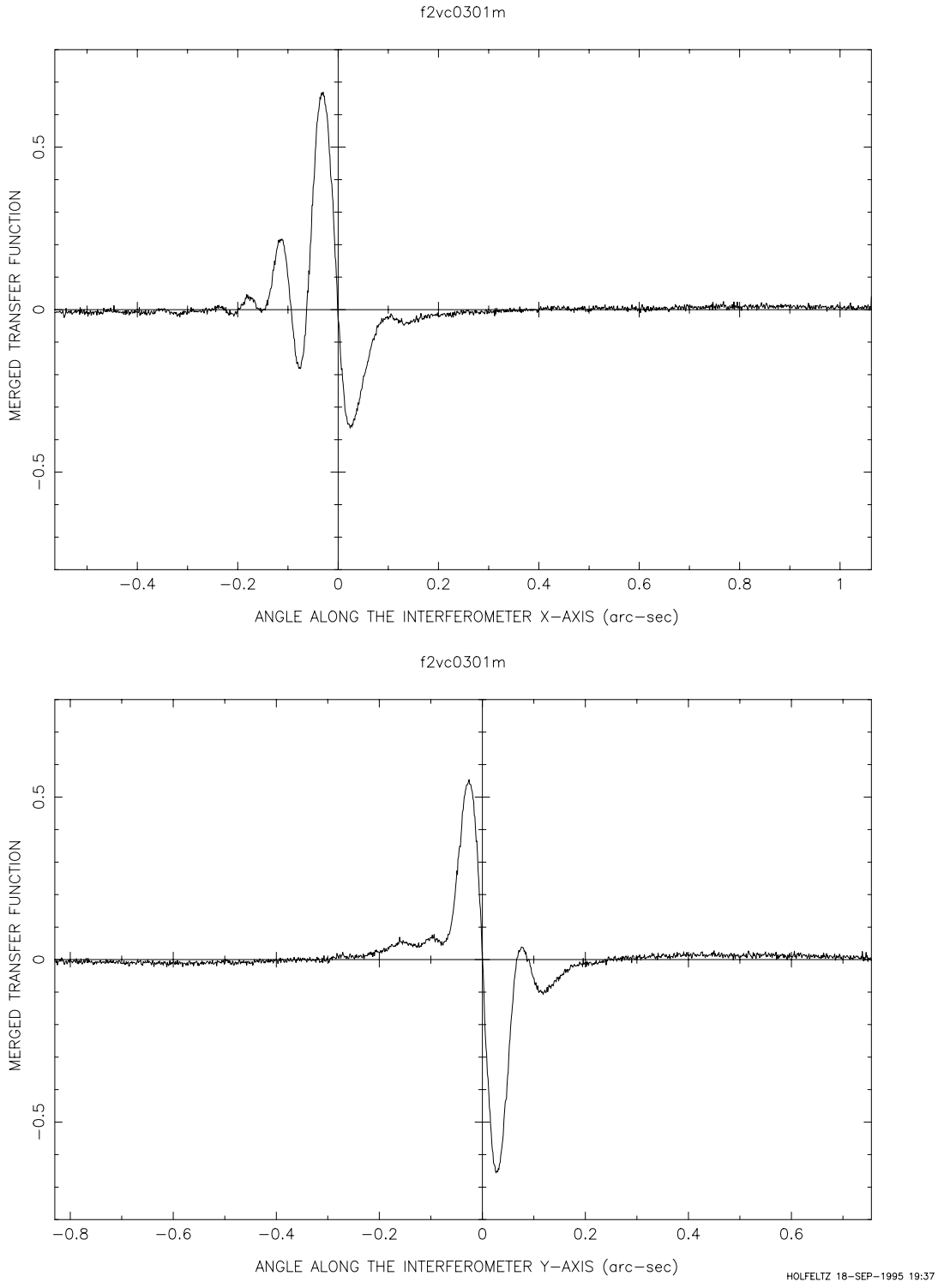


Figure 8: Neutral Density Filter (F5ND) Calibration Transfer Function at (142”, 712”)

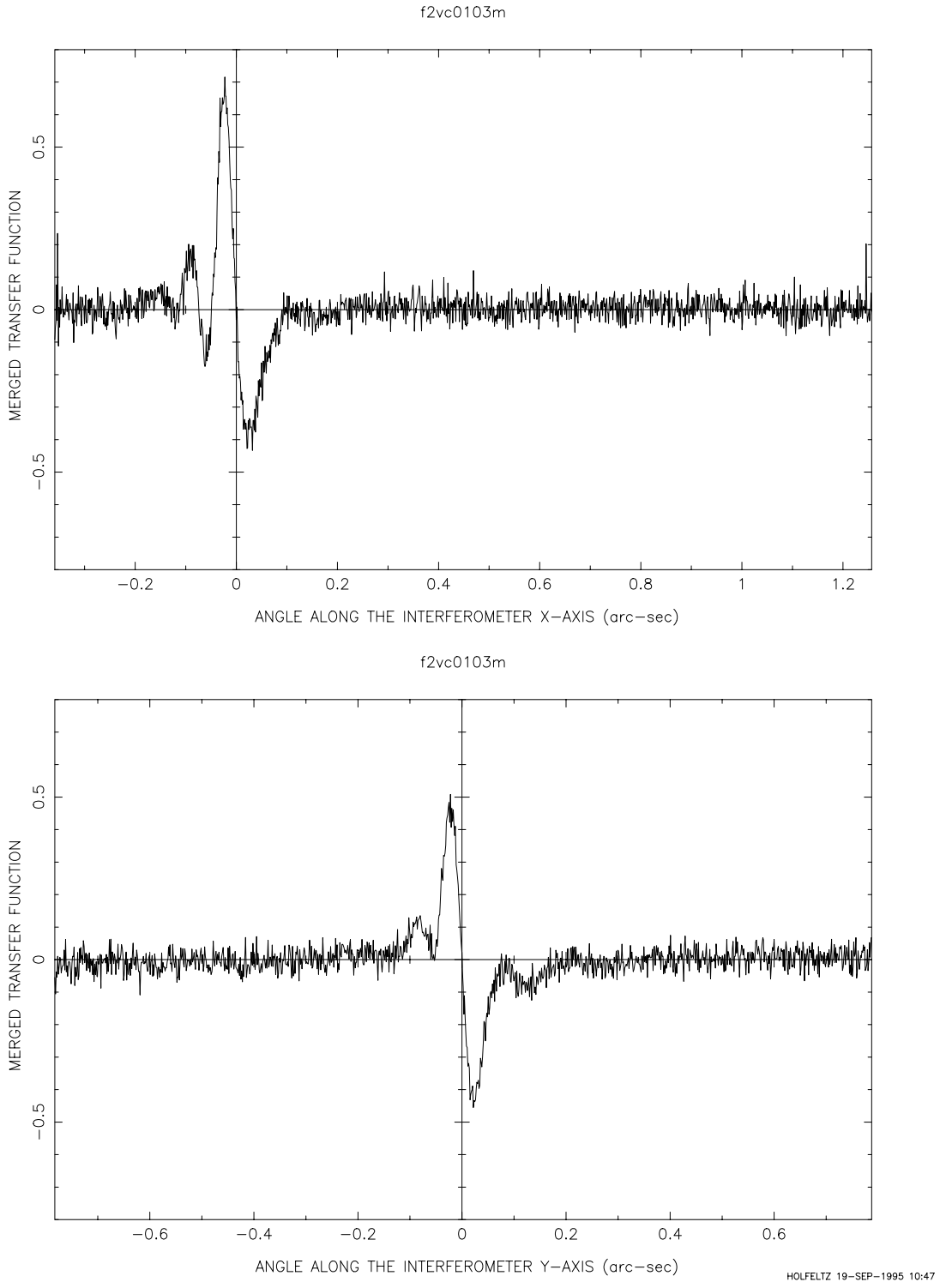


Figure 9: Neutral Density Filter (F5ND) Calibration Transfer Function at (0”, 726”)

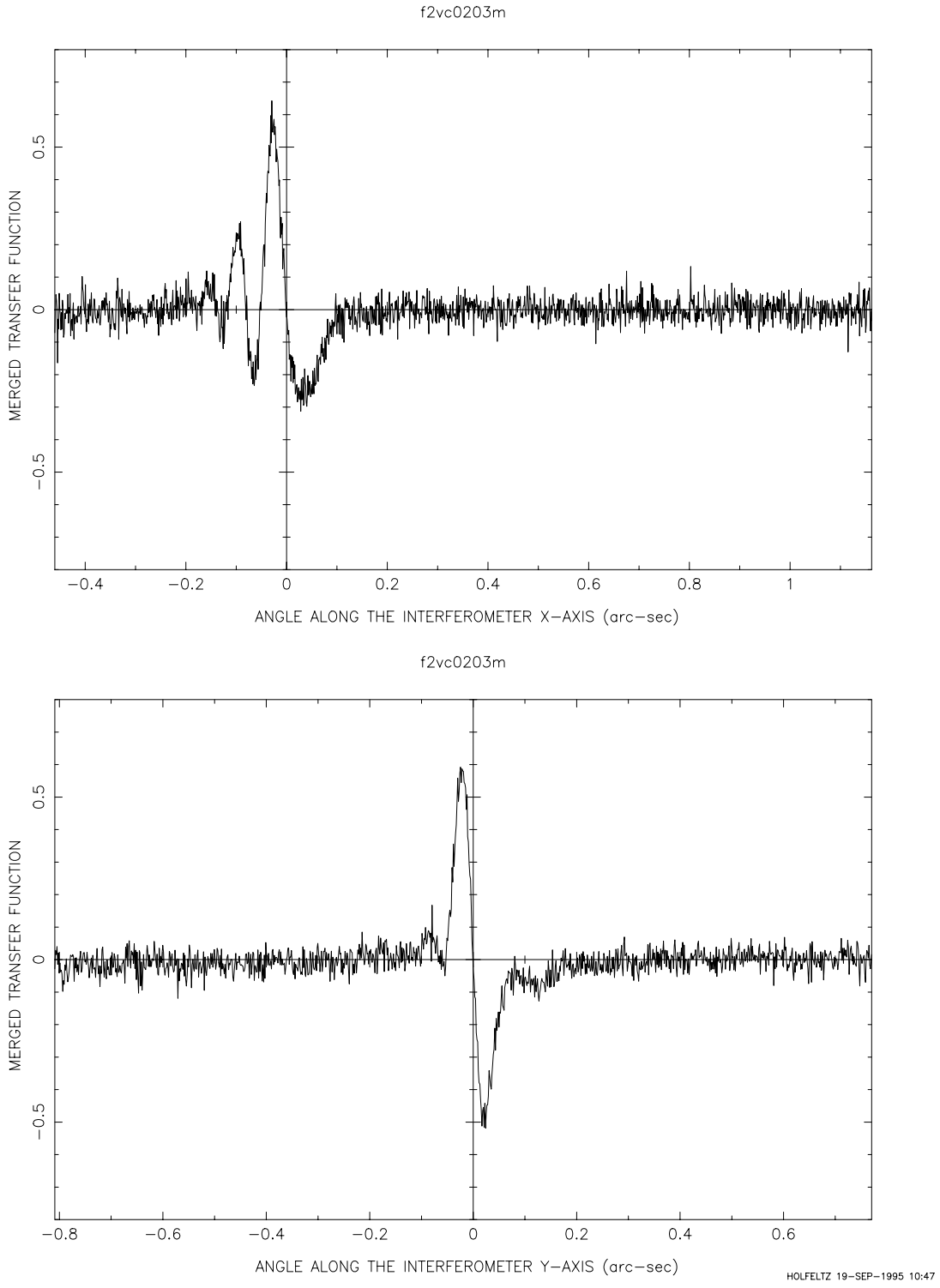
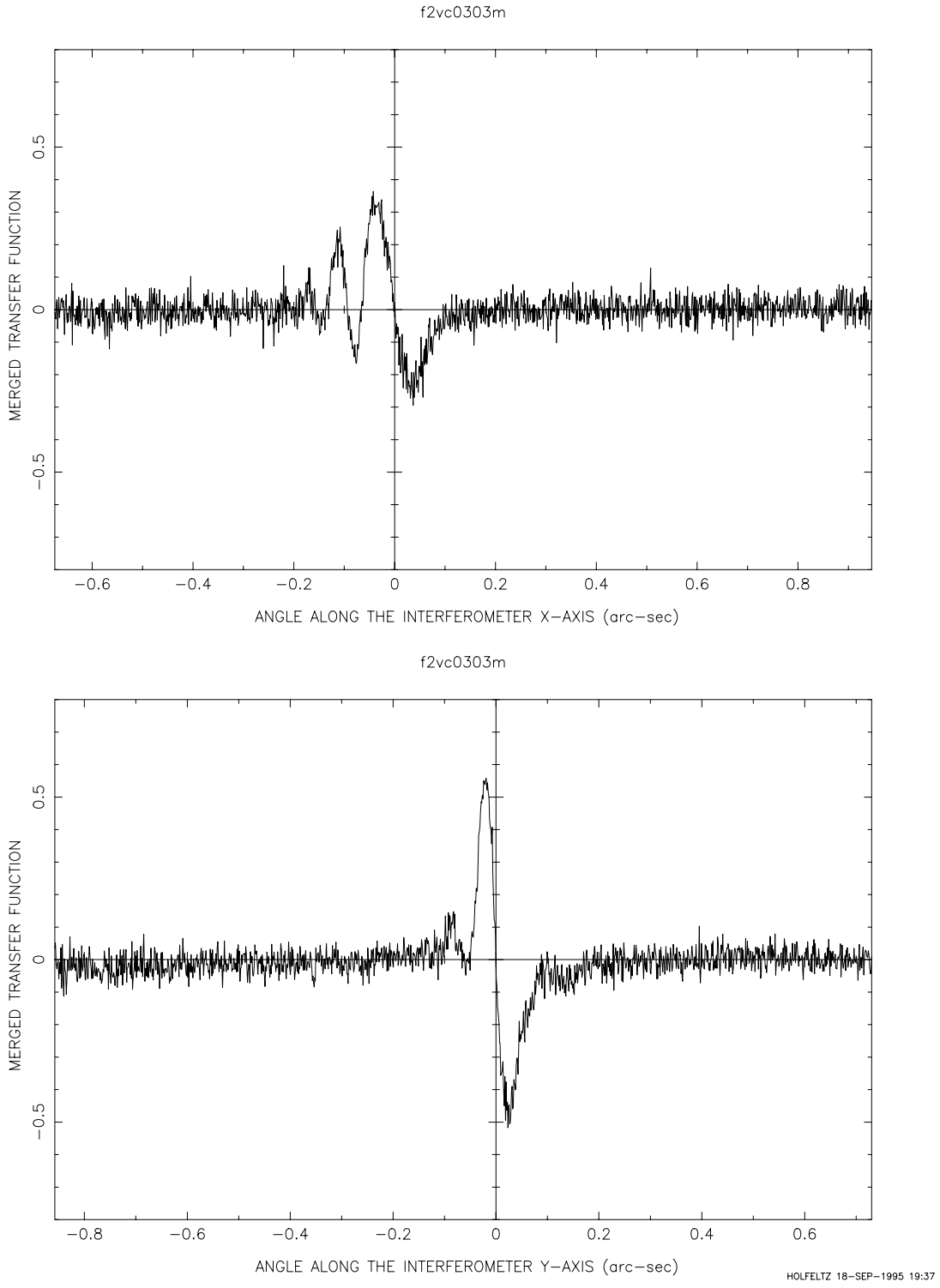


Figure 10: Neutral Density Filter (F5ND) Calibration Transfer Function at (-142”, 712”)



The Results

Significant parameters of the reference S-curves are summarized in Table 3 through Table 5; see Figure 11 for definitions of these parameters. Filenames are given in column 1, axis (x or y) in column 2. Columns 3-5 give the absolute value of the peak of the primary and secondary lobes and the full width at half maximum of the primary lobe, respectively. Data for the positive lobes are given first in each table followed by the same information for the negative lobes (see Figure 11).

Figure 11: Definition of parameters given in Table 3 through Table 5.

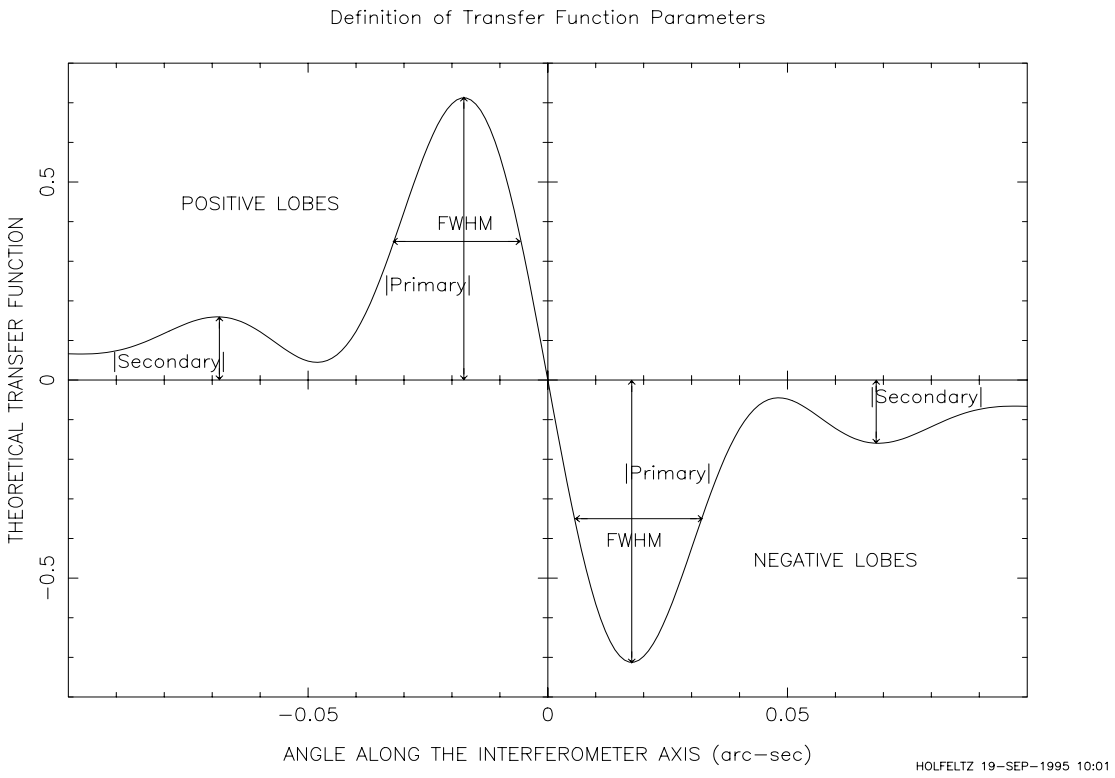


Table 3. Parameters for Clear Filter (F583W) Calibration Transfer Functions

Filename	Axis	[a]|Primary|	[a]|Secondary|	[b]FWHM
		Positive Lobes		
F2VC0102M	X	0.68	0.22	0.029
	Y	0.48	0.13	0.028
F2VC0202M	X	0.56	0.33	0.033
	Y	0.66	0.10	0.027

[a] ±0.02 arcsec

[b] Full width at half maximum for the primary lobe, ±0.001 arcsec

Filename	Axis	[a]|Primary|	[a]|Secondary|	[b]FWHM
F2VC0302M	X	0.35	0.25	0.039
	Y	0.65	0.12	0.028
Negative Lobes				
F2VC0102M	X	0.35	0.01	0.044
	Y	0.44	0.08	0.034
F2VC0202M	X	0.26	0.02	0.051
	Y	0.50	0.08	0.032
F2VC0302M	X	0.22	0.02	0.057
	Y	0.49	0.05	0.035

[a] ±0.02 arcsec

[b] Full width at half maximum for the primary lobe, ±0.001 arcsec

Table 4. Parameters for PUPIL Filter Calibration Transfer Functions

Filename	Axis	[a]|Primary|	[a]|Secondary|	[b]FWHM
Positive Lobes				
F2VC0101M	X	0.73	0.12	0.038
	Y	0.50	0.11	0.038
F2VC0201M	X	0.72	0.17	0.036
	Y	0.58	0.06	0.037
F2VC0301M	X	0.65	0.22	0.041
	Y	0.55	0.07	0.040
Negative Lobes				
F2VC0101M	X	0.51	0.04	0.037
	Y	0.63	0.13	0.037
F2VC0201M	X	0.46	0.04	0.041
	Y	0.62	0.13	0.039
F2VC0301M	X	0.36	0.04	0.049
	Y	0.67	0.10	0.039

[a] ±0.01 arcsec

[b] Full width at half maximum for the primary lobe, ±0.001 arcsec

Table 5. Parameters for Neutral Density Filter (F5ND) Calibration Transfer Functions

Filename	Axis	[a]|Primary|	[a]|Secondary|	[b]FWHM
		Positive Lobes		
F2VC0103M	X	0.65	0.17	0.030
	Y	0.50	0.12	0.028
F2VC0203M	X	0.52	0.24	0.034
	Y	0.55	0.08	0.034
F2VC0303M	X	0.32	0.22	0.045
	Y	0.56	0.13	0.028
		Negative Lobes		
F2VC0103M	X	0.38	0.03	0.047
	Y	0.44	0.09	0.037
F2VC0203M	X	0.26	0.03	0.066
	Y	0.47	0.09	0.038
F2VC0303M	X	0.24	0.03	0.055
	Y	0.47	0.07	0.041

[a] ±0.01 arcsec

[b] Full width at half maximum for the primary lobe, ±0.001 arcsec

The co-added S-curves (`*.fit`) and polynomial fits to the curves (`*.poly`) are available on the VAX/VMS science cluster at the Institute on `disk$boston_data` in directory [`holfeltz.go.refdat`]. A list of all available reference Transfer Functions (`ref.lis`) is available in the same directory.