

FOS Pre-COSTAR Target Pointing Analysis

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Abstract

A log of Spacecraft Small Angle Maneuvers (SAM) during the Faint Object Spectrograph target acquisition sequence has been compiled from March 21, 1991 to December 3, 1993. During this time there was no FOS Aperture Location update to the Project Data Base (PDB).

Analysis of the log shows no obvious trends in: time, V2 direction, or V3 direction. The only trend seen is a systematic +V2 direction offset for the dominant guide star in FGS 2. There is no trend seen for the dominant guide star in either FGS 1 or FGS 3.

The lack of trends is due to the combination of several errors; target coordinate error, guide star coordinate error, position of guide stars within the Fine Guidance Sensors, FOS target acquisition method error, and other internal FOS errors (Filter Grating Wheel non-repeatability, GIMP, etc.).

I. Introduction

The total spacecraft SAM were calculated for each FOS target acquisition sequence (Binary Search and Pickup methods only). Models of the Binary Search and Pickup target acquisition commanding were used, rather than determining the actual spacecraft pointing. The SAMs for V2 and V3 were calculated for each step of the target acquisition sequence, summed, and then entered into the log. The time, guide star, dominant FGS, and sub-dominant FGS information in the log was obtained from the SMS.

No moving targets were included in the log. Any observations that had known problems that would increase the target coordinate error (proper motion errors, extended targets, unusually large initial pickup scans, etc.) were excluded. However, it is likely that not all such problems were caught. Failed acquisitions were not included.

No attempt was made to estimate the target coordinate errors due to insufficient resources. No other errors were calculated due to the gargantuan task of estimating all the errors.

II. Analysis of Pointing Statistics

The mean and standard deviations of the pointing offset magnitude and the V2 and V3 pointing offset SAMs are given in Tables 1-6. Figures 1-12 show the plots versus time for the magnitude, V2, and V3 pointing offset SAMs. All three FGS, each dominant FGS, and FGS 1 and 3 dominant were analyzed.

Since FGS 2 dominant acquisitions were biased in the +V2 direction, the combination of FGS 1 and FGS 3 is a more accurate picture than all three FGSs. Section III will discuss the FGS 2 dominant problem.

Precise pointing of the calibration target, G191-B2B, is shown in Figures 10 - 12 and Table 6. Only FGS 1 and 3 dominant acquisitions were analyzed. All included acquisitions of this target utilized a four stage Peakup with an expected positioning error of 0.035 - 0.04 arcseconds. While this scenario minimizes the target coordinate error, there were too few points to determine any real trend.

In addition, histogram plots with 6 month bins of the V2 and V3 pointing offsets were made for each dominant FGS and FGS 1 and 3 together. There was no trend any of in the means, although it is known that FGS 1 and 3 were drifting away from each other.

III. FGS 2 Dominant Problem

Early in the mission, the FOS team established a rule that FGS 2 not be used as the Dominant FGS. This was based on empirical evidence that showed FGS 2 was not well aligned and placed the target near the edge of the FOS 4.3 aperture (the target acquisition aperture) and occasionally caused target acquisition failures (private communication from George Hartig). In mid-1992 this rule was revoked because it was believed that the FGSs were then well aligned.

As Figure 8 and Table 4 show, FGS 2 still suffered from a one arcsecond +V2 tendency. This had also caused a proportionally higher number of target acquisition failures. There were seven target acquisition errors out of 27 acquisitions for FGS 2 dominant (a 26% failure rate) versus six failures out of 51 acquisitions for FGS 1 dominant (12% failure rate) and five failures out of 52 acquisitions for FGS 3 dominant (10% failure rate).

The reason for this problem with FGS 2 is unknown. On November 19, 1992, the FOS team requested again that FGS 2 not be used as the Dominant FGS. To our knowledge no other instrument has noticed this effect.

IV. Conclusion

Other than the FGS 2 dominant problem, nothing obvious could be determined. A more thorough analysis incorporating all the errors may provide more insight, however the errors would probably

obscure any trends due to FOS aperture location or FGS drift.

More analysis on the FGS 2 behavior is needed, but is beyond the current resources of the FOS Calibration team.

Copies of the Target Pointing SAM log will be made available by the FOS Calibration team. It is on the FOS account on the science cluster in the [fos.ta] directory and is called "gs_acq_presm.log".

Figure Captions

Figure 1: Magnitude of the V2 and V3 pointing offset SAM versus time for all three FGS.

Figure 2: V2 pointing offset SAM versus time for all three FGS.

Figure 3: V3 pointing offset SAM versus time for all three FGS.

Figure 4: Magnitude of the V2 and V3 pointing offset SAM versus time for FGS 1 and FGS 3 dominant.

Figure 5: V2 pointing offset SAM versus time for FGS 1 and FGS 3 dominant.

Figure 6: V3 pointing offset SAM versus time for FGS 1 and FGS 3 dominant.

Figure 7: Magnitude of the V2 and V3 pointing offset SAM versus time for FGS 2 dominant.

Figure 8: V2 pointing offset SAM versus time for FGS 2 dominant.

Figure 9: V3 pointing offset SAM versus time for FGS 2 dominant.

Figure 10: V2 pointing offset SAM versus time for FGS 1 and FGS 3 dominant and calibration target G191-B2B. The pointing errors are minimized because it is with precise pointing Peakup.

Figure 11: V2 pointing offset SAM versus time for FGS 1 and FGS 3 dominant and calibration target G191-B2B. The pointing errors are minimized because it is with precise pointing Peakup.

Figure 12: V3 pointing offset SAM versus time for FGS 1 and FGS 3 dominant and calibration target G191-B2B. The pointing errors are minimized because it is with precise pointing Peakup.

Table 1: All FGSs Mean and Standard Deviation

	V2 (arcsec)	V3 (arcsec)	Magnitude (arcsec)	Number of Points
Red	0.20 ± 0.64	-0.05 ± 0.69	0.84 ± 0.48	238
Blue	0.24 ± 0.66	-0.02 ± 0.58	0.76 ± 0.49	307
Both			0.80 ± 0.49	545

Table 2: FGS 1 and 3 Mean and Standard Deviation

	V2 (arcsec)	V3 (arcsec)	Magnitude (arcsec)	Number of Points
Red	0.13 ± 0.61	-0.06 ± 0.70	0.81 ± 0.48	221
Blue	0.20 ± 0.61	-0.03 ± 0.58	0.73 ± 0.47	287
Both			0.76 ± 0.48	508

Table 3: FGS 1 Mean and Standard Deviation

	V2 (arcsec)	V3 (arcsec)	Magnitude (arcsec)	Number of Points
Red	-0.11 ± 0.54	-0.29 ± 0.61	0.73 ± 0.47	106
Blue	-0.03 ± 0.51	-0.29 ± 0.57	0.69 ± 0.40	134
Both			0.71 ± 0.44	240

Table 4: FGS 2 Mean and Standard Deviation

	V2 (arcsec)	V3 (arcsec)	Magnitude (arcsec)	Number of Points
Red	1.11 ± 0.29	-0.01 ± 0.60	1.26 ± 0.25	20
Blue	0.88 ± 0.92	0.13 ± 0.55	1.28 ± 0.50	17
Both			1.27 ± 0.40	37

Table 5: FGS 3 Mean and Standard Deviation

	V2 (arcsec)	V3 (arcsec)	Magnitude (arcsec)	Number of Points
Red	0.36 ± 0.59	0.16 ± 0.71	0.88 ± 0.48	115
Blue	0.40 ± 0.63	0.15 ± 0.52	0.75 ± 0.53	153
Both			0.81 ± 0.51	268

Table 6: G191-B2B FGS 1 & 3 Mean and Standard Deviation

	V2 (arcsec)	V3 (arcsec)	Magnitude (arcsec)	Number of Points
Red	0.20 ± 0.47	-0.58 ± 0.29	0.76 ± 0.26	7
Blue	0.10 ± 0.66	-0.18 ± 0.74	0.73 ± 0.09	2
Both			0.75 ± 0.23	9

Figure 1 FOS Acquisition Pointing Offsets vs Time For All FGS

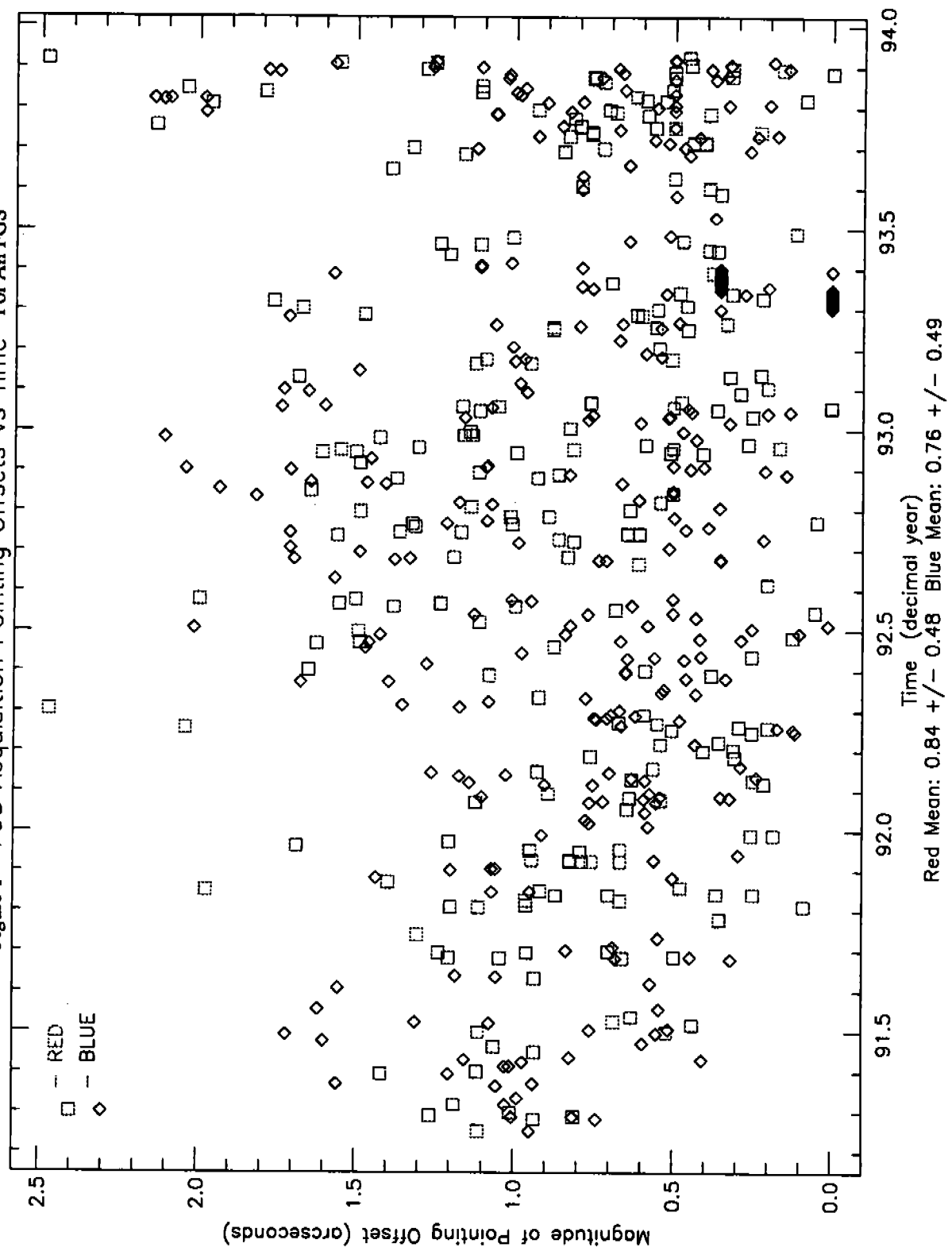


Figure 2 FOS V2 Acquisition Pointing Offsets vs Time For All FGS

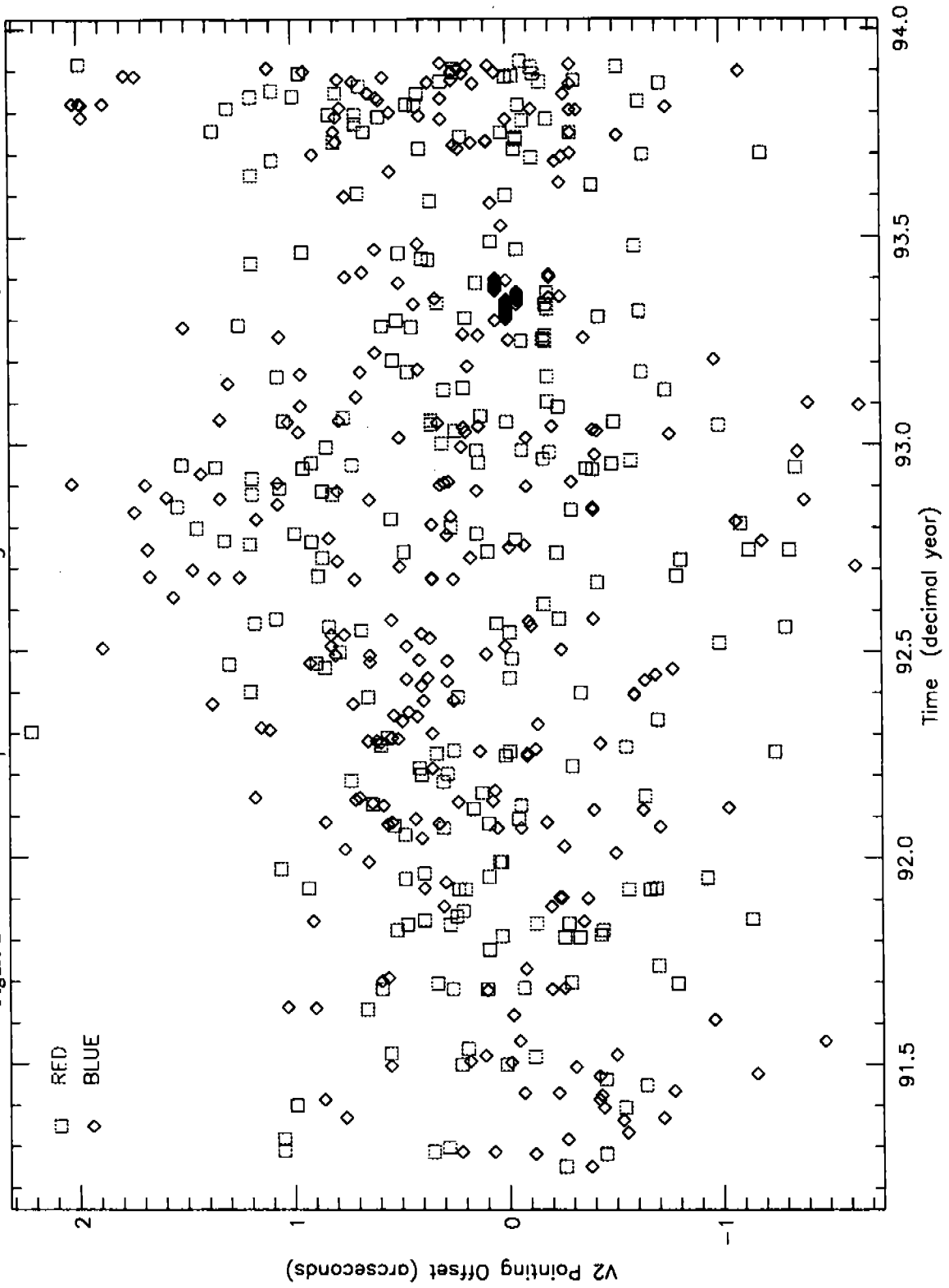


Figure 3 FOS V3 Acquisition Pointing Offsets vs Time For All FGS

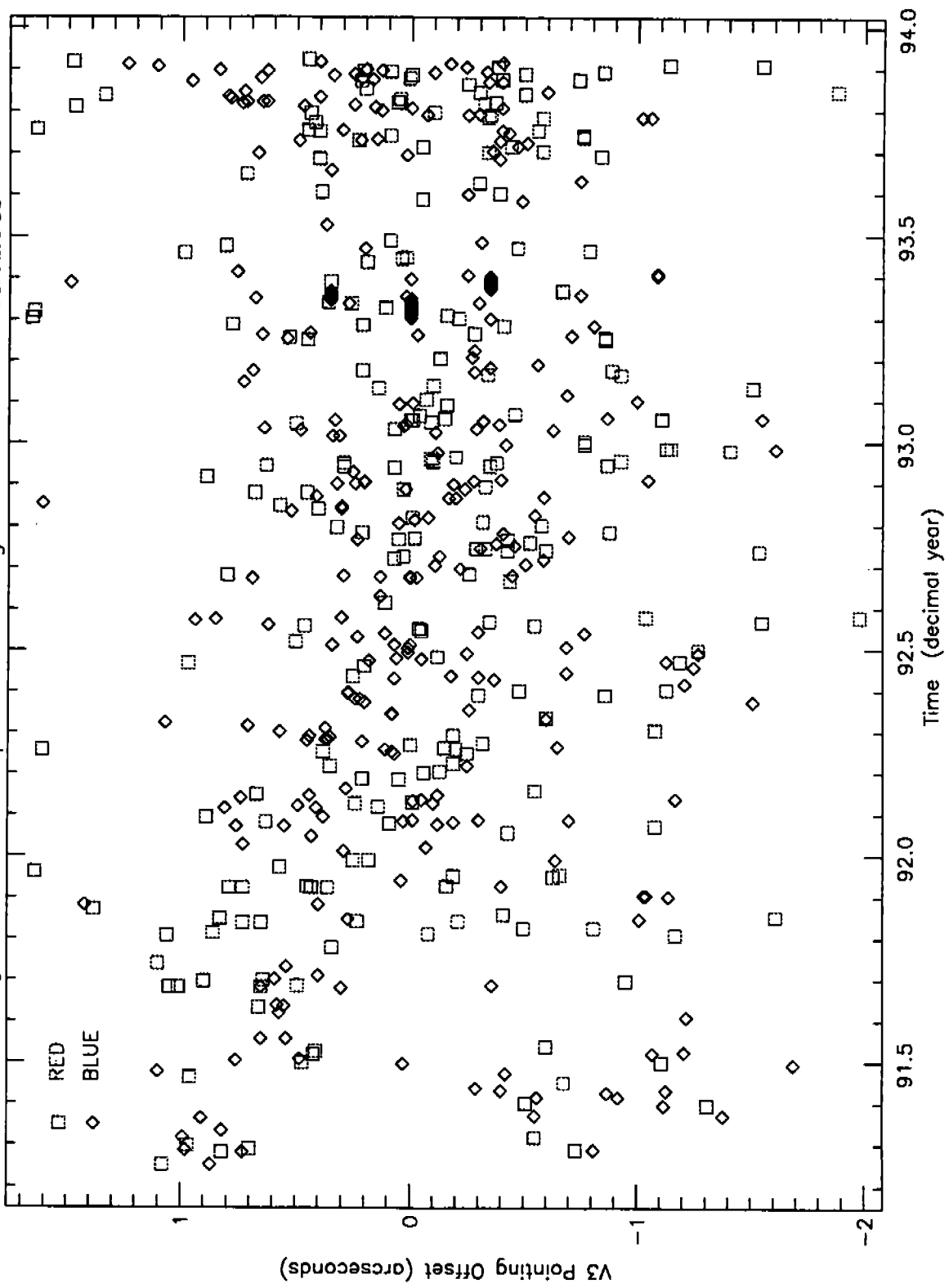


Figure 4 FOS Acquisition Pointing Offsets vs Time For FGS 1 & 3

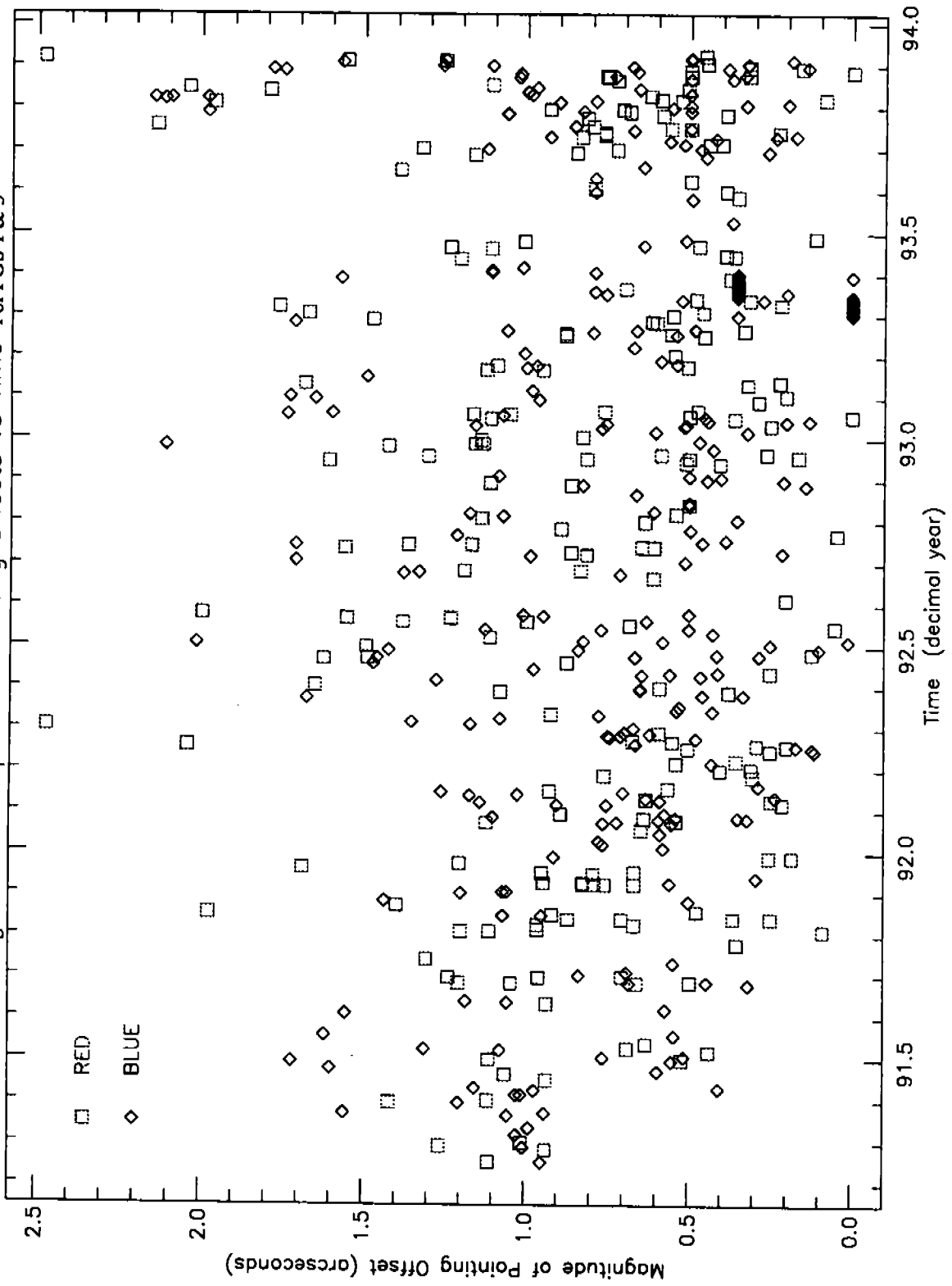


Figure 5 FOS V2 Acquisition Pointing Offsets vs Time For FGS 1 & 3

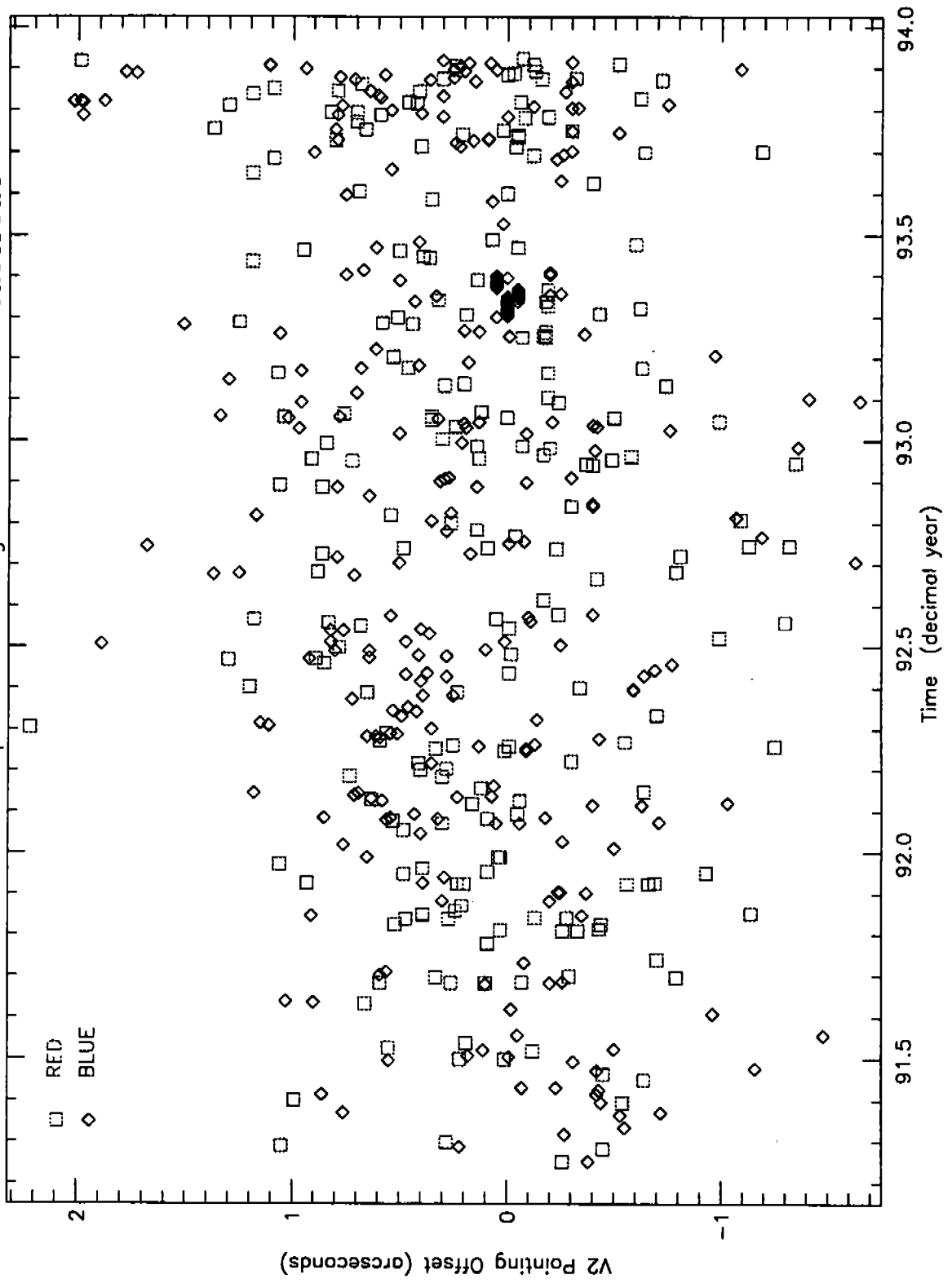


Figure 6 FOS V3 Acquisition Pointing Offsets vs Time For FGS 1 & 3

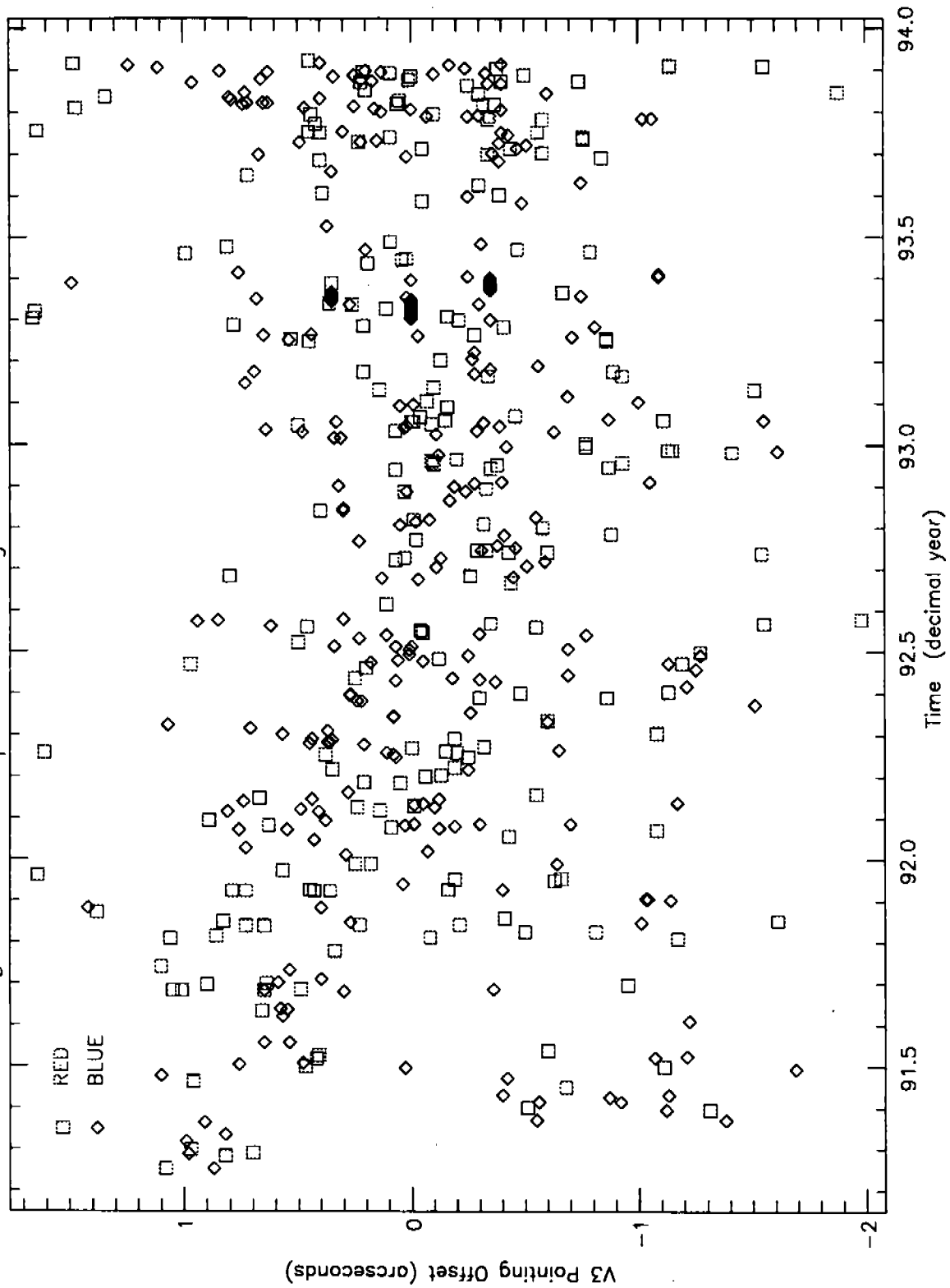


Figure 7 FOS Acquisition Pointing Offsets vs Time For FGS 2

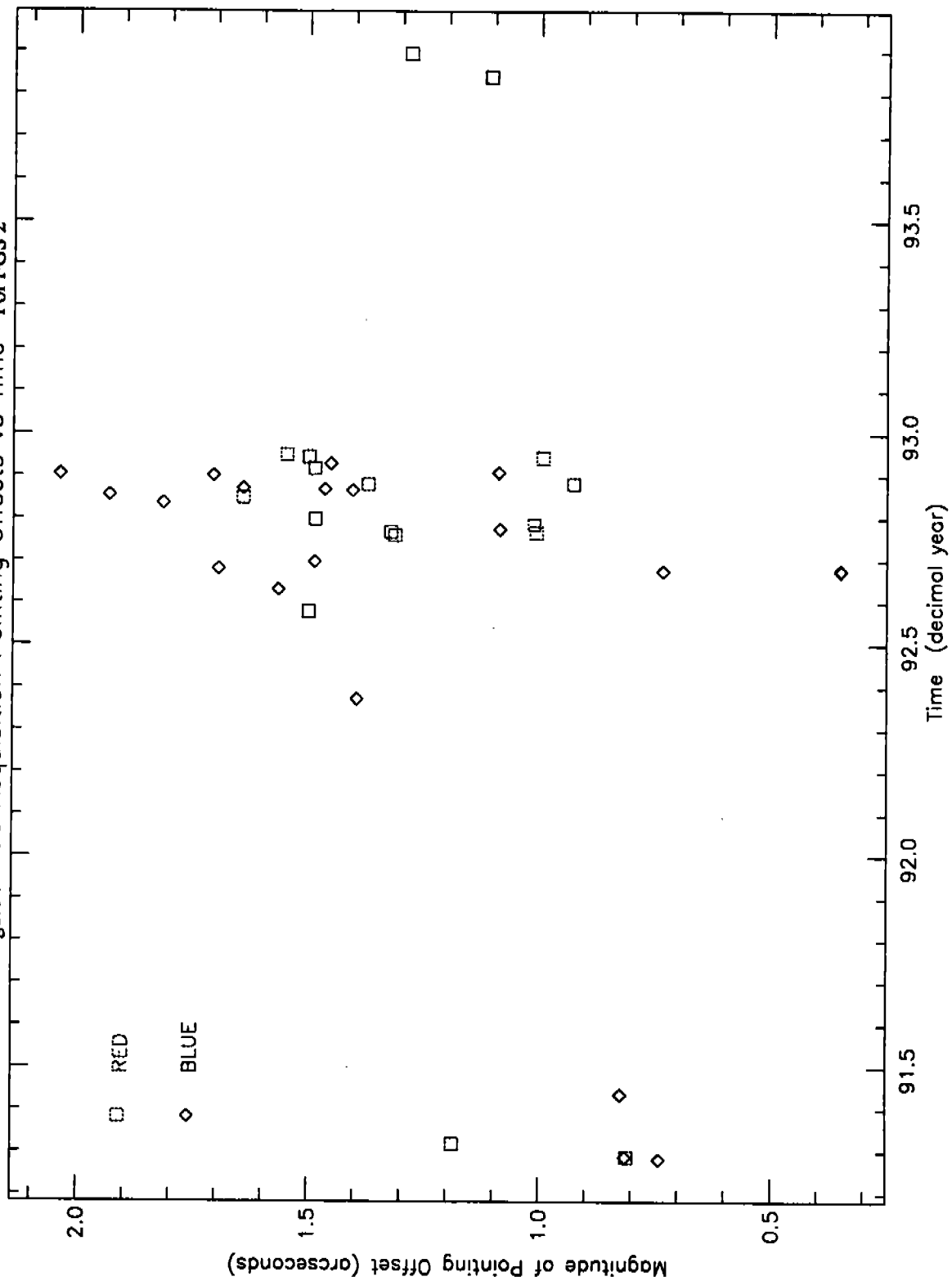


Figure 8 FOS V2 Acquisition Pointing Offsets vs Time For FGS2

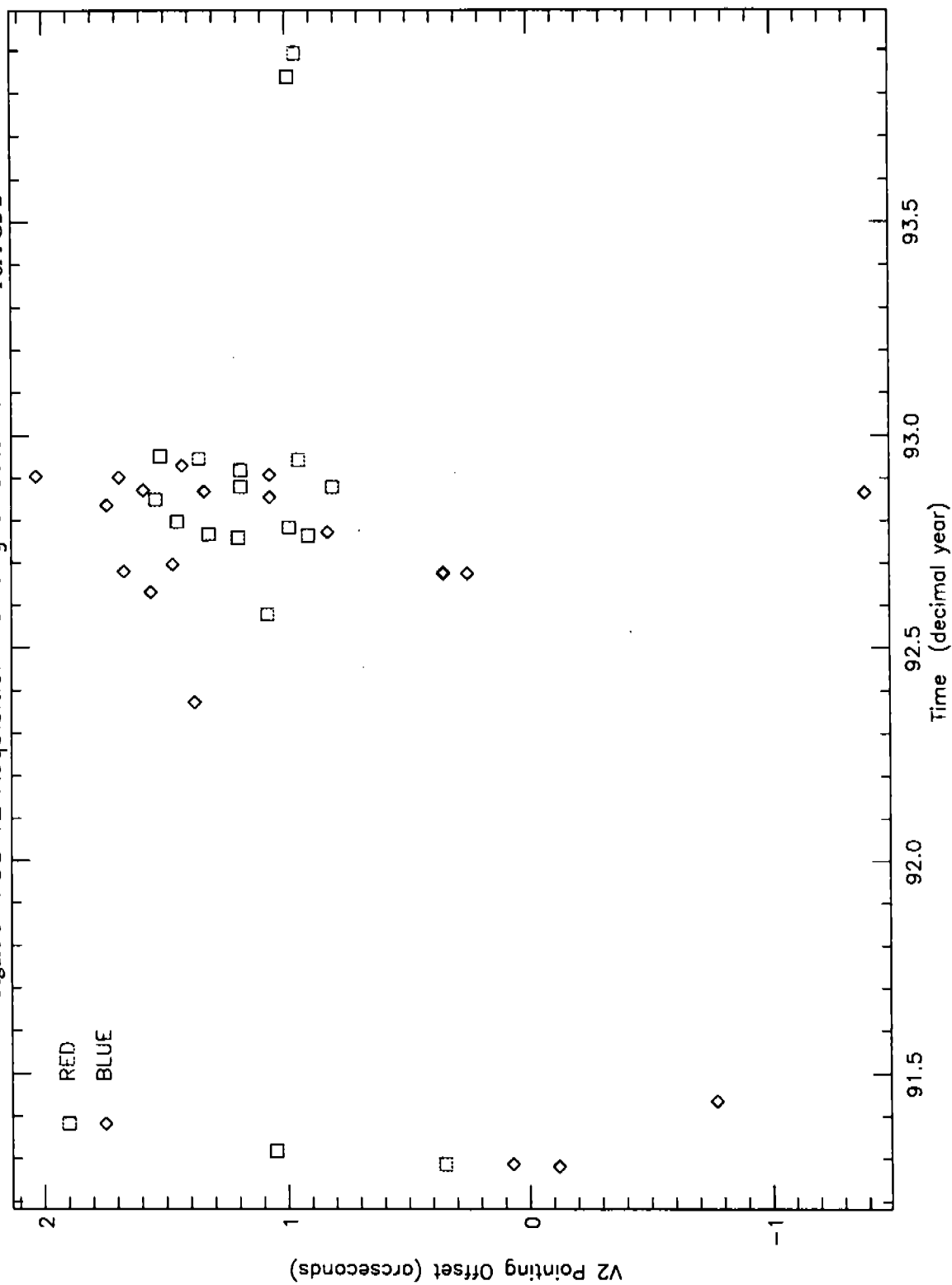


Figure 9 FOS V3 Acquisition Pointing Offsets vs Time For FGS 2

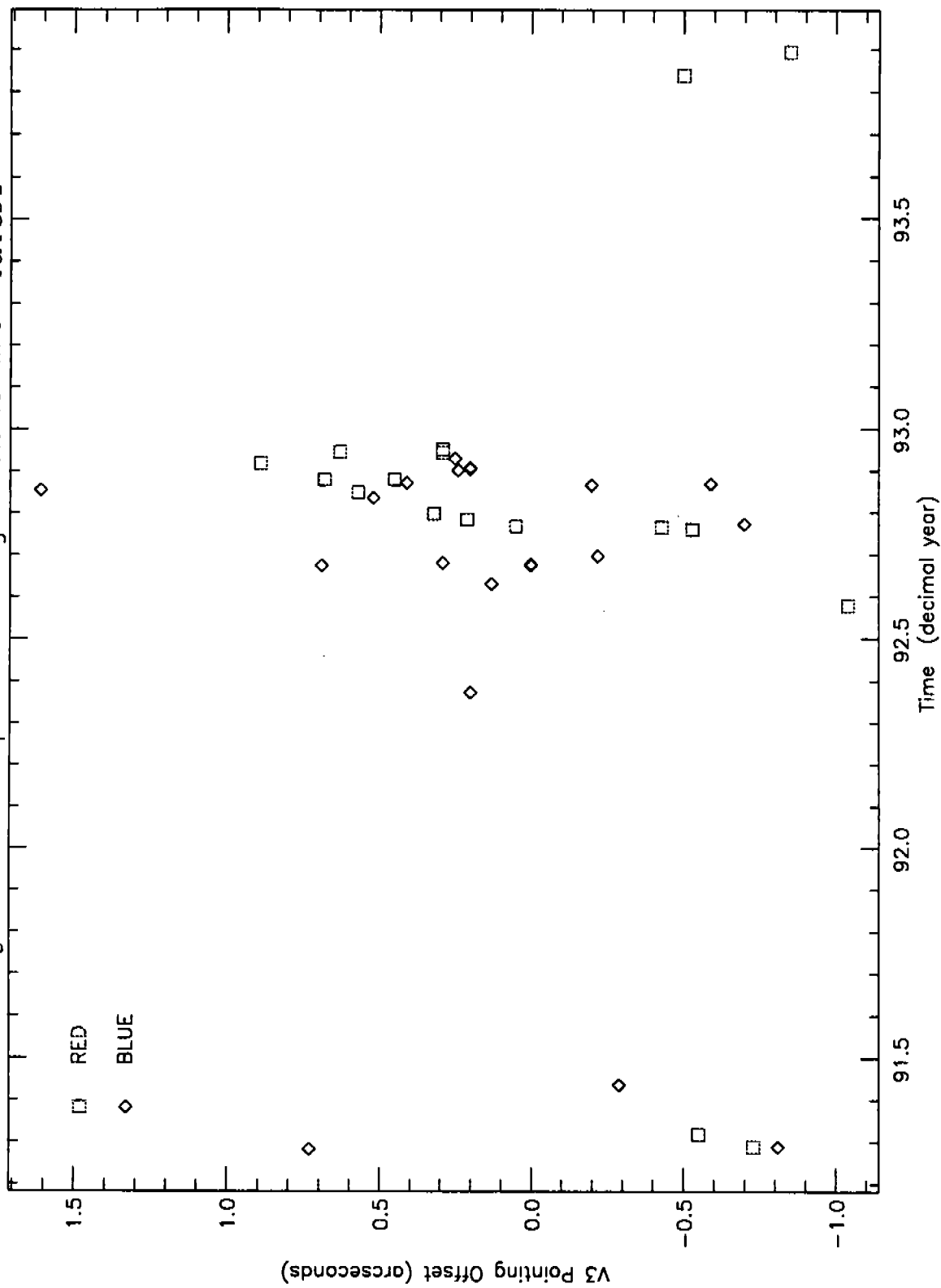


Figure 10 FOS Acquisition Pointing Offsets vs Time for G191-B2B

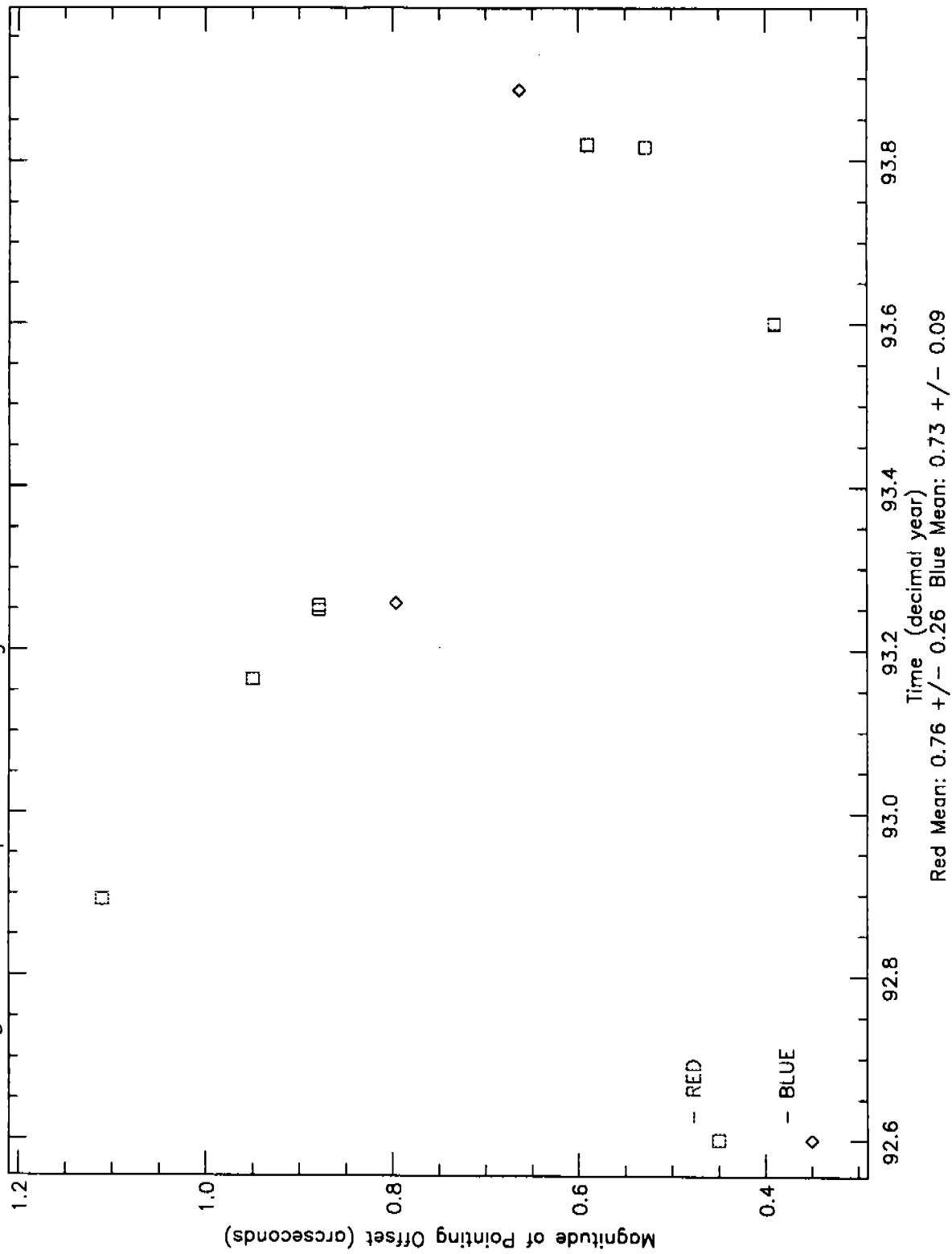


Figure 11 FOS V2 Acquisition Pointing Offsets vs Time for G191-B2B

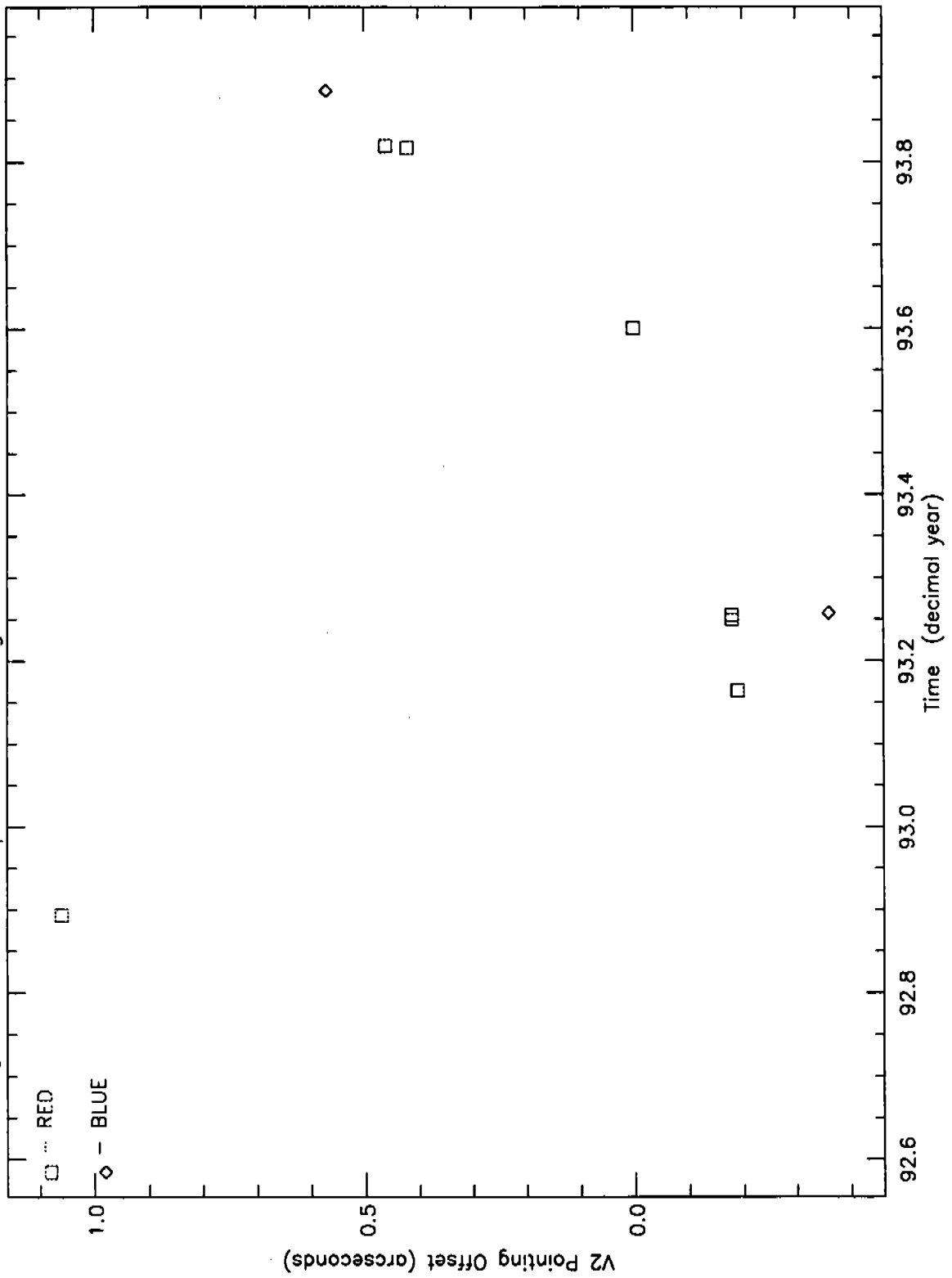


Figure 12 FOS V3 Acquisition Pointing Offsets vs Time for G191-B2B

