

Inspired by the successes achieved by Cam Wade for the VLA, I have included some extra terms in the pointing equation in the VLBA pointing analysis program PTANAL. All of the terms are listed below. Previously, only the first 6 were used and that is all that the on-line system understands. The attached figures show a sample of early results. They are:

- Figure 1: 4cm data, April 26-30, 1991. Old style 6 parameter fit.
- Figure 2: Same data, new 13 parameter fit (no axis non-perpendicularity)
- Figure 3: 4cm data, May 2. Old style 6 parameter fit.
- Figure 4: May 2 data, April 26-29 parameters forced. Fit only for colimation offsets (az did not change, el was different by 5 arcseconds).
- Figure 5: 1cm data, May 14. Old style 6 parameter fit.
- Figure 6: May 14 data, 13 parameter fit (no axis non-perp.).
- Figure 7: May 14 data, April 26-29 paramaters forced. Fit only for colimation offsets.

It seems clear that major improvements in pointing can be made by including the two theta terms and the encoder axis offsets. The axis perpendicularity term might as well be added at the same time since it might be needed some day. From examination of the plots, I suspect that more terms may be needed but this will require considerable further study. We may need to resort to a lookup table for track roughness, something that is provided for in the ACU.

One problem with introducing the new terms is that some are highly correlated so the fit results may not be very meaningful physically. This is true for the sag, colimation offset, and encoder axis offset in elevation and for the encoder offset, the colimation offset, and the axis non-perpendicularity in azimuth. The basic problem is that we sample less than a quarter turn in elevation.

The terms:	Term	Functional Form.	
		Az	El
1.	West Tilt	$\cos(Az) \sin(El)$	$-\sin(Az)$
2.	North Tilt	$\sin(Az) \sin(El)$	$\cos(Az)$
3.	Az. Encoder Offset	1.0	---
4.	Az. Colimation Offset	$\cos(El)$	---
5.	Sag	---	$\cos(El)$
6.	El. Colimation Offset	---	1.0
7.	Two Theta terms	$\cos(2Az) \cos(El)$	---
8.	"Potato Chip" terms	$\sin(2Az) \cos(El)$	---
9.		---	$\cos(2Az)$
10.		---	$\sin(2Az)$
11.	Axis Non-perpendicularity	$\sin(El)$	---
12.	Az encoder axis offset	$\cos(Az) \cos(El)$	---
13.		$\sin(Az) \cos(El)$	---
14.	El encoder axis offset	---	$\sin(El)$

Note: The  $\cos(El)$  term of the El encoder offset is degenerate with the sag. The El encoder offset and El colimation offset are also degenerate.

PT 4cm

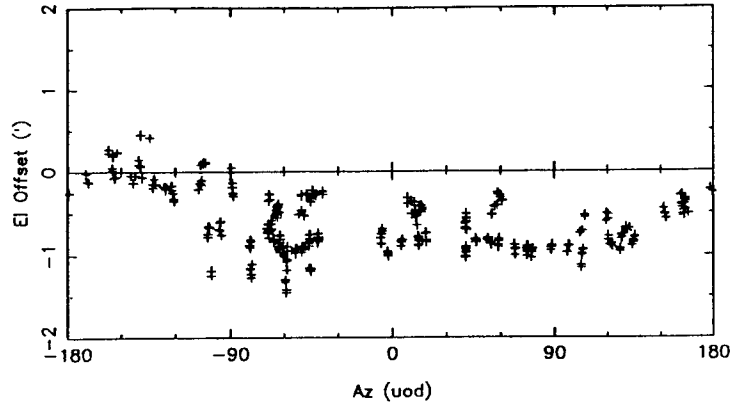
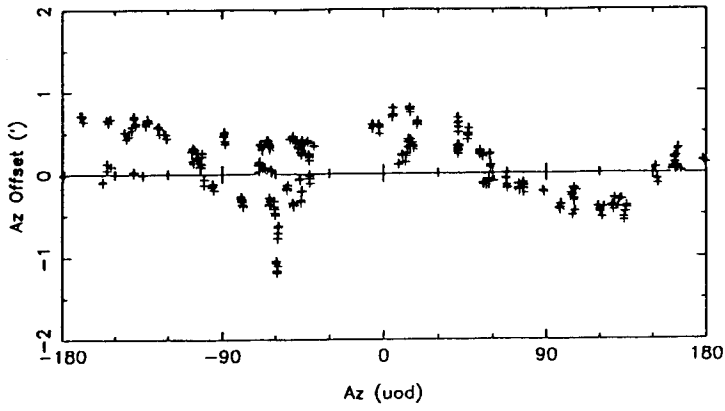
29 Apr 1991

C. Walker

6 Parameter Fit

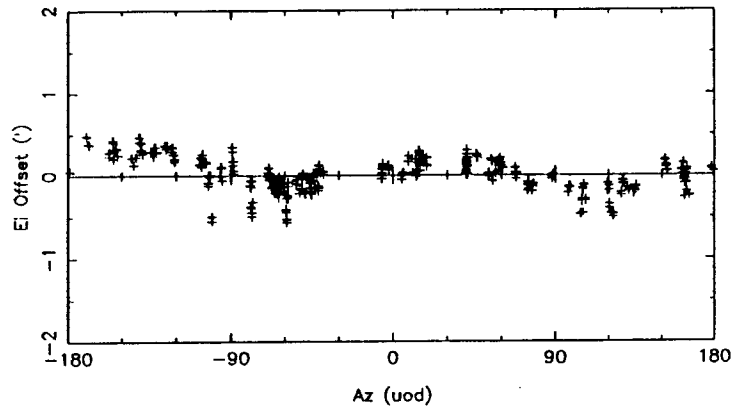
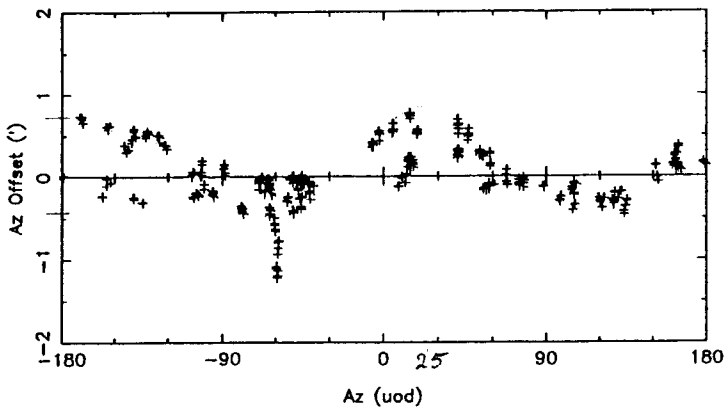
AZ PREFIT

EL PREFIT



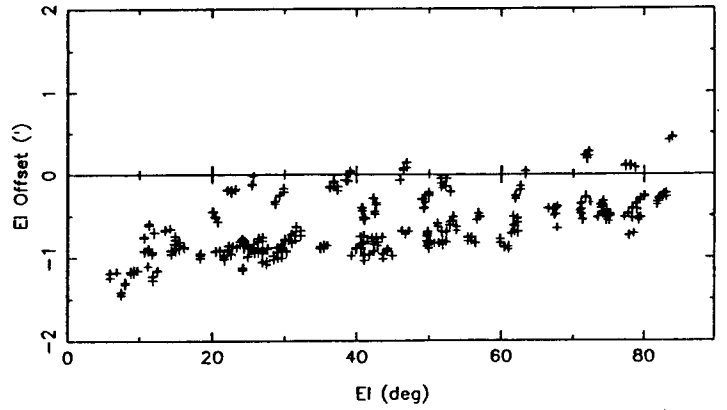
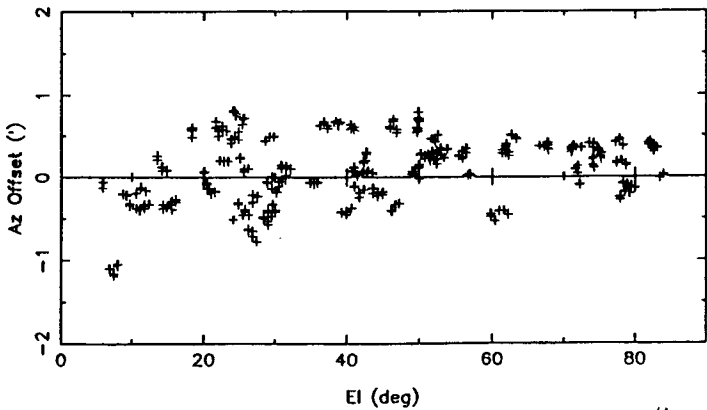
AZ POSTFIT

EL POSTFIT



AZ PREFIT

EL PREFIT



AZ POSTFIT RMS 211"

EL POSTFIT RMS 12.0"

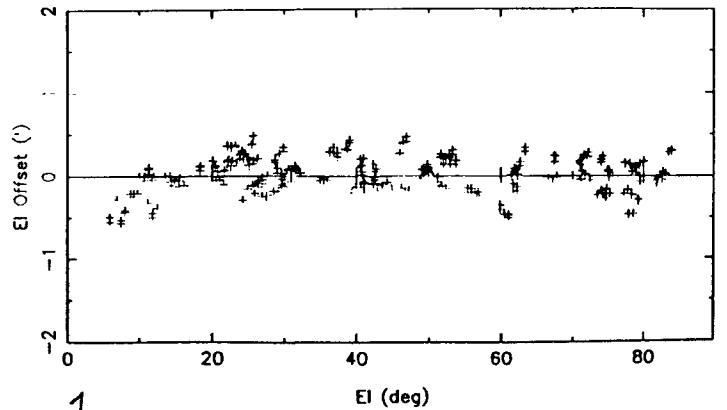
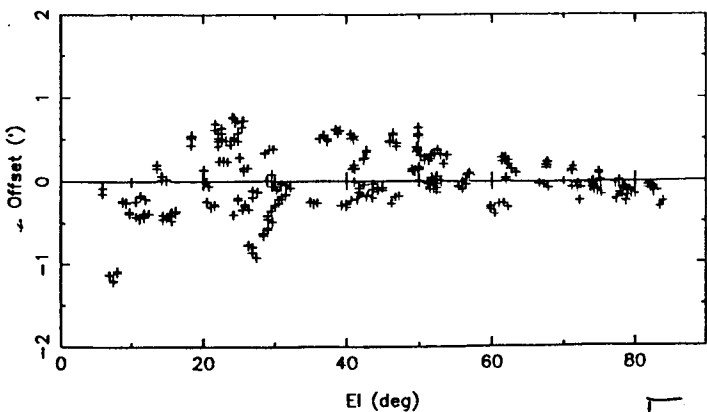


Figure 1

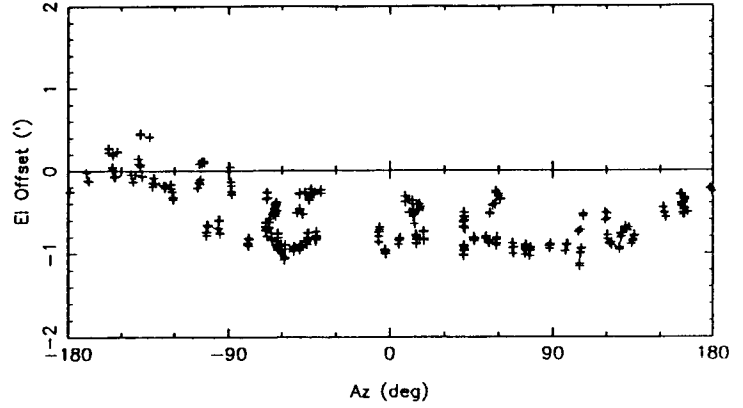
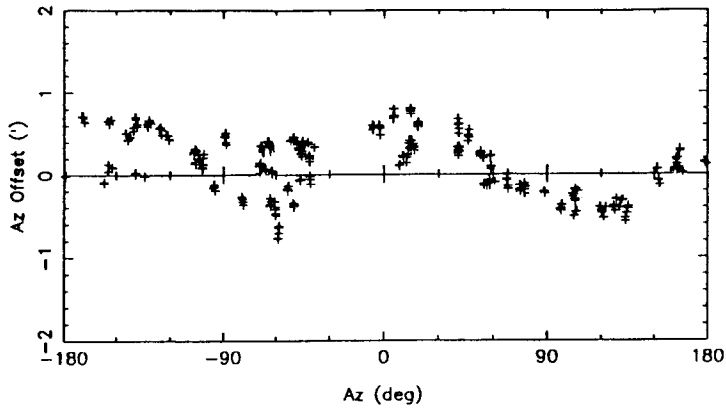
PT 4cm

29 Apr 1991

13 Parameter Fit

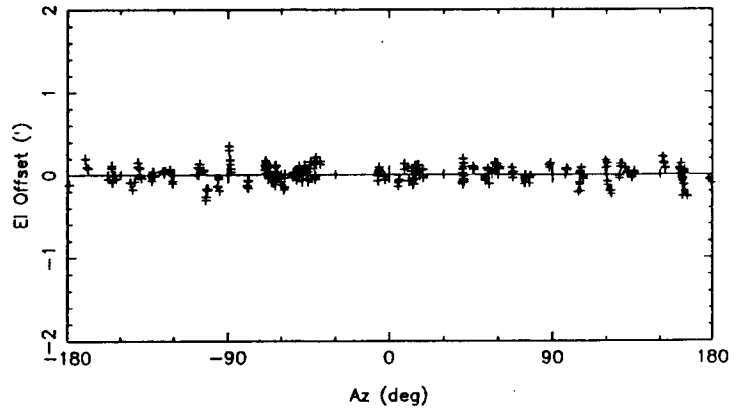
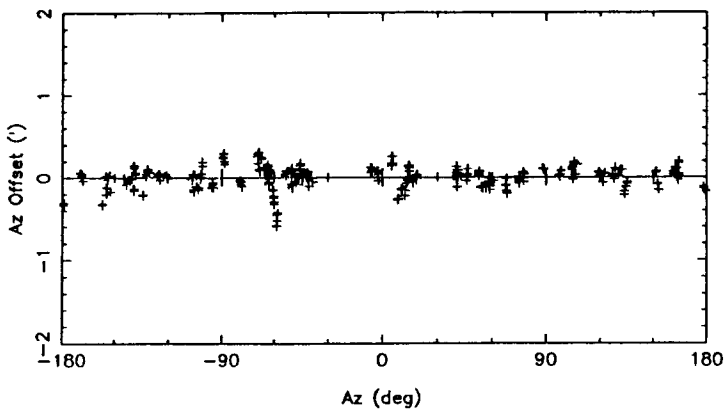
AZ PREFIT

EL PREFIT



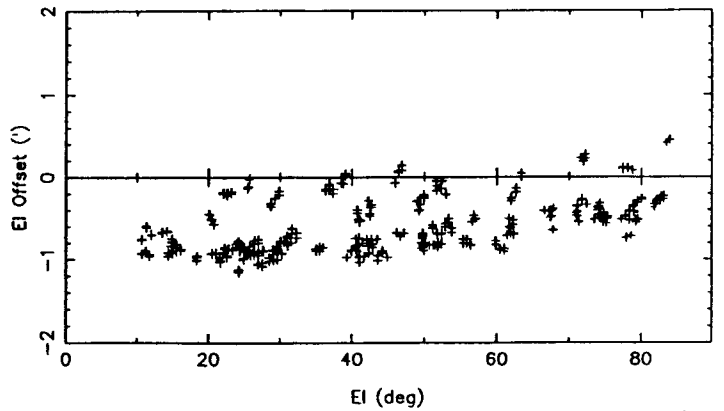
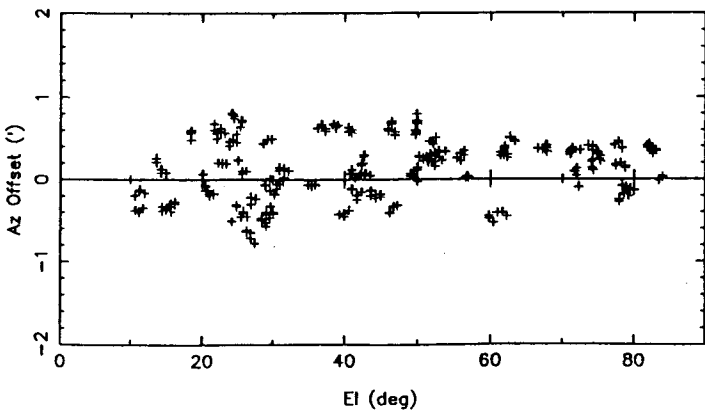
AZ POSTFIT

EL POSTFIT



AZ PREFIT

EL PREFIT



AZ POSTFIT *Rms 7.6"*

EL POSTFIT *Rms 6.1"*

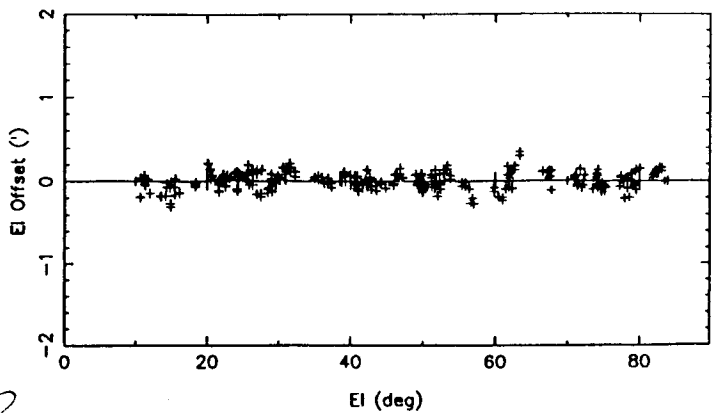
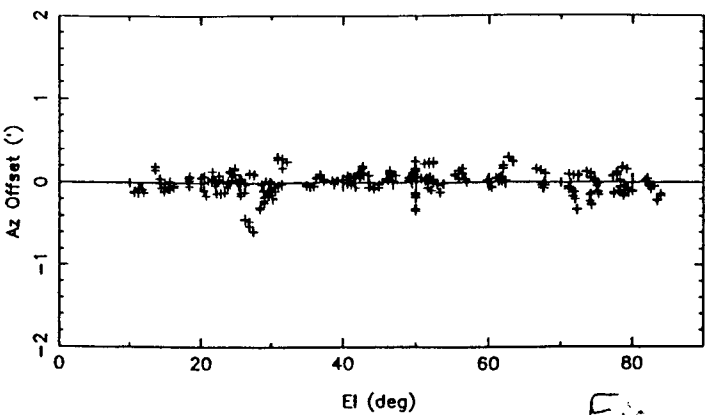


Figure 2

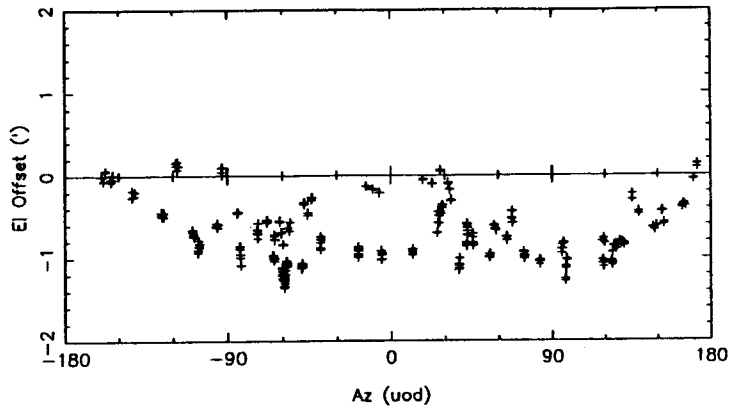
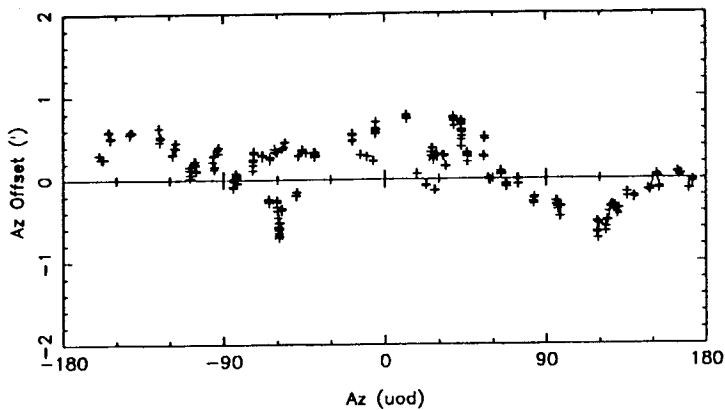
PT 4cm

2 May 1991

6 Parameter-Fit

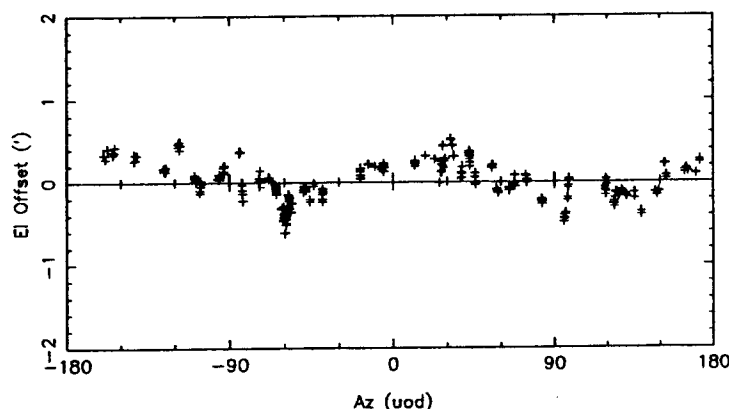
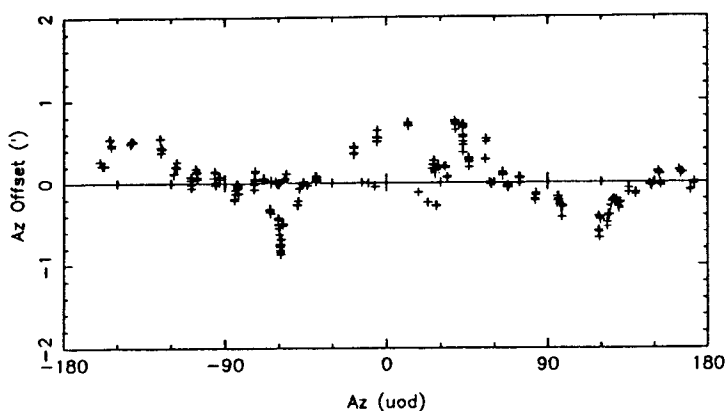
AZ PREFIT

EL PREFIT



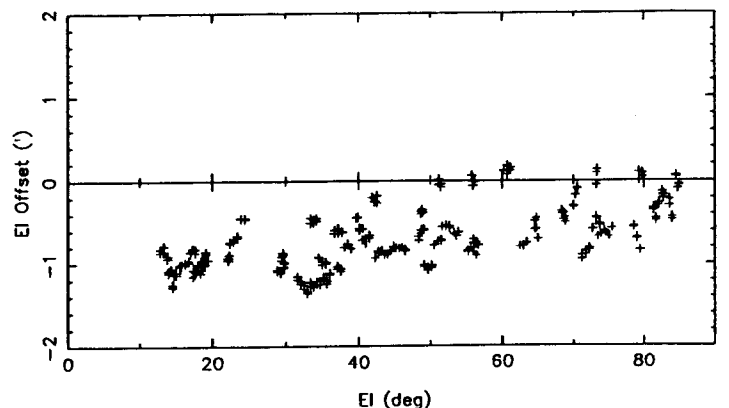
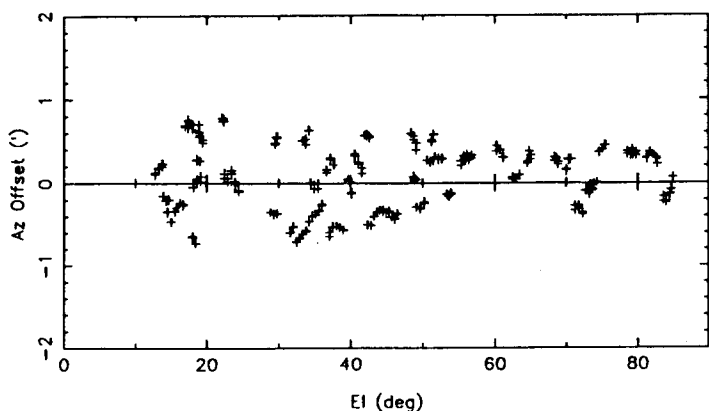
AZ POSTFIT

EL POSTFIT



AZ PREFIT

EL PREFIT



AZ POSTFIT RMS 21.0"

EL POSTFIT RMS 14.2"

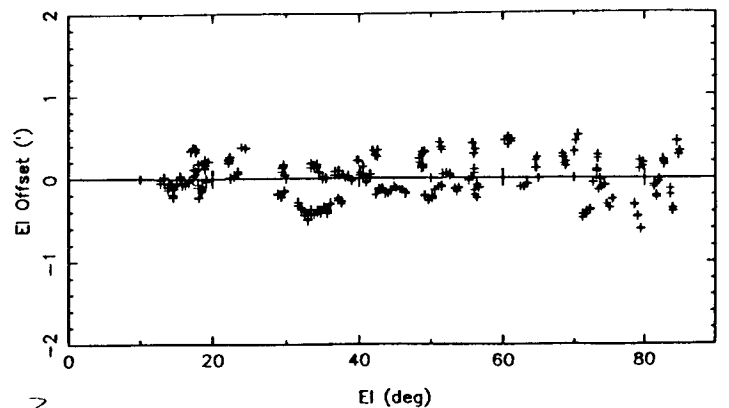
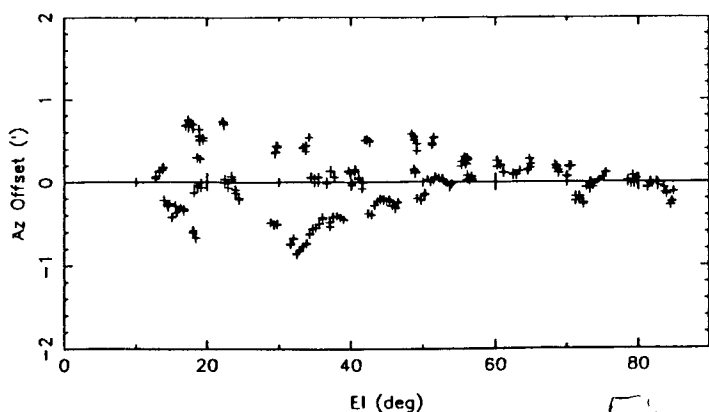


Figure 3

Force II parameters from April 26-30 results

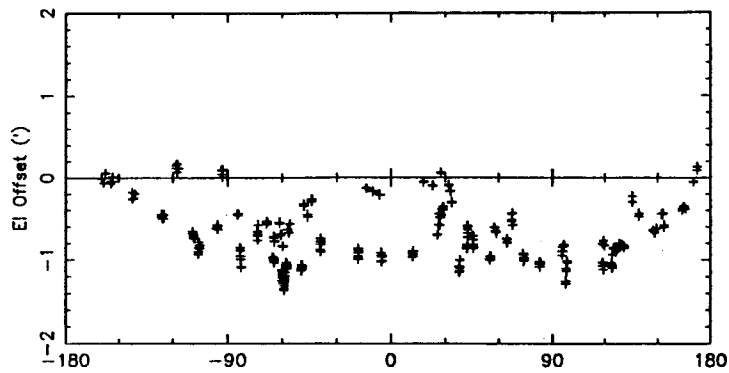
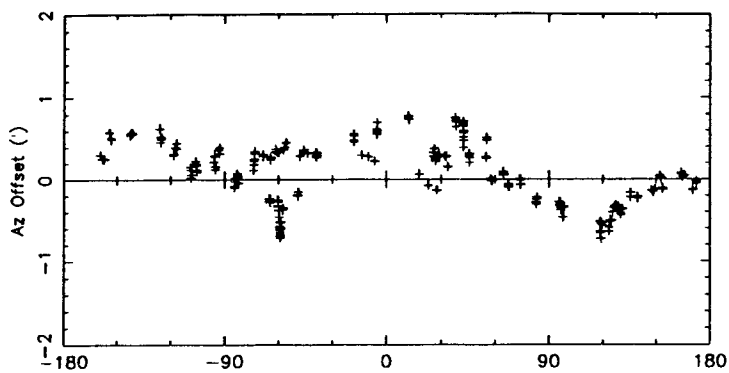
PT 4cm

2 May 1991

Fit colimation offsets only

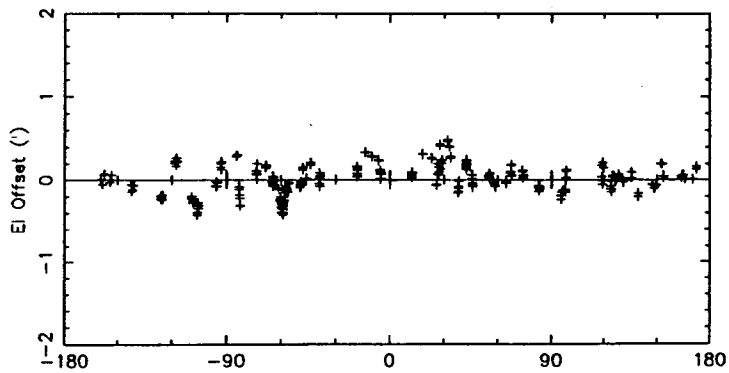
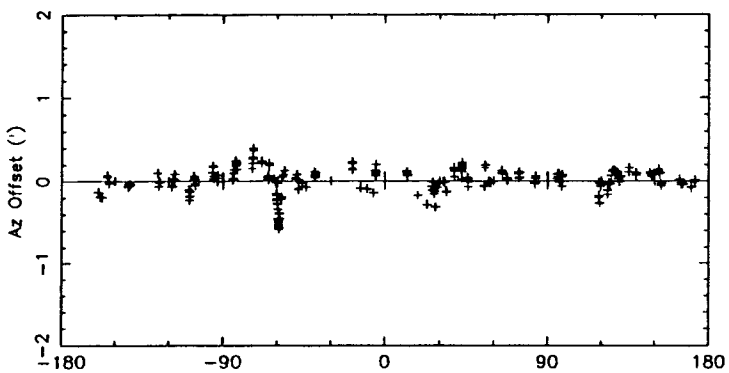
AZ PREFIT

EL PREFIT



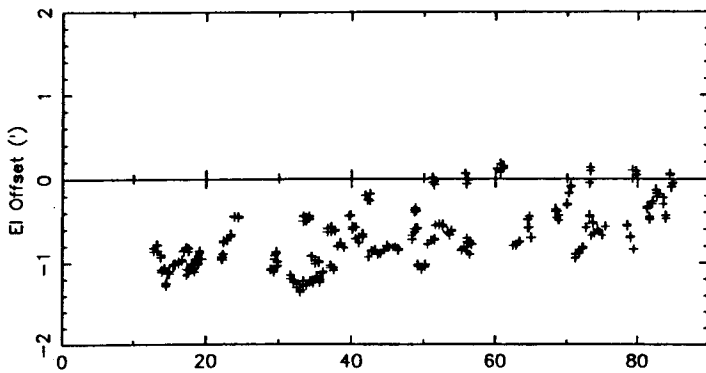
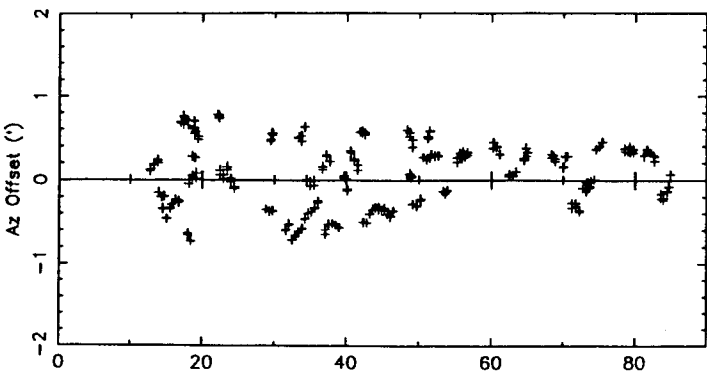
AZ POSTFIT

EL POSTFIT



AZ PREFIT

EL PREFIT



AZ POSTFIT

EL POSTFIT

Rms 9.5"

Rms 10.4"

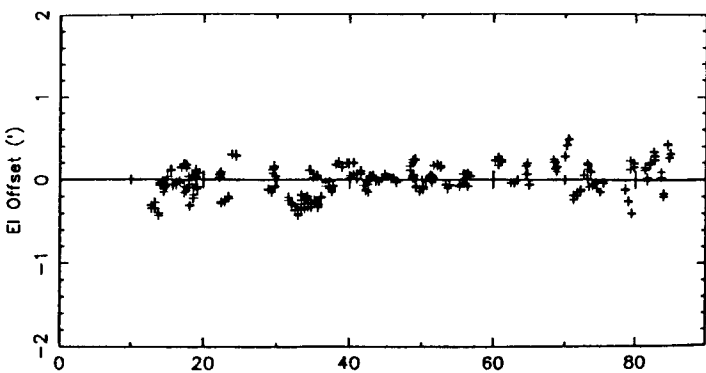
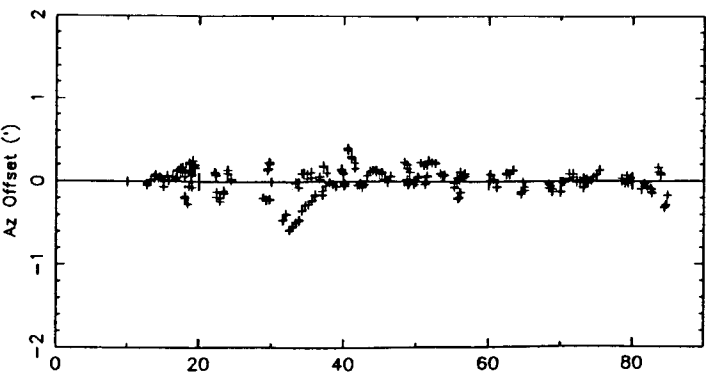
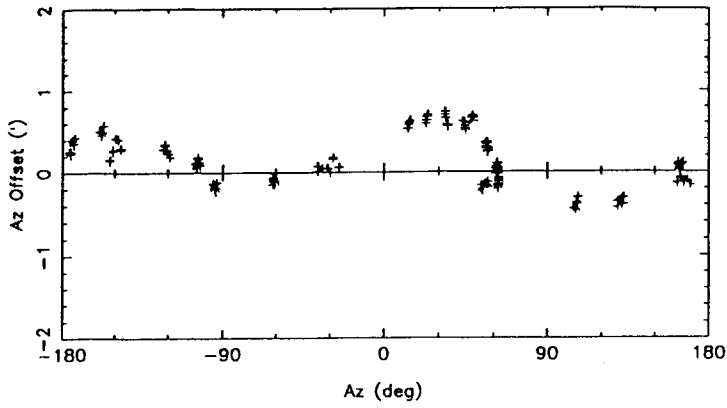


Figure 4

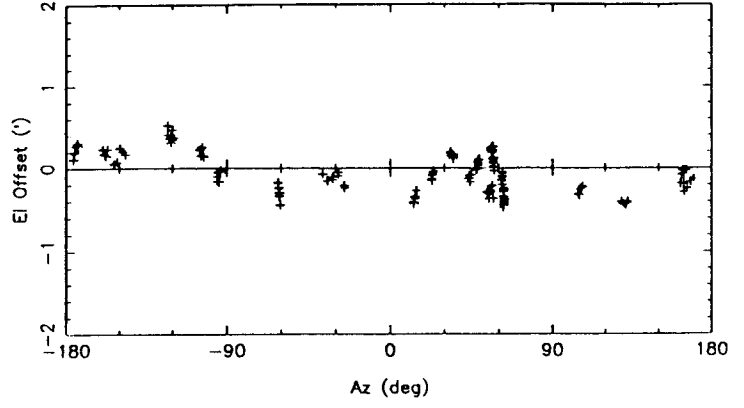
PT 1cm

14 May 1991

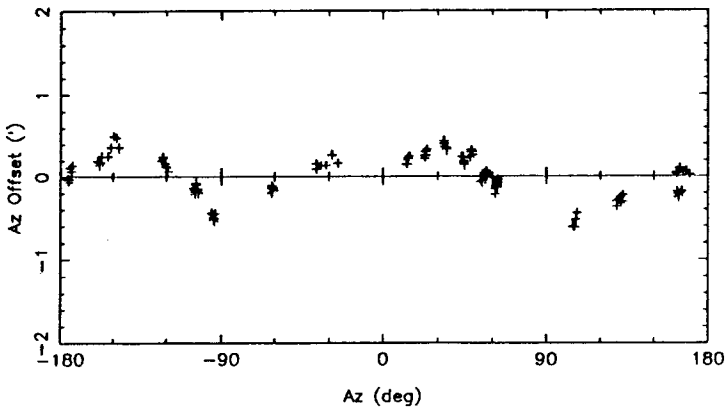
AZ PREFIT



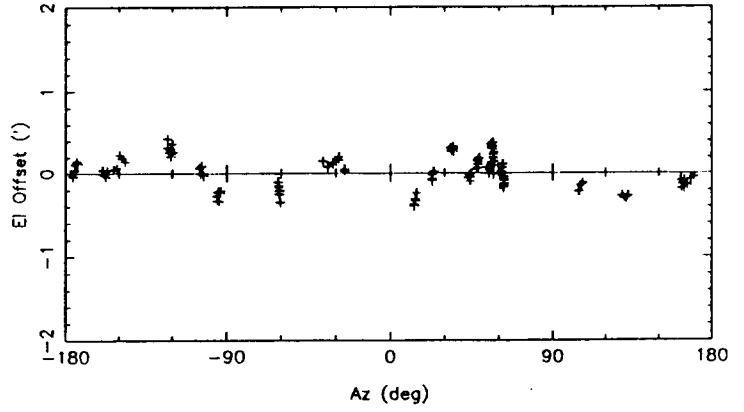
EL PREFIT



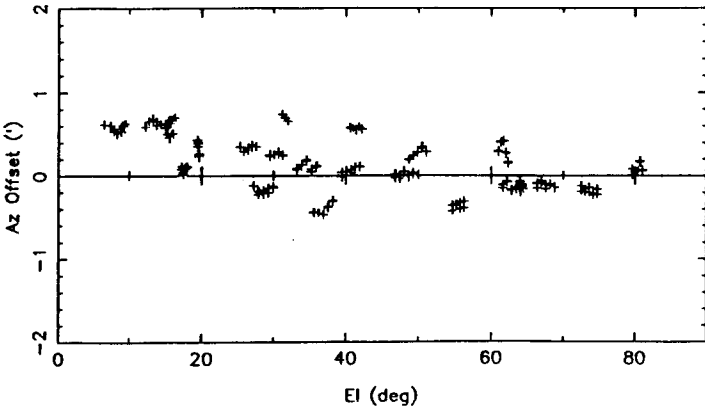
AZ POSTFIT



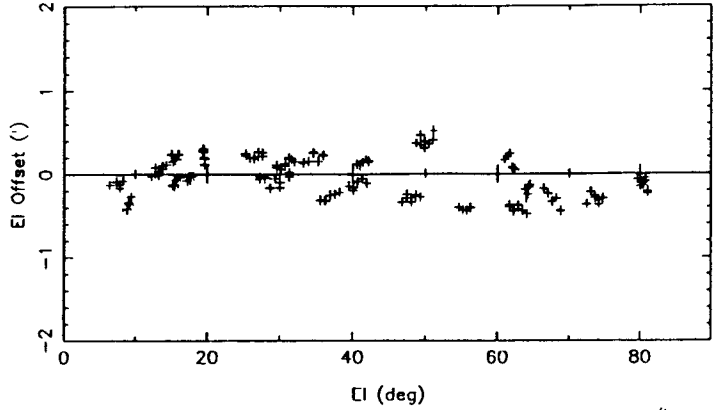
EL POSTFIT



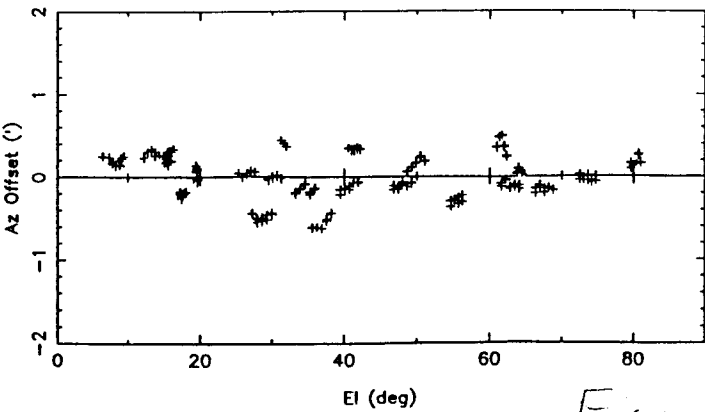
AZ PREFIT



EL PREFIT



AZ POSTFIT *RMS 15.2"*



EL POSTFIT *RMS 11.6"*

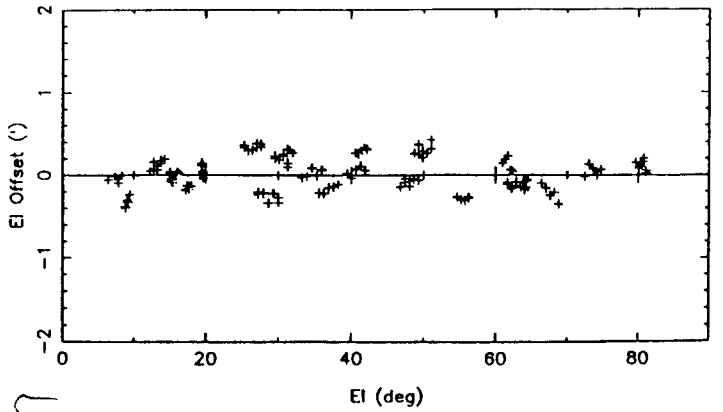
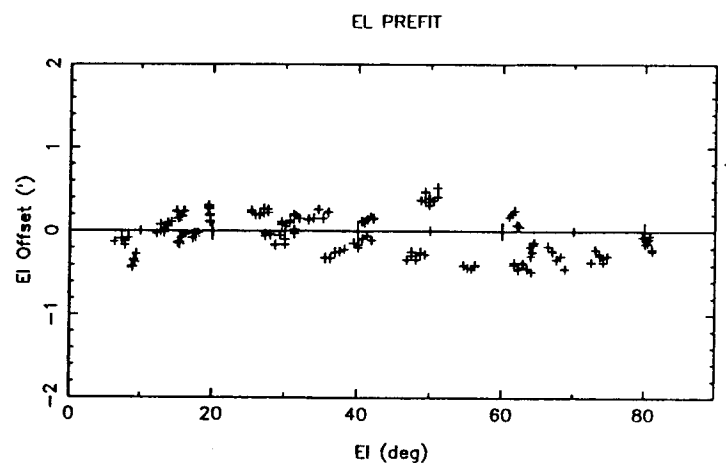
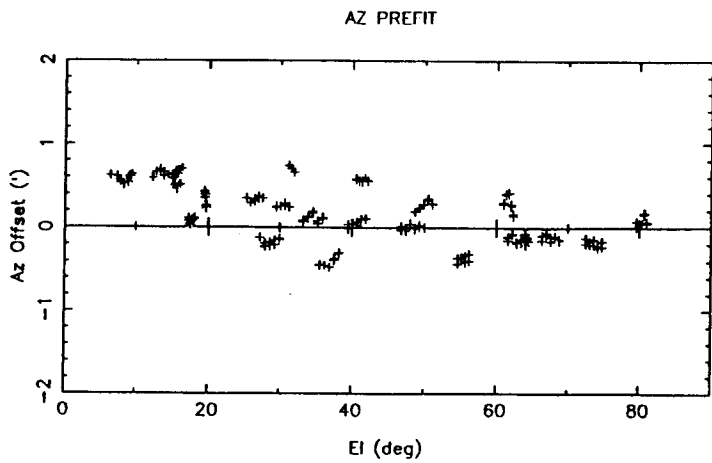
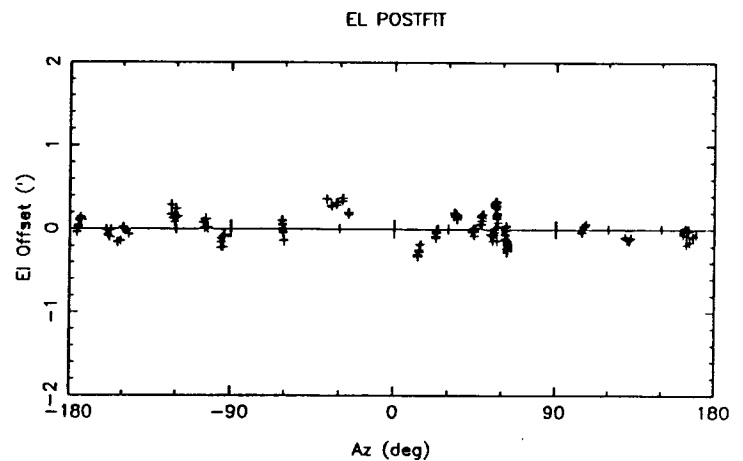
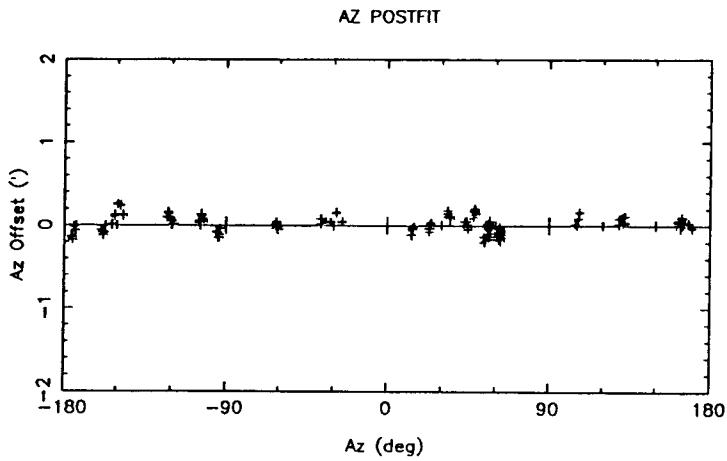
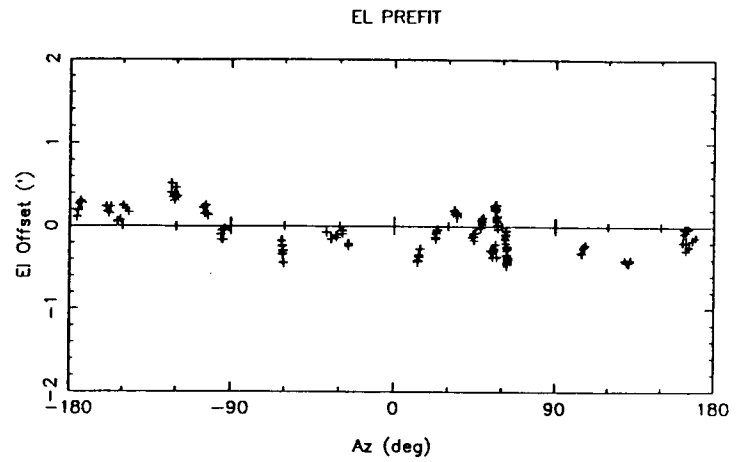
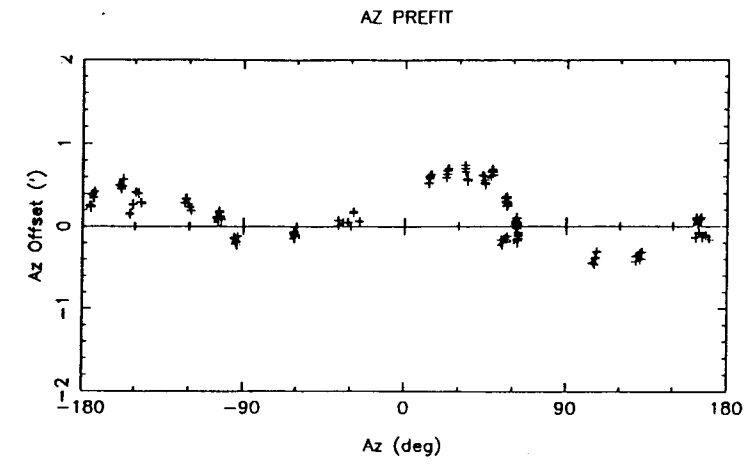


Figure 5

PT 1cm

14 May 1991

13 Parameter Fit



AZ POSTFIT *Rms 5.9"*

EL POSTFIT *Rms 9.3"*

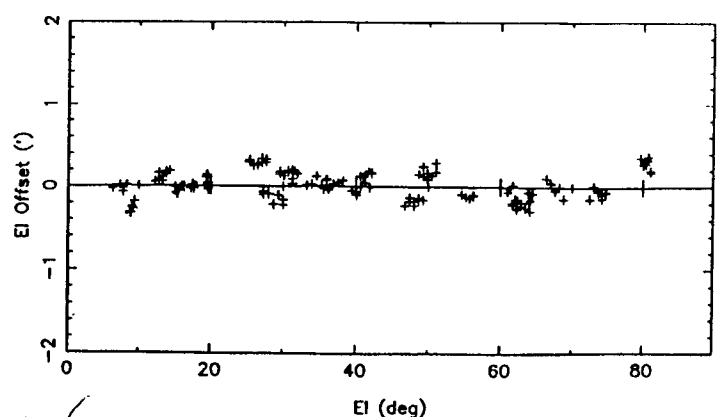
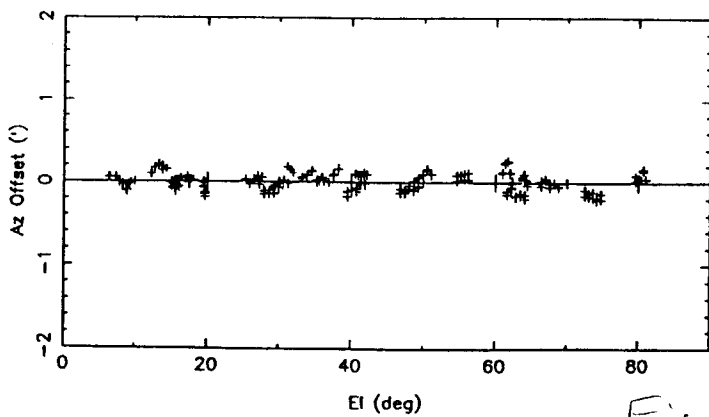
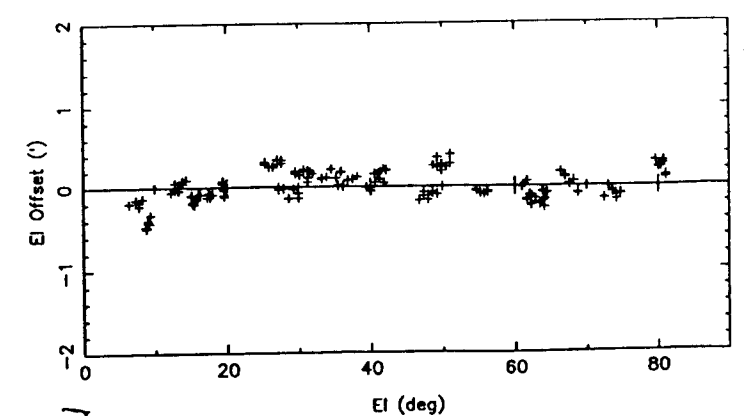
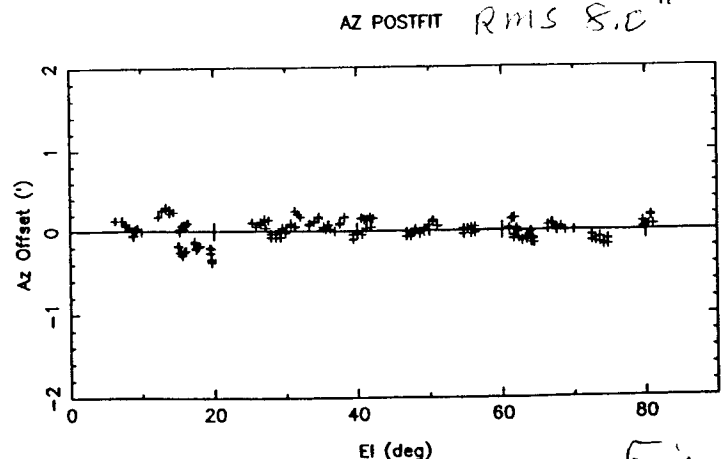
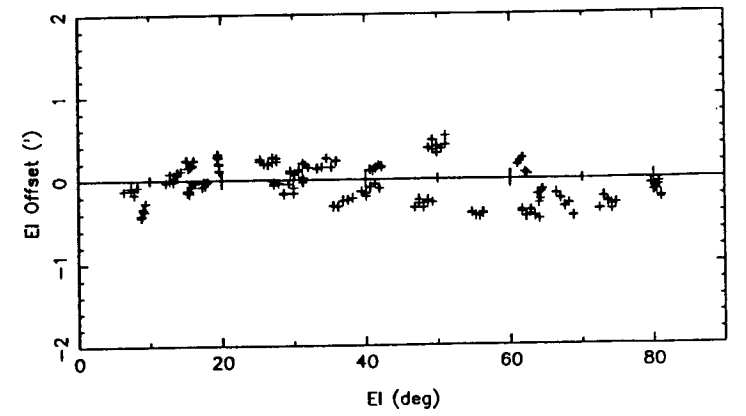
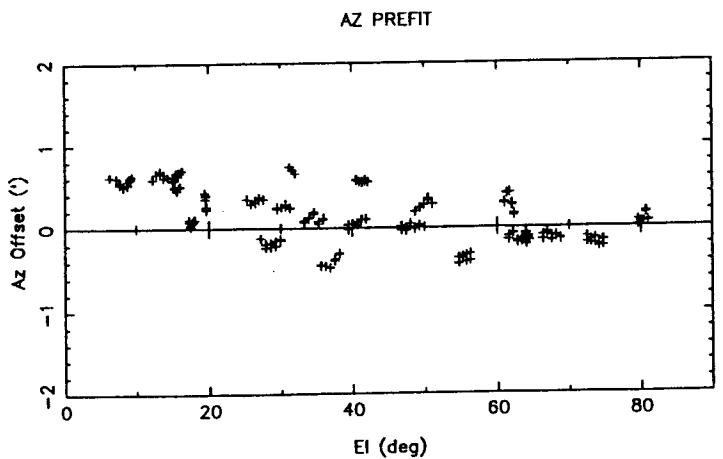
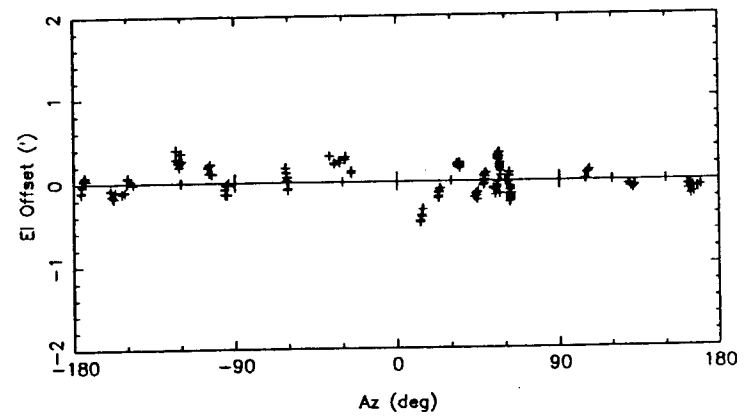
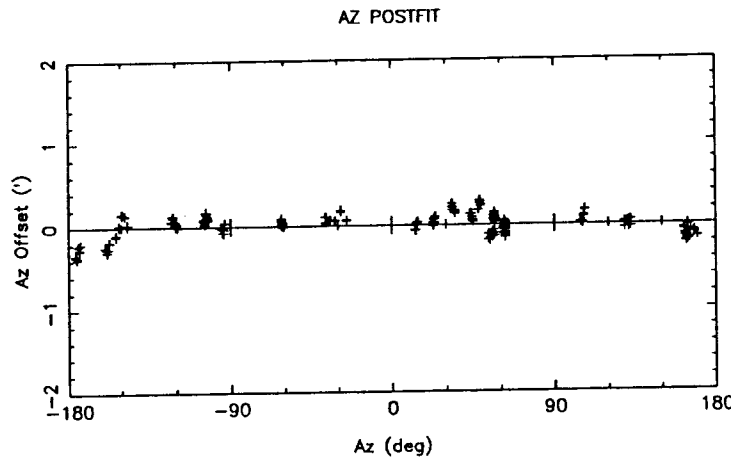
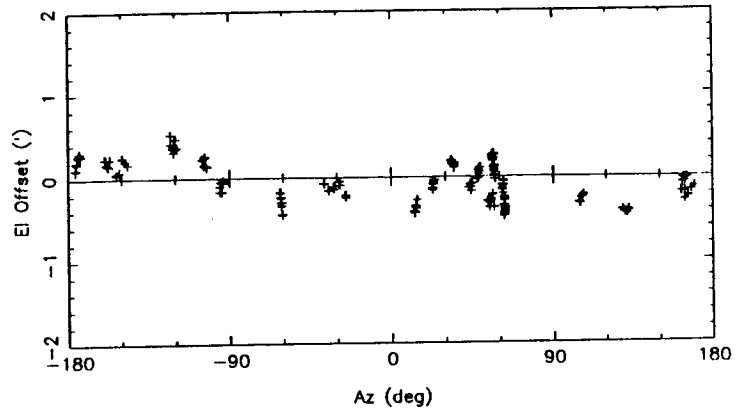
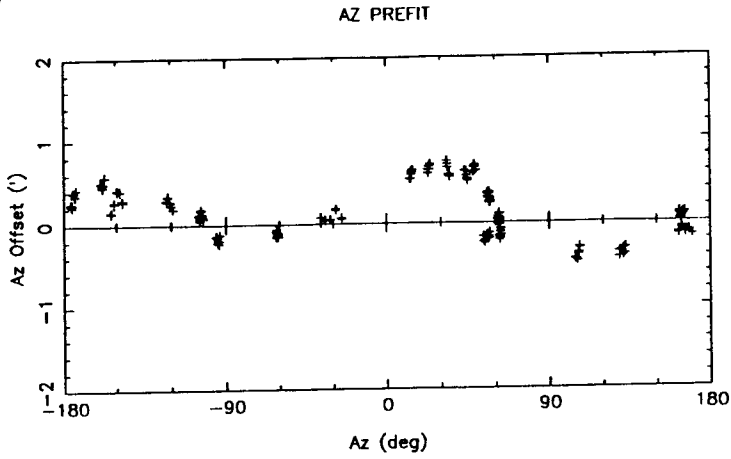


Figure 6

PT 1cm

14 May 1991  
2 parameter fit  
11 parameters forced  
to 4cm results



RMS 8.0"

RMS 10.4"

Figure 7