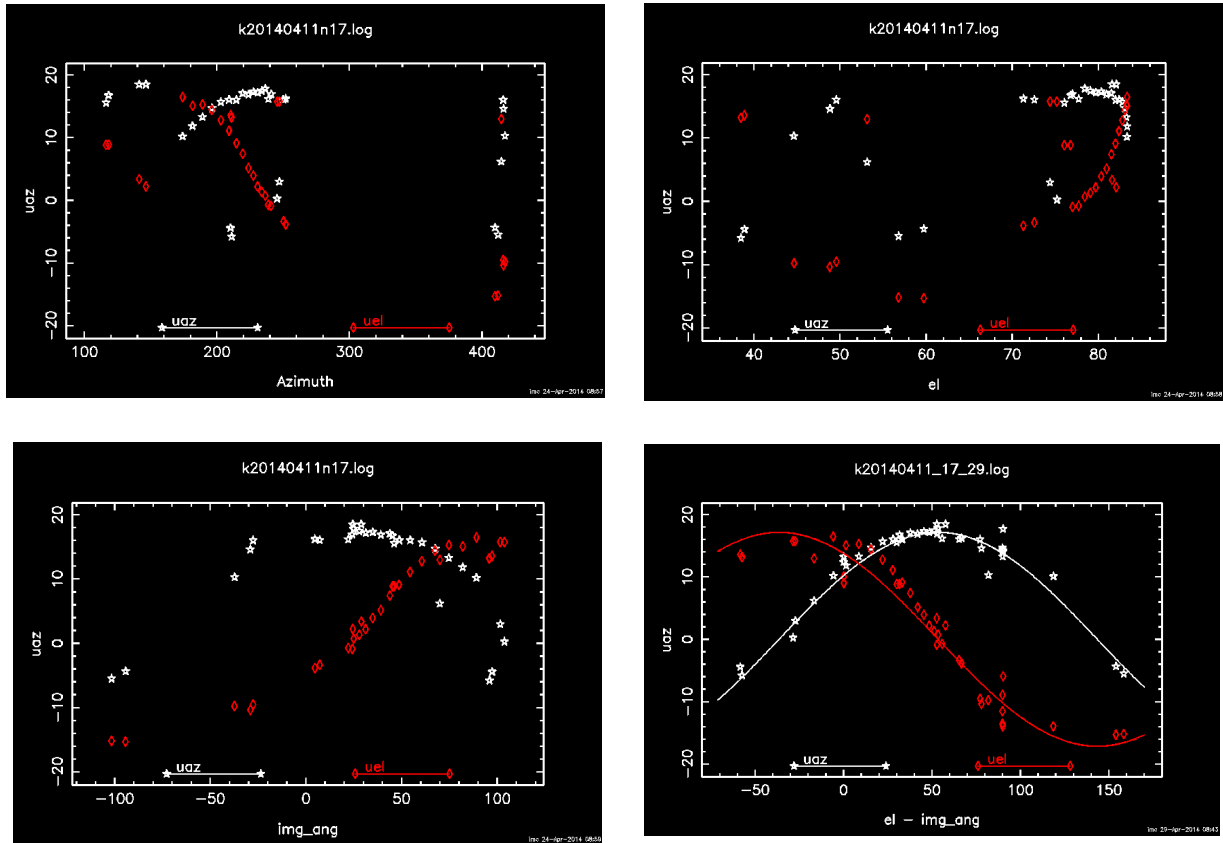


HARP / K-mirror problems April 2014

Following the removal and replacement of the array for maintenance, large pointing errors were encountered. Pointing residuals u_{az}, u_{el} are shown below as functions of azimuth, elevation (E), the K-mirror angle (M a.k.a. 2K) and (E-M), respectively:



Definition of the residuals as unique functions of any of these quantities only seems possible in the case of (E-M). Theory suggests that their forms should be

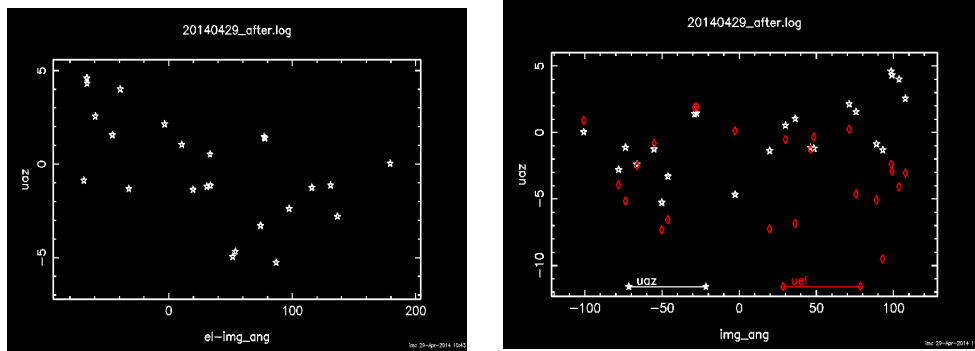
$$\begin{aligned} u_{az} &= xc + xd \cdot \cos(E-2K) + yd \cdot \sin(E-2K) \\ u_{el} &= yc - xd \cdot \sin(E-2K) + yd \cdot \cos(E-2K) \end{aligned}$$

and the 40 data obtained on 20140411 + 20140417 + 20140429 (above) yield $(xc, yc, xd, yd) = (0.5, 0.2, 10.1, 13.8)$, leaving residuals in (u_{az}, u_{el}) of $(1.5'', 2.5'')$ rms.

The data of 20140429 filled a gap in (E-M) space – $80 < E-M < 150$ – and allowed installation in `/jac_sw/itsroot/src/tcs/thi/THI.tide` and testing later that night of

```
KM_PNTG_OFF.X1 = -10.1
KM_PNTG_OFF.Y1 = -13.8
```

The subsequent pointing had rms scatters in of (2.7", 3.1") - worse than anticipated! – and showed only weak systematics as functions of (az, el, 2K, or E-2K) – the strongest is shown below left.



The plot above right shows the residuals as a function of 2K (=M), which is the next likely dependency of these residuals; but no strong systematic shows. However, display may be problematic given the additional functional form expected:

$$\begin{aligned} uaz &= -x0*\sin(2K) - y0*\cos(2K) \\ uel &= x0*\cos(2K) - y0*\sin(2K) \end{aligned}$$

A full solution to the data of UT20140411+17+29, of the form

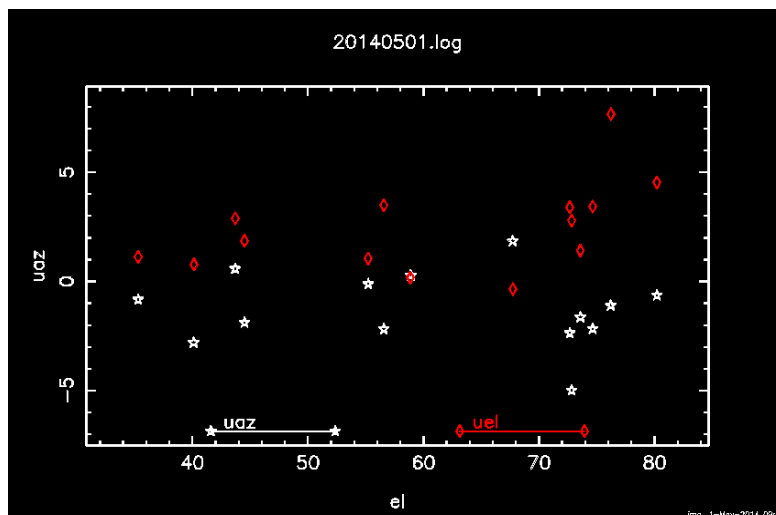
$$\begin{aligned} uaz &= xc - x0*\sin(2K) - y0*\cos(2K) + xd*\cos(E-2K) + yd*\sin(E-2K) \\ uel &= yc + x0*\cos(2K) - y0*\sin(2K) - xd*\sin(E-2K) + yd*\cos(E-2K) \end{aligned}$$

is (xc, yc, x0, y0, xd, yd) = (0.4, -0.4, -3.2, -6.1, 4.9, 9.9), with rms residuals of (1.5", 1.6").

Per was getting similar results, so on UT20140501 we tried this (averaged) model:

$$\begin{aligned} KM_PNTG_OFF.X0 &= 3.3 \\ KM_PNTG_OFF.Y0 &= 5.0 \\ KM_PNTG_OFF.X1 &= -5.5 \\ KM_PNTG_OFF.Y1 &= -9.8 \end{aligned}$$

14 logged data had rms residuals in (az,el) of (1.6", 2.0"), with the strongest remaining systematic being of uel-vs-el:



Additional Notes

- imc analysis accomplished using customized Fortran programs
 - /home/imc/pointing/progs/opt4.exe
 - /home/imc/pointing/progs/opt6.exe
- The unexpected number of data from 20140429 with (E-M)=precisely 0.0 and 90.0 may be due (Per) to use of AZ-EL frame for pointing.
- The data recorded in the TPOINT (.pnt) files are not accompanied by K-Mirror terms, and have been rendered unusable for pointing model analysis: needs fixing . . .

imc/20140501