VLBA Test Memo 74

VLBA Pointing Stability

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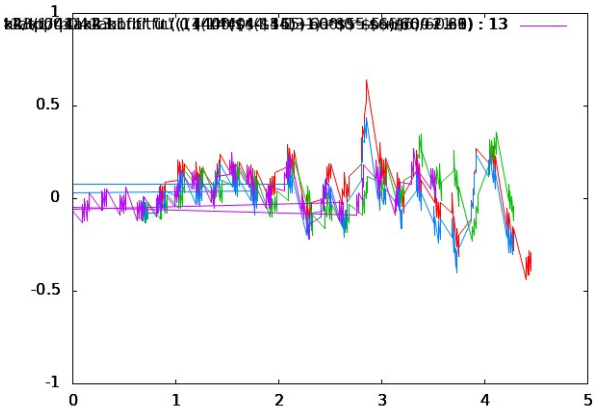
June 22, 2022

A series of test observations were made to assess the day to day pointing stability of the VLBA antennas. Observations were made at approximately the same GST (Greenwich sidereal time) each day. Observations were made at 2cm and 4cm wavelengths. The source observed was 4C39.25. For most stations, the source passes north of the zenith, and a large range of azimuths is covered, approaching 180 degrees. For the stations at the ends of the array, SC and MK, where the source is rising or setting, a very much smaller range of azimuths are covered. The dates of the observations are given in the table.

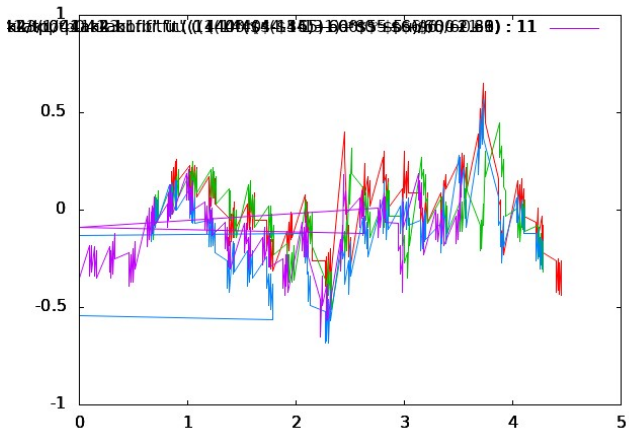
Observation Code	Date	Trace color	Comments
TP041AK1	May 10/11, 2022	Red	PT did not observe
TP041AK2	May 14/15, 2022	Green	
TP041AK3	May 24/25, 2022	Violet	HN did not observe
TP041AK4	June 4/5, 2022	Blue	

The elevation bearings at HN were replaced between TP041AK2 and TP041AK4. Therefore that are no meaningful comparisons between observations for HN, and it is omitted from further discussion. The pointing at 2cm and 4cm tracked each other very well, indicating that there were no substantial subreflector problems – there were no unexpected lateral motions of the subreflector or problems with the reproducibility of the subreflector rotation. The main results are the plots below. The ordinates are the measured pointing errors in arcminutes, the abscissas are the GST in hours. The trace color for the plots is given in the table. For most stations the reproducibility between observations is very good. In a few cases it is absurdly good – deviations of no more than a couple of arcseconds. The exception is the elevation at LA, where the first day is displaced by about 0.4 arcminutes. This is a puzzle. There was no change to the parameter database. The two centimeter pointing did not change, or at least did not change as much (the relative pointing between 4cm and 2cm changes by about .3 arcminutes).On the other hand, it is clear that there are fairly large unmodeled systematic effects, some of quite small scale in time (and thus in azimuth). SC and MK, where the azimuth range is much smaller than at other stations, tend to show less of this structure. One suspects that these systematic features are due to unmodeled rail height deviations. It seems likely that pointing could be improved by modeling the rail through on-the-sky pointing results rather than the current method of theodolite level measurements of the rail surface.

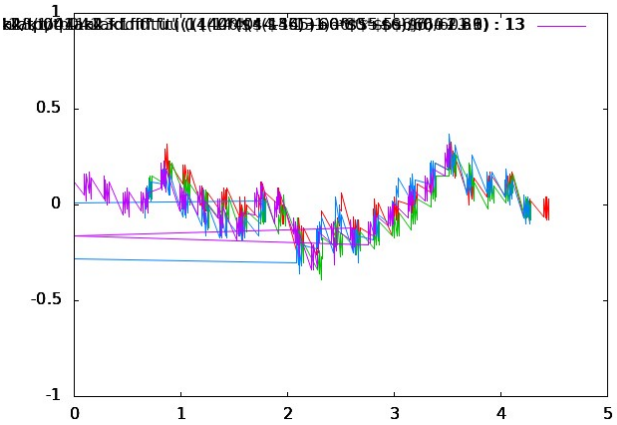
BR Azimuth



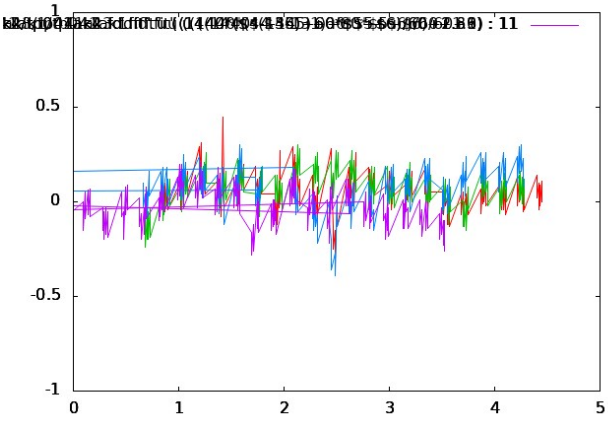
BR Elevation



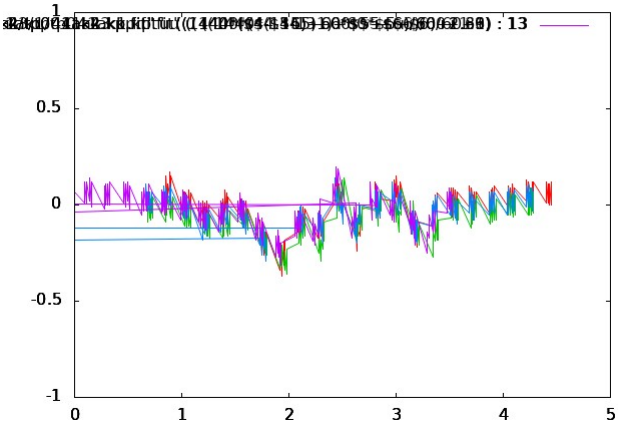
FD Azimuth



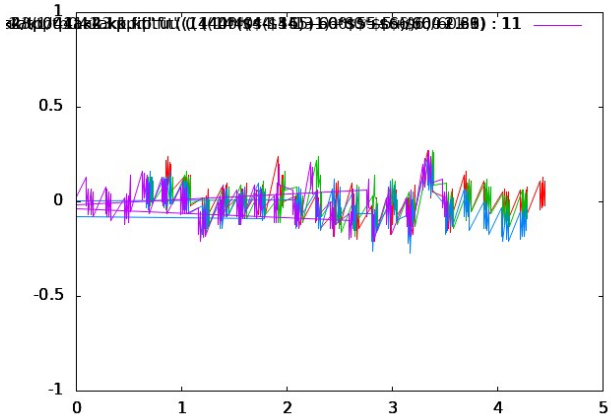
FD Elevation



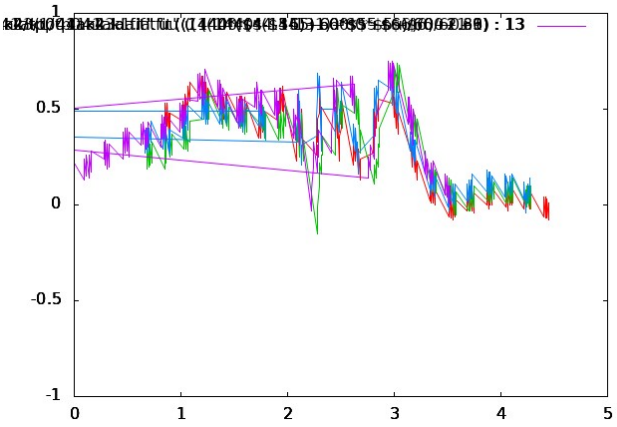
KP Azimuth



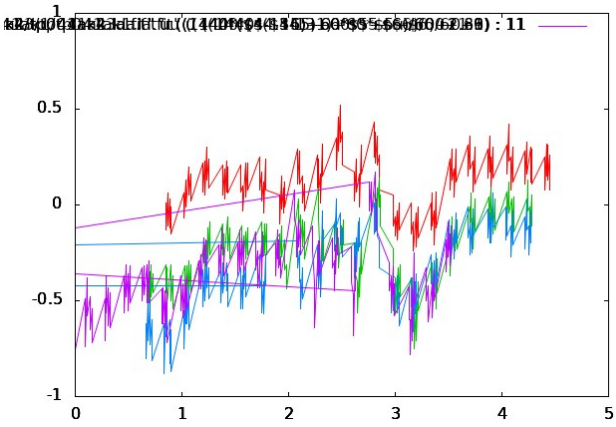
KP Elevation



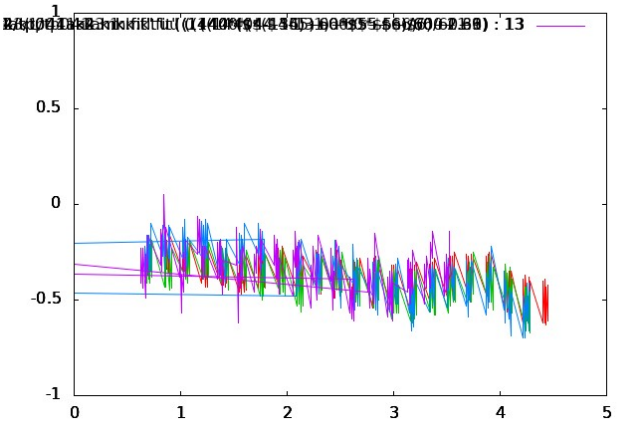
LA Azimuth



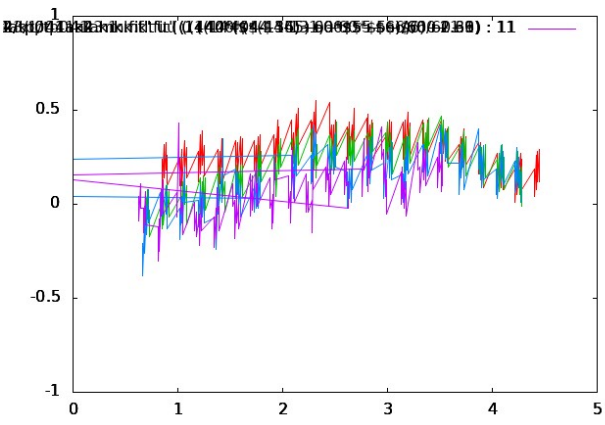
LA Elevation



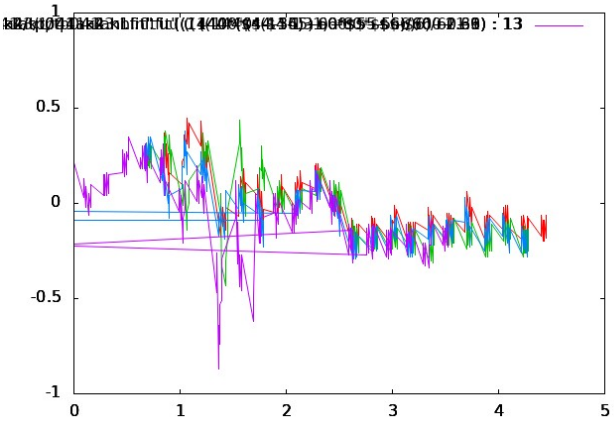
MK Azimuth



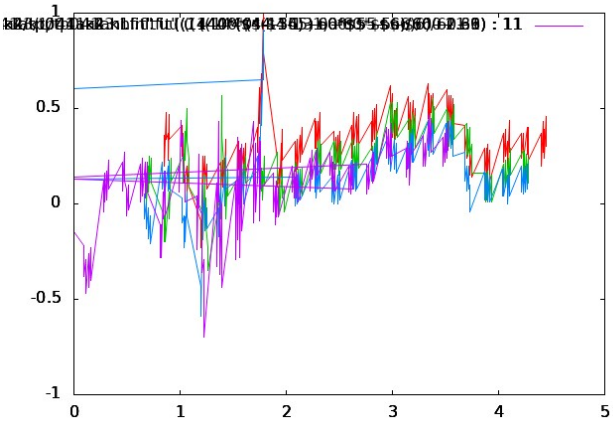
MK Elevation

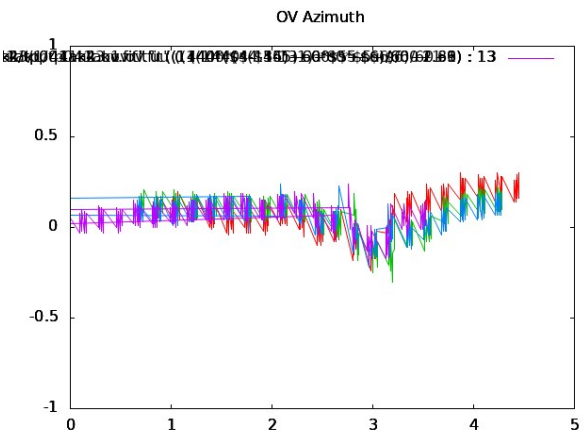


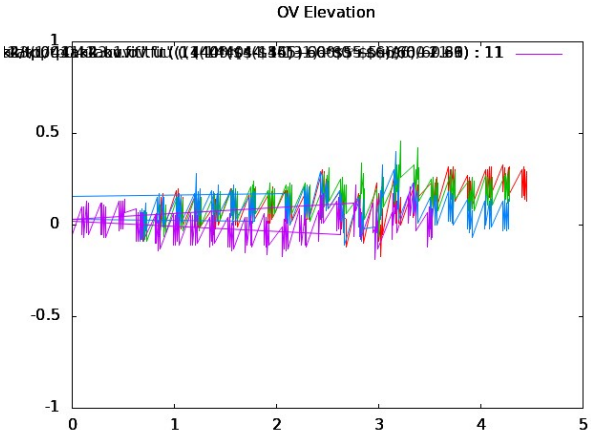
NL Azimuth



NL Elevation




OV Azimuth
1
0.5
0
-0.5
-1
0
1
2
3
4
5


OV Elevation
1
0.5
0
-0.5
-1
0
1
2
3
4
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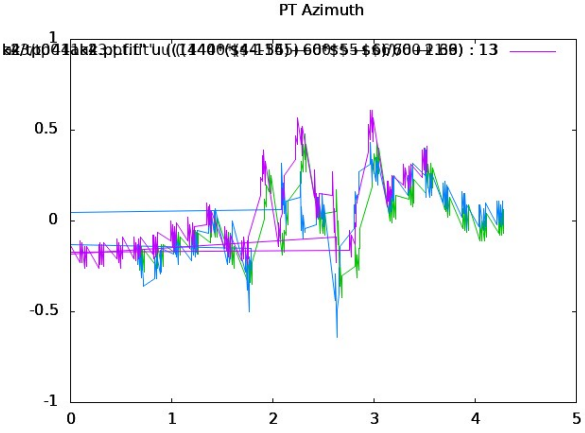
PT Azimuth
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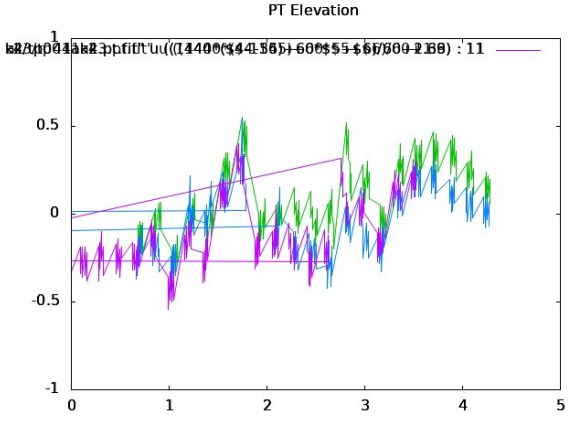
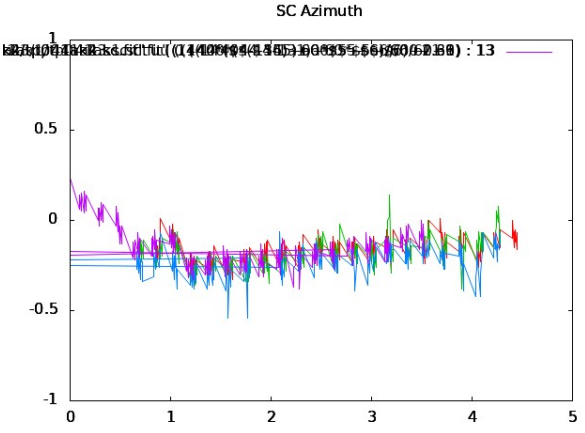
0
-0.5
-1
0
1
2
3
4
5


PT Elevation
1
0.5
0
-0.5
-1
0
1
2
3
4
5


SC Azimuth
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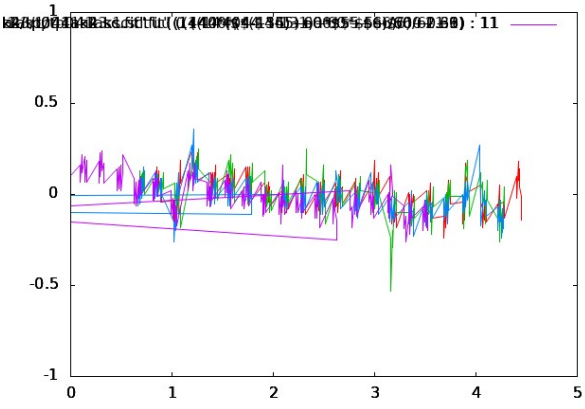
-0.5
-1
0
1
2
3
4
5


SC Elevation
1
0.5
0
-0.5
-1
0
1
2
3
4
5