Chandra X-ray Center

URL: http://cxc.harvard.edu/ciao3.4/why/dither.html
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Dither

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Introduction

The Chandra spacecraft has a built−in dither on its pointing position to average across calibration uncertainties. In ACIS, dithering keeps one bad pixel from ruining an entire observation and smooths over chip gaps; in HRC, it prevents too many photons entering a single microchannel plate pore (which will eventually lower the QE of the pore). For both instruments, dither smooths out small effects of QE variations to a scale on which the QE can be efficiently calibrated.

How Data Analysis is Affected

The spectral analysis of sources can be affected by the dither, since the spectral response of the ACIS chips depends upon on which node the source is detected. As discussed in the Aimpoints section of the POG, the ACIS−S aimpoint is shifted slightly to ensure that the dithered flux of an on−axis point source remains on one node of the chip in order to ease the analysis of such sources. The aimpoint shift is recorded in the event file header keyword "`SIM_Z`".

The dither period can introduce spurious periods into light curves − or any general timing analysis procedure − as discussed in the "ACIS−S3: a spurious period of exact 1000 seconds" thread from the Chandra Users' discussion group.

Visualizing the Dither Pattern

The following table summarizes the parameters of the dither pattern:

	Peak−to−peak Span (arcsec)	Nominal Period in Y (s)	Nominal Period in Z (s)	POG Reference
ACIS	16	1000	707	ACIS chapter
HRC	40	1087	768	HRC chapter

This motion is recorded in the aspect solution file and can be plotted using either *Prism* or *ChIPS*. Below we use *ChIPS*:

```
unix% chips

Welcome to ChIPS, version CIAO 3.4
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```
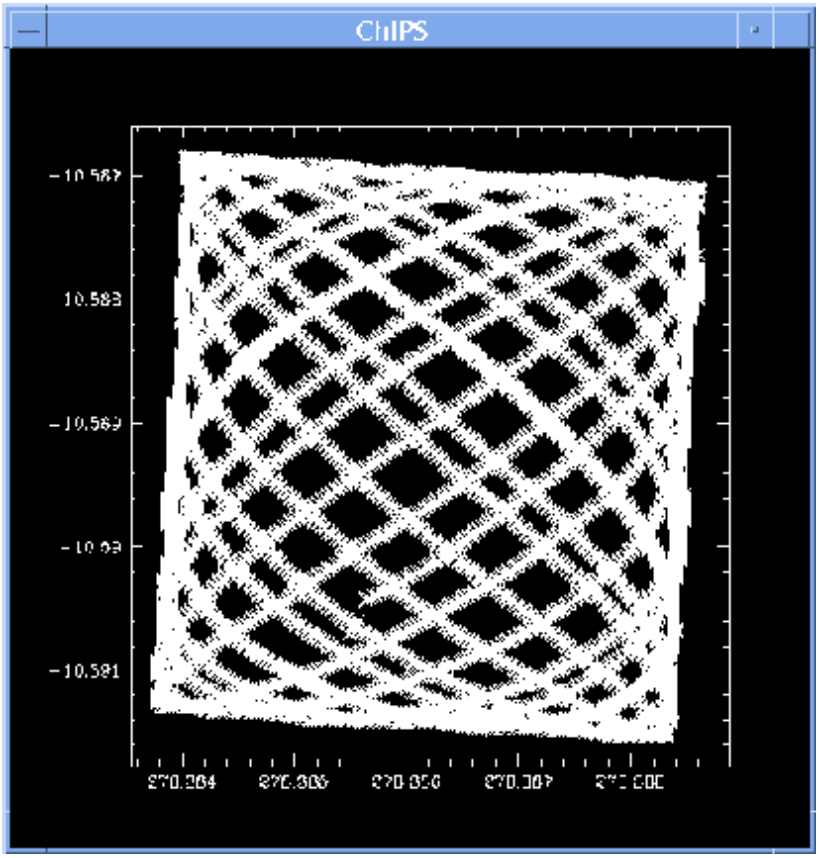

```
chips> curve "pcadf084244404N001_asol1.fits[cols ra,dec]"
```

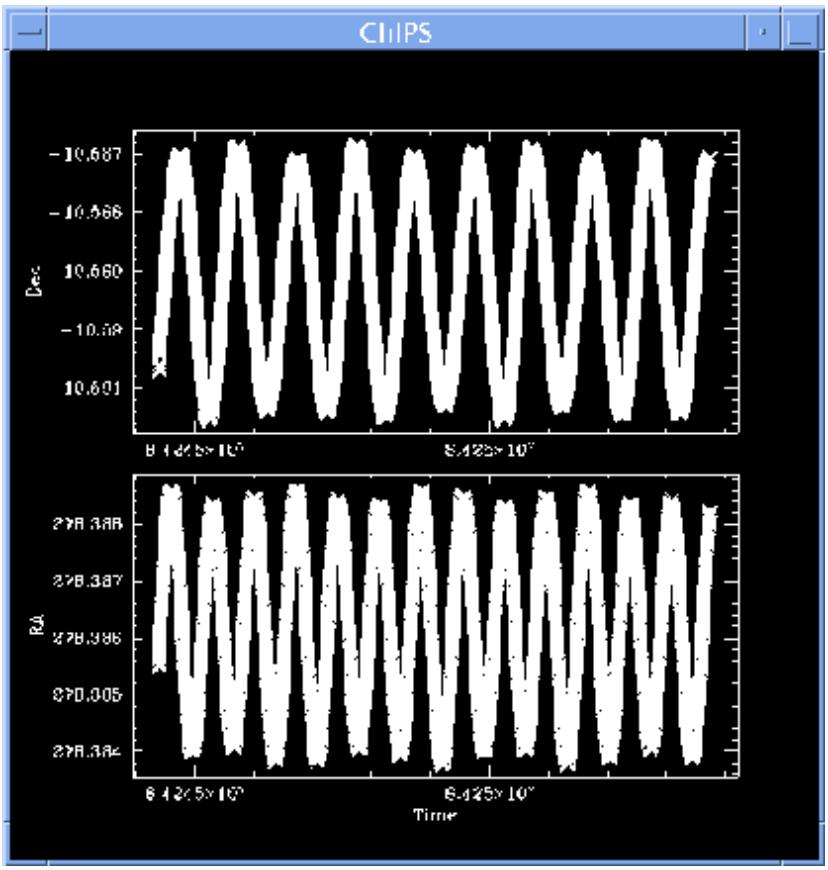
The resulting plot shows the dither pattern (a Lissajous figure) of the observation:



It is also possible to plot either coordinate as a function of time:

```
chips> clear
chips> split 2; split gap 0.05
chips> d 1 curve "pcadf084244404N001_asol1.fits[cols time,dec]"
chips> d 2 curve "pcadf084244404N001_asol1.fits[cols time,ra]"
chips> d 1 ylabel "Dec"; d 2 ylabel "RA"; xlabel "Time"
```

These commands create the following plots of RA and Dec vs time:



See the introductory threads on ChIPS and Prism for more information on their plotting capabilities.

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