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Subject: KCROSS question

Hi Rosita-

Sorry for the delay.Â I've added the others back into the cc list so they can see my answer to your question.

On Tue, Oct 7, 2014 at 9:42 AM, Rosita Paladino <paladino@ira.inaf.it> wrote:

> Your suggestion was to compute the kcr table using solint=int, and
> plot the solutions as function of time.
> The plots, which are now in the webpage, are not clear at all to me.
> Should I plot the solutions in other ways, or did I misunderstood
> your suggestion.

I think your time-dependent cross-hand delay plots look just as they should, though the effect is perhaps more subtle than I have seen in other cases.

The basic point is that the source linear polarization signal (as a function of parallactic angle, and thus also time) is 90 deg out of phase between the parallel hands and the cross hands (I've suppressed contributions from instr pol and Stokes V):

XX = I + (Qcos(p) + Usin(p))
XY = YX = -Qsin(p)+Ucos(p)
YY = I - (Qcos(p)+Usin(p))

Note that the parallel hand ratio is approximately

1+2(q.cos(p)+u.sin(p))

(q and u are the fractional Stokes parameters)

....i.e., the ratio contains the same function of p as XX.Â

For the cross-hand delay calculation, we want to choose a scan where the source's cross-hand contribution is a maximum (in absolute value), since this will minimize the mean effect of instr pol, etc.

Notice that the cross-hand terms containing Q and U is the derivative (w.r.t. p) of the parallel hand terms containing Q and U.Â Since these terms are sines and cosines of p, this is equivalent to saying they are 90 deg out of phase.Â Thus, the cross-hand polarization source contribution is greatest at the same p (and time) that the _slope_ of the source polarization contribution to the parallel hand is largest.Â Â Judging from the gain ratio plot,
this appears to be either the scan 48 (upward slope) or scan 93 (downward).Â Â
(Please note that there is an inconsistency between the thumbnail plots shown onÂ the page and the larger plots you get when you click on them.Â The larger plots include scan 4 and have seven scans in all, and the thumbnails exclude scan 4 and have only six.)

Looking at the per-integration KCROSS solution plot (you should redo with poln='X', I think, to exclude the points at zero which are for Y), it looks like the
smallest rms also occurs in scans 48 and 93.Â This is exactly how it should be since this is where the source polarization signal should be greatest.Â
However, the effect, though clear, is not very dramatic.Â Â In the old days of the polarization test campaigns, we had more continuous time coverage of a single, very bright, calibrator, and the time-dependent change in KCROSS SNR was easier to see.Â Most of the time, I think, we could see that sufficient source signal was available for most scans, but a few---those corresponding to peaks (zero slope) in the gain ratio plot---the KCROSS solution would be low SNR and more clearly unreliable.Â

In this case, I think I'd choose scan 48 (solint='inf') for the KCROSS solution that will be used in the subsequent steps.Â Â Scan 93 is also ok, and even the others aren't too bad.Â Â None appear to be catastrophic.Â Â
To see that they all are about the same is good---a solution from one scan will be ~right for all of them.Â Â Most notably, the cross-hand delay is not a function of SB, which would have been catastrophic.Â One could consider using solint='inf', combine='scan', and just aggragate all of the scans for the KCROSS solution.Â Â This is not formally necessary---the goal here is to get a non-catastrophic cross-hand delay that will ensure that the frequency average is nominally coherent for the QU part of the XYf+QU solve.Â The XYf part of that solution will describe the non-linear parts of the cross-hand phase spectrum, and sweep up any small residual delay that the KCROSS fails to include.

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> However, from the phase vs chan plots I would say the scan to use could be the 29 or 48, where at least one correlation phase is closer to 0. Could that choice make sense???

The cross-hand phase spectrum plots (baseline-averaged or not) don’t seem to be especially useful in isolating the best scan, probably because the relative
quality among scans is not that different. I think those plots just aren’t helpful in this
case.Â Â That "one correlation phase is closer to 0" is not relevant.

I hope this helps!

Cheers,
George