OBSERVING WITH OFFSET PHASE TRACKING AND
ANTENNA POINTING POSITIONS

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1. WHY BOTHER?

In the C and D configurations low level, relatively constant correlated signals occur at the shorter spacings. These spurious signals can sometimes be as large as 5 mJy but are commonly about 0.5 mJy. They produce artifacts near the phase center of the map at the 0.02 mJy level and limit the sensitivity of deep integrations in the D and C configurations at 20cm and 6cm after about 10 hours integration. The cause of the signals is uncertain. The best guess is that they are produced by low level cross-talk between some of the antennas. No way has yet been found to elliminate the signals. They may may be weaker versions of the strong signals which sometimes occur between shadowed antennas.

If the phase tracking position is significantly displaced from the antenna pointing position, it is possible to place these artifacts outside of the primary beam area. It should then be possible to reach the expected sensitivity levels for long integrations.

2. HOW TO APPLY THE OFFSET

To apply an offset between the phase and pointing positions in continuum or spectral line mode, use the mode field of the observing card image. Do not displace the phase and pointing positions for the calibrator observations. The offsets are obtained as follows:
  a. The position on the observing card should correspond to the antenna pointing position; that is, the center of the field of view.
  b. Place the letter 'O' for the observing mode. The phase center will then be precisely SOUTH of the antenna pointing position by an amount dependant on configuration and frequency.

POINTING - PHASE CENTER POSITIONS

FREQUENCY	CONFIGURATION			
	D	C	B	A
		(arc minutes)		
90cm (Pband)	100	30	10	3
20cm (Lband)	25	7.6	2.3	0.7
6cm (Cband)	6.6	2.0	1.0	0.3
3cm (Xband)	4.0	1.5	0.7	0.3
2cm (Uband)	2.7	0.8	0.3	0.2
1.3cm (Kband)	1.5	0.5	0.3	0.2

c. If you want the phase tracking center to be displaced NORTH of the pointing position, insert 'ON' for the mode.

3. DELAY TRACKING

The delay tracking position will still remain coincident with the phase tracking center. At 50 MHz bandwidth this would produce unacceptably large bandwidth smearing in the A, B and C configurations if the phase tracking center were placed well outside the primary beam area. The numbers in the above table are a compromise between the magnitude of the offset of the phase and pointing positions and the loss of coherence at 50 MHz. As the numbers now stand there is slight loss of coherence at 6cm. At 20cm bandwidth 50 MHz should not be used in the C and D configurations when using offset positions. The plots below display the smearing in the D-Configuration.
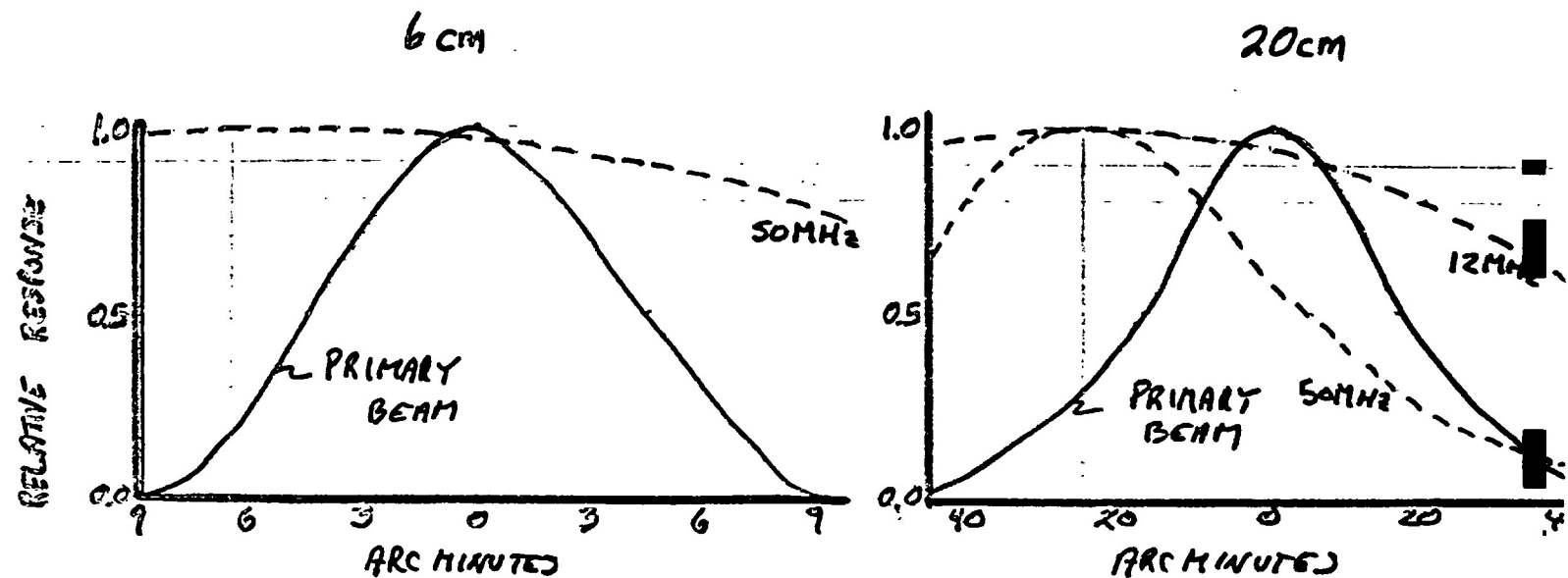
4. DEC-10 REDUCTIONS

Reduce your DEC-10 data in the usual manner. The observing position listed in the DEC-10 or PIPELINE data base will be the phase tracking center and all parameter calculations will be based on this position; egs (U,V,W) coordinates. Correction of the (U,V,W) coordinates to the antenna pointing position can be made in AIPS.

There is a good possibility that the first data record of an observation of a source with an offset phase and pointing position will be bad. The program QUACK should be run if this is the case. In order to carry the calibrated visibility data to AIPS, run EXPVIS to include the antennas file which will be needed in AIPS to correct the (U,V,W) coordinates. Running UVFITS from data in the DEC-10 and the PIPELINE will not include this antennas file.

5. AIPS REDUCTIONS

Since the most maps made from the data will be centered on the antenna pointing position, it is best to correct the phases from the tangent point at the phase tracking center to the antenna pointing center accurately before mapping. While it is possible to shift the phase center in the mapping routines in AIPS and the PIPELINE, these programs do not correct the phase with high precision. The errors are probably unimportant for detection experiments but are more important for high dynamic range maps, especially at 20cm and 6cm.

First, read in the visibility data using the task UVLOD. To correct the phases with respect to antenna tracking center run the task UVFIX twice. You must have an antennas file in order to run UVFIX. First, set

INNAME, INCLASS, INSEQ AND INDISK	for input UV data set
OUTNAME, OUTCLASS, OUTSEQ AND OUTDISK	for output UV data set
SHIFT = 0,0	
APARM = 1,0,0,0,0,0,0,0	
BPARM = 0,0,N	where N = 0.5 * MODCOMP integration time.

This execution will correct the time of each visibility data point. The original time corresponds to the end of the modcomp integration period, whereas the midpoint of the integration is better. More exact (U,V,W) coordinates are also calculated for each point using the antenna file. Those calculated by the MODCOMPS are rounded too heavily.

Second, rerun UVFIX in order to shift the phases from a tangent point at the phase tracking position to the antenna pointing position. The setup is

INNAME, INCLASS, INSEQ AND INDISK	for input UV data set equal to ouput of first UVFIX run
OUTNAME, OUTCLASS, OUTSEQ AND OUTDISK	for output UV data set
SHIFT = 0,-N	for mode 'O'
SHIFT = 0, N	for mode 'ON'
	where N is the magnitude of the offset
APARM = 0	
BPARM = 0	

All subsequent AIPS analyses are unchanged. Remember that there may be significant bandwidth smearing within the primary beam.