Dterms Estimation

July 2015

1 Relation between measured and true visibilities

$$\begin{pmatrix} I'-I \\ Q'-Q \\ U'-U \\ V'-V \end{pmatrix} = \frac{1}{2}\begin{pmatrix} \gamma_{++} & \gamma_{+1} & \delta_{+-} & -j\delta_{-+} \\ \gamma_{+1} & \gamma_{++} & \delta_{++} & -j\delta_{--} \\ \delta_{+-} & -\delta_{++} & \gamma_{++} & j\gamma_{--} \\ -j\delta_{-+} & -j\delta_{--} & j\gamma_{--} & j\gamma_{++} \end{pmatrix}\begin{pmatrix} I \\ Q \\ U \\ V \end{pmatrix} \tag{1}$$

Assumptions:

- The source is unpolarized, (Q=U=V=0)

$$\begin{pmatrix} I'-I \\ Q' \\ U' \\ V' \end{pmatrix} = \frac{1}{2}\begin{pmatrix} \gamma_{++} & \gamma_{+1} & \delta_{+-} & -j\delta_{-+} \\ \gamma_{+1} & \gamma_{++} & \delta_{++} & -j\delta_{--} \\ \delta_{+-} & -\delta_{++} & \gamma_{++} & j\gamma_{--} \\ -j\delta_{-+} & -j\delta_{--} & j\gamma_{--} & j\gamma_{++} \end{pmatrix}\begin{pmatrix} I \\ 0 \\ 0 \\ 0 \end{pmatrix} \tag{2}$$

$$\begin{aligned} I'-I =& \frac{1}{2}\gamma_{++}I \\ Q' =& \frac{1}{2}\gamma_{+-}I' \\ U' =& \frac{1}{2}\delta_{+-}I' \Rightarrow \delta_{+-} = \frac{2U}{I'} \\ V' =& \frac{1}{2}\delta_{-+}I' \Rightarrow \delta_{-+} = -\frac{2V}{I'} \end{aligned}$$

2 Computing Dterms

$$\begin{pmatrix} \delta_{+-,1} \\ \delta_{-+,1} \\ \delta_{+-,2} \\ \delta_{-+,2} \\ \delta_{+-,3} \\ \delta_{-+,3} \end{pmatrix} = \begin{pmatrix} 1 & -1 & 1 & -1 \\ 1 & 1 & -1 & -1 \\ 1 & -1 & 1 & -1 \\ 1 & 1 & -1 & -1 \\ 1 & -1 & 1 & -1 \\ 1 & 1 & -1 & -1 \end{pmatrix}\begin{pmatrix} D_{xm} \\ D_{ym} \\ D^*_{xn} \\ D^*_{yn} \end{pmatrix} \tag{3}$$

3 Estimation of Dterms using 3 datasets

Steps:

- Image XX, XY, YX and YY polarizations (averaged over all frequencies)
- Calculate stokes parameters
  stokes I =XX + YY
  stokes Q = XY + iYX
  stokes U = XY -iYX
  stokes V = XX - YY
- Write individual stokes data to fits files
- Extract stats at Pictor A (for now did it manually)

3 consecutive JDs when Pictor A is close to zenith: 2455819.66988,2455819.67684,2455819.68380

JD	stokes I	stokes Q	stokes U	stokes V
2455819.66988	669.88	7.09	7.09	11.05
2455819.67684	783.42	8.04	8.04	8.74
2455819.68380	625.46	6.35	6.35	6.83

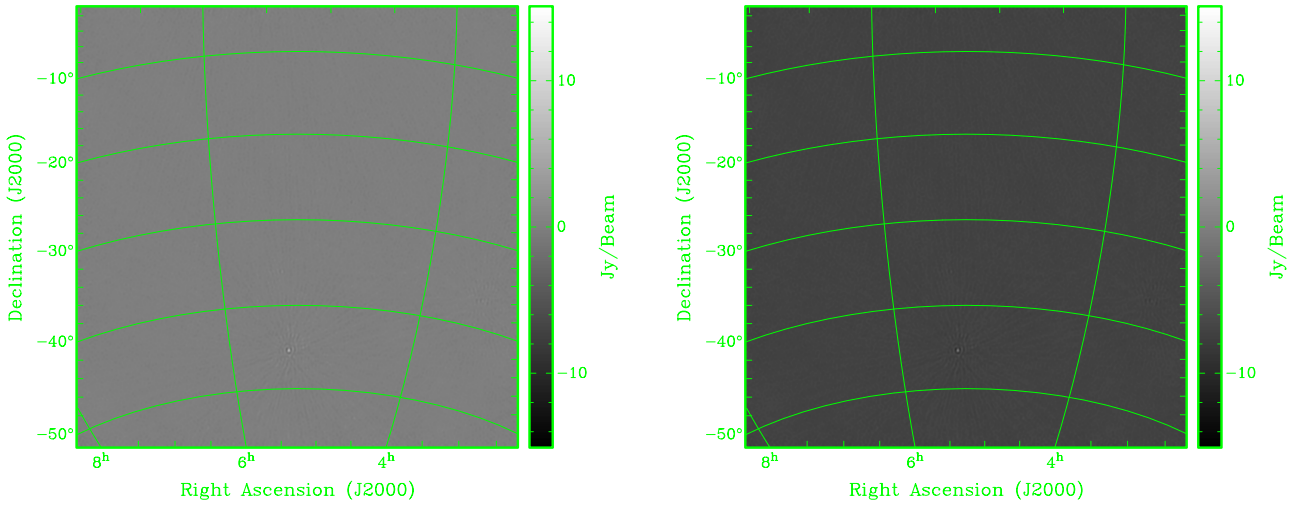
Results:
$\mathrm{D}_{xm} = -0.00434211$
$D_{ym} = -0.00858255$
$D^*_{xn} = 0.00858255$
$D^*_{yn} = 0.00434211$

4 Correcting for Dterms in image plane

$$U = XY + YX - \delta_{+-} I'$$
$$V = XX - YY - \delta{-+} I'$$

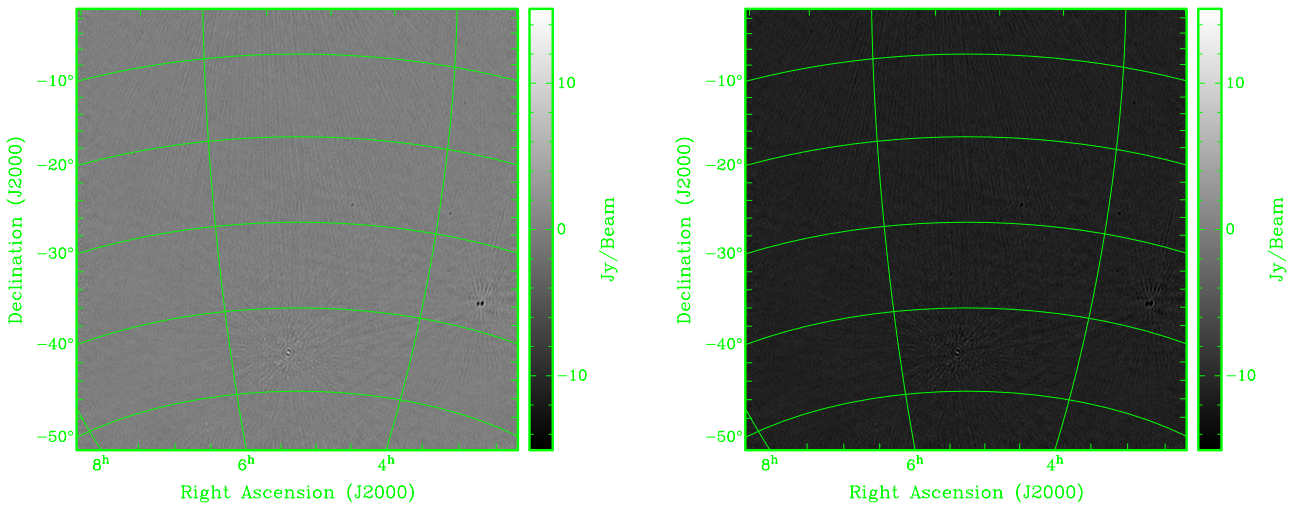
JD	stokes U	stokes V
2455819.66988	0.000549	0.001239
2455819.67684	0.007381	0.006521
2455819.68380	0.003401	0.001696

4.1 JD 2455819.66988



(a) before correcting for the Dterms. (b) after correcting for the Dterms.

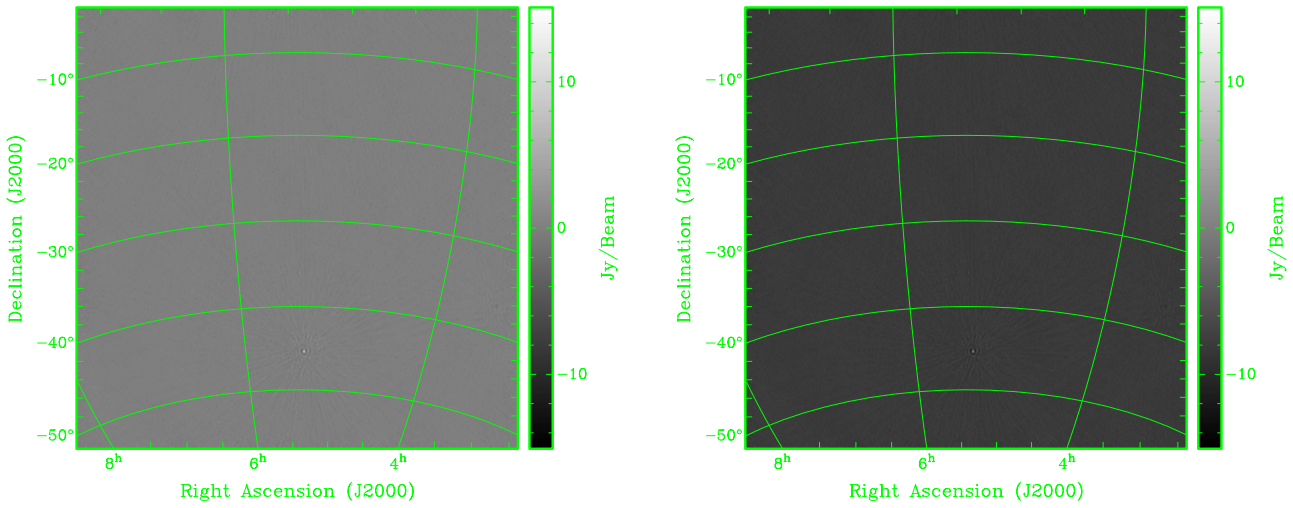
Figure 1: Stokes U images



(a) before correcting for th Dterms. (b) after correcting for the Dterms.

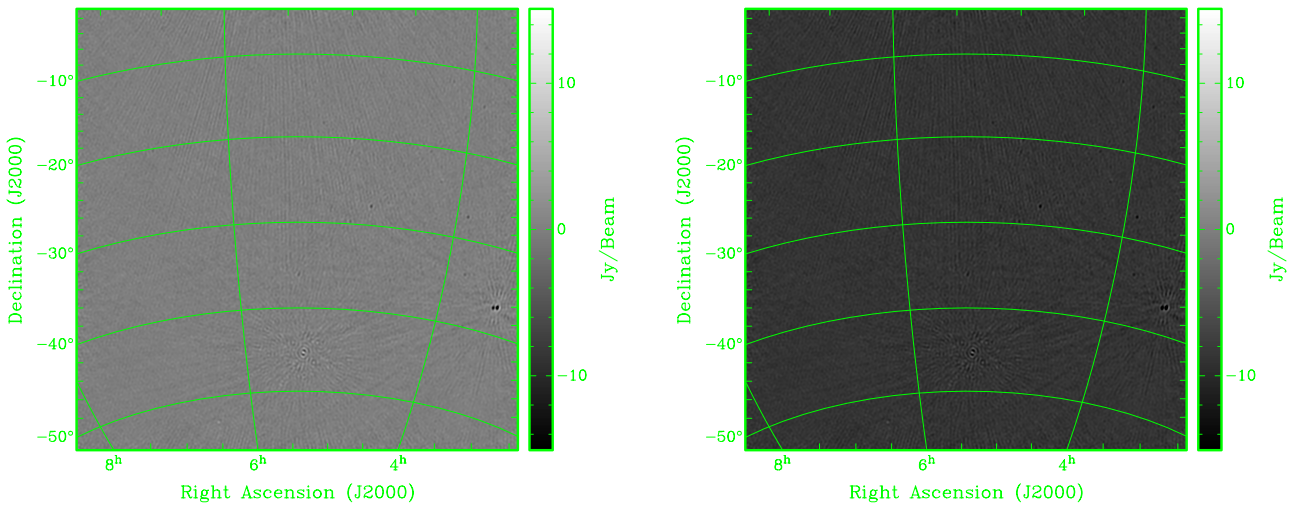
Figure 2: Stokes V images

5 JD 2455819.67684



(a) before correcting for the Dterms. (b) after correcting for the Dterms.

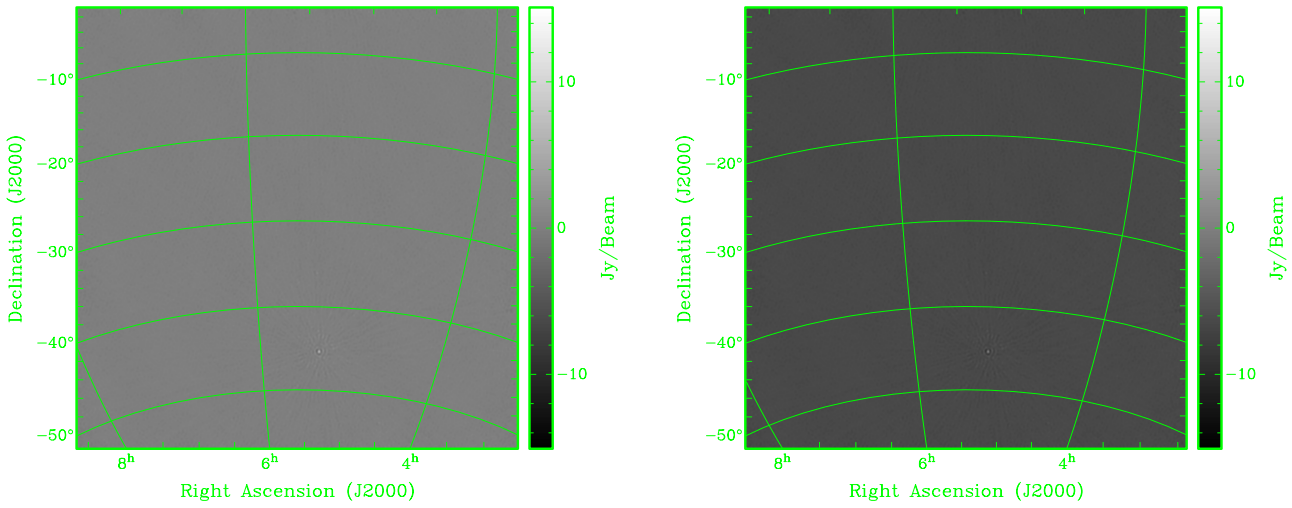
Figure 3: Stokes U images



(a) before correcting for the Dterms. (b) after correcting for the Dterms.

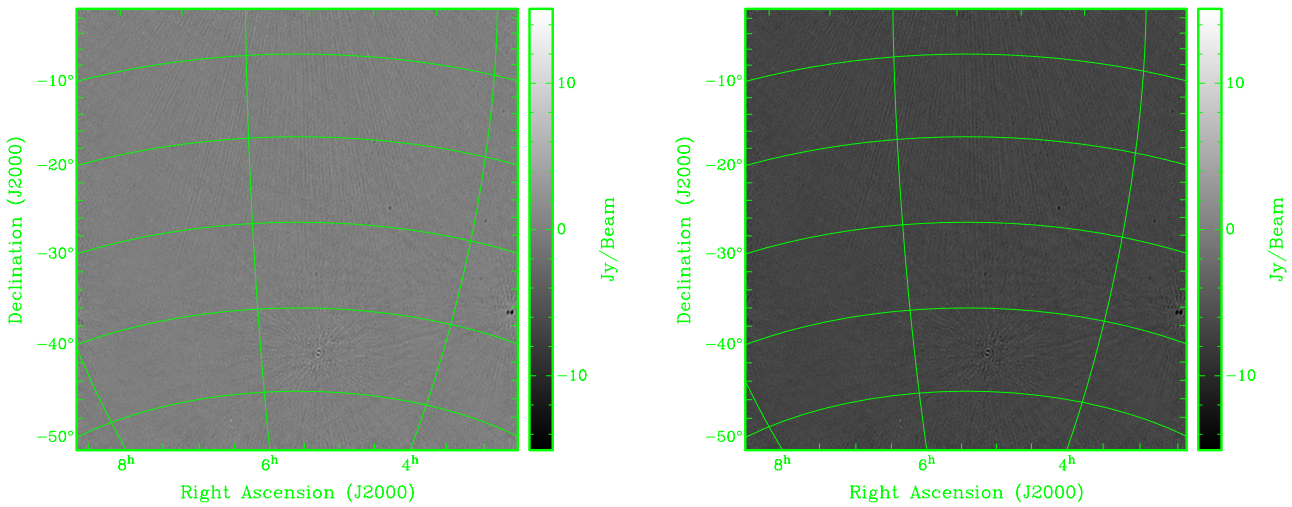
Figure 4: Stokes V images

6 JD 2455819.68380



(a) before correcting for the Dterms. (b) after correcting for the Dterms.

Figure 5: Stokes U images



(a) before correcting for the Dterms. (b) after correcting for the Dterms.

Figure 6: Stokes V images