Summary:

Application of DDE in the imaging step

THE Question

Once you have the calibration solution (direction, time, frequency dependent: beam, ionosphere, Faraday rotation, etc), how do you quickly recover the information on the sky state, in full polarisation?

- If the calibration solution is:
    - direction dependent
    - time and frequency independent
THEN you can deal with DDE in the image plane

- NOT POSSIBLE If the calibration solution is
    - direction, time and frequency dependent

The answers to the question

Once you have the calibration solution (direction, time, frequency dependent: beam, ionosphere, Faraday rotation, etc), how do you quickly recover the information on the sky state, in full polarisation?

- Facet based imager

    If facets are small enough you can deal with many effects

G_0 G_1 G_2 G_3 G_4

- AW Projection (S. Bhatnagar)

    - Multiplication in the image plane is a convolution in the Fourier plane

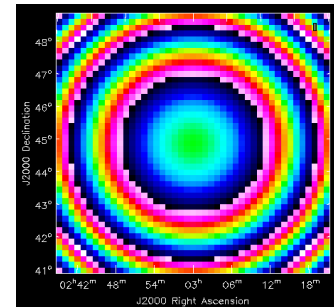# A-Projection

Convolution function (4*4)

Beam (4*4)　　　　**W term (scalar)**

$$\mathrm{Vec}(V_{pq}) = (G_q^* \otimes G_p)\mathrm{FT}\left[\left(E_{q,\vec{s}}^* \otimes E_{p,\vec{s}}.\exp\left(-2\pi i w_{pq}.\left(\sqrt{1-l^2-m^2}-1\right)\right)\right)\right]$$

$$\star \int_s \mathrm{Vec}(X_{\vec{s}}).\exp\left(-2\pi i(u_{pq}l + v_{pq}m)\right)dl.dm$$
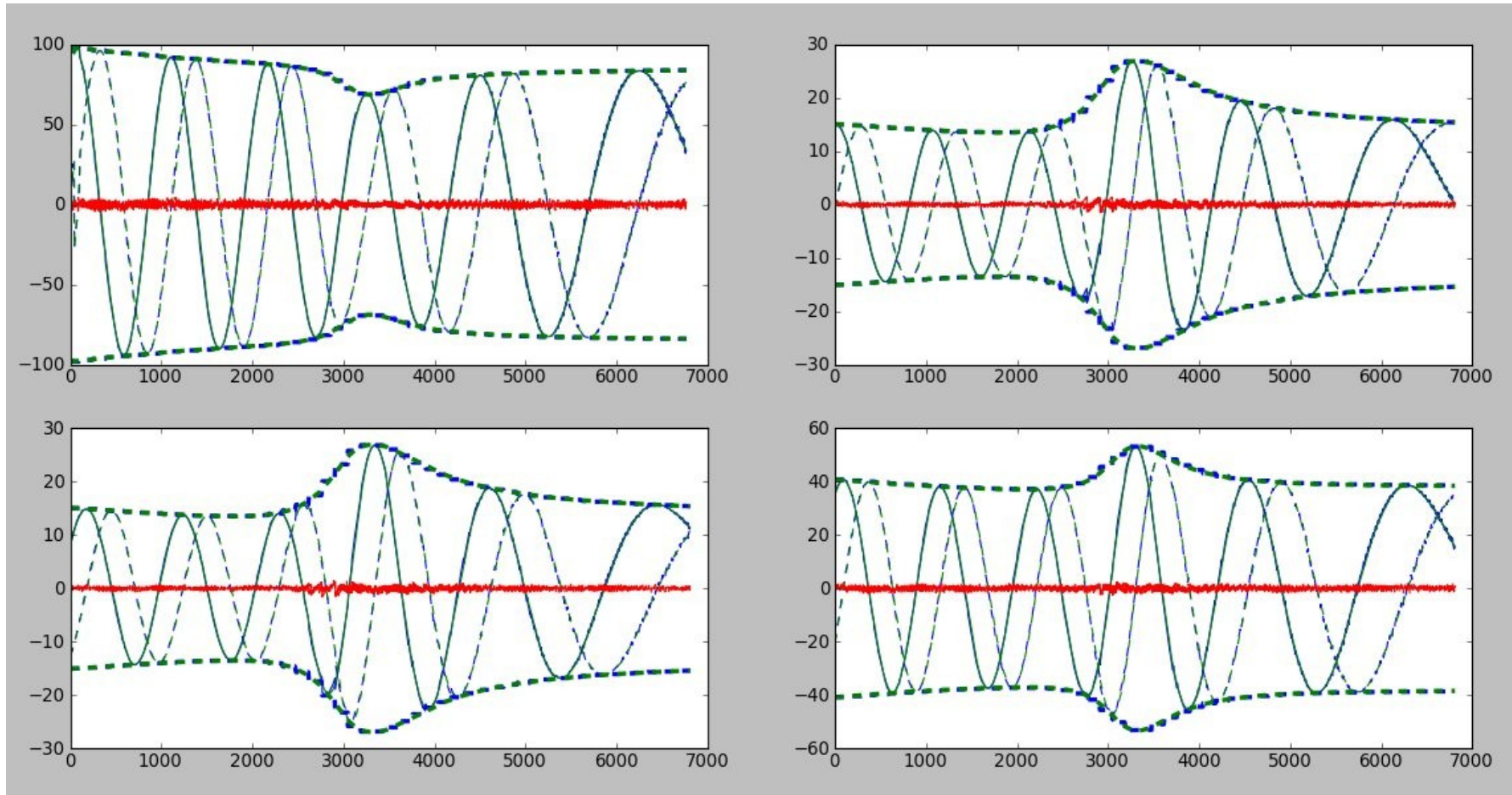
Convolution

2D FFT

This is an **EXACT** map from sky plane to the Visibilities in the UVW space!

Also UV Brick can do that in the future for computing fast predicts (talk by Iniyan)
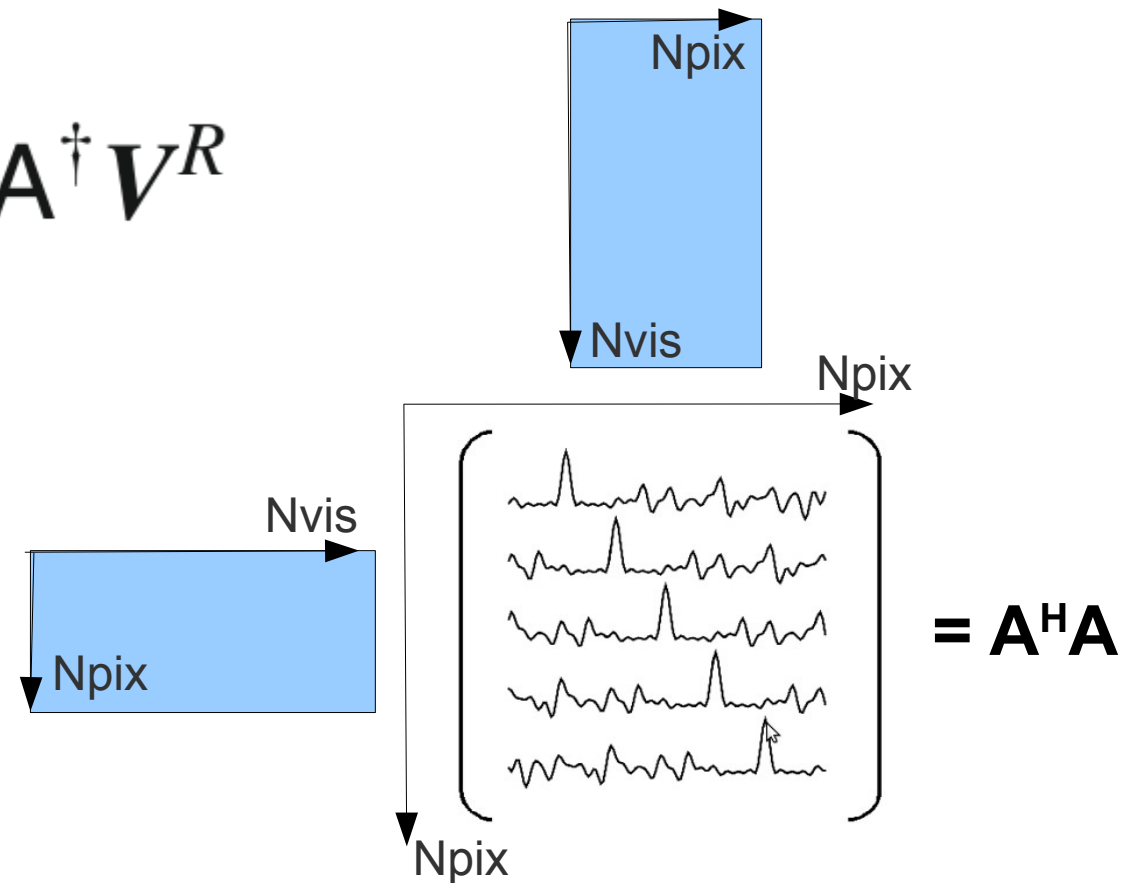
A-Projection fully implemented for LOFAR

Cyril Tasse, Ger van Diepen, Joris van Zwieten, Bas van der Tol

Sanjay Bhatnagar, Urvashi Rau, Kumar Golap

The dark side of A-Projection

The inverse map is approximative! (based on pseudo-inverse)

$$I^R = \left[A^\dagger A\right]^{-1} A^\dagger V^R$$

$$= A^H A$$

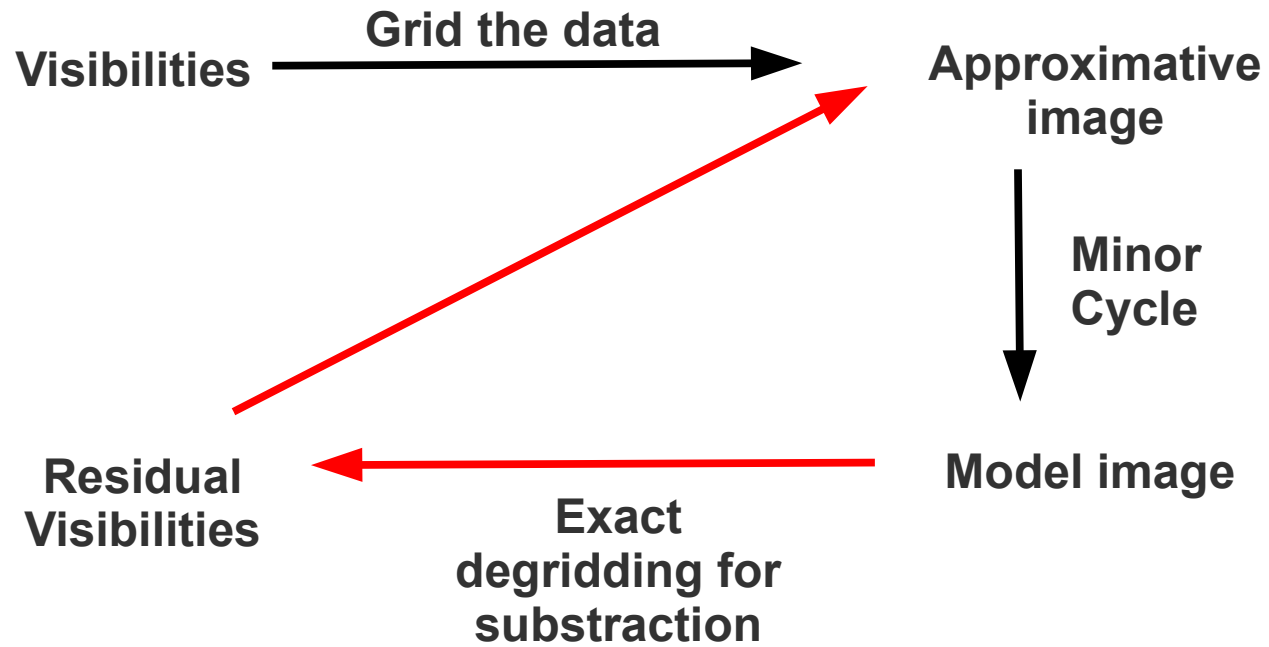See Urvashi Rau PhD thesis

The dark side of A-Projection

Because UV coverage is not continuous and infinite?

Is there any connection between this approximation and the "unitarity" of the various Jones Matrices in the ME?

$$I^R = \left[A^\dagger A \right]^{-1} A^\dagger V^R$$

What kind of effect are we introducing when we assume A^{H}A is purely diagonal?

Npix

Nvis

Npix

Nvis

Npix

Npix

$= A^H A$

Is there a smart way not to make an approximation in the gridding/imaging step?

See Urvashi Rau PhD thesis

Convergence?

Visibilities $\longrightarrow$ **Grid the data** $\longrightarrow$ **Approximative image**

Minor Cycle

Residual Visibilities $\longleftarrow$ **Exact degridding for substraction** $\longleftarrow$ **Model image**

Convergence?

Visibilities → Grid the data → Approximative image

What are the parameters that affect convergence speed?

Minor Cycle

Which of the Mueller terms should be considered in the gridding step?

Residual Visibilities ← Exact degridding for substraction ← Model image

How biased will the recovered fluxes of faint sources be, as those will be cleaned less?

Still a lot of work to be done....