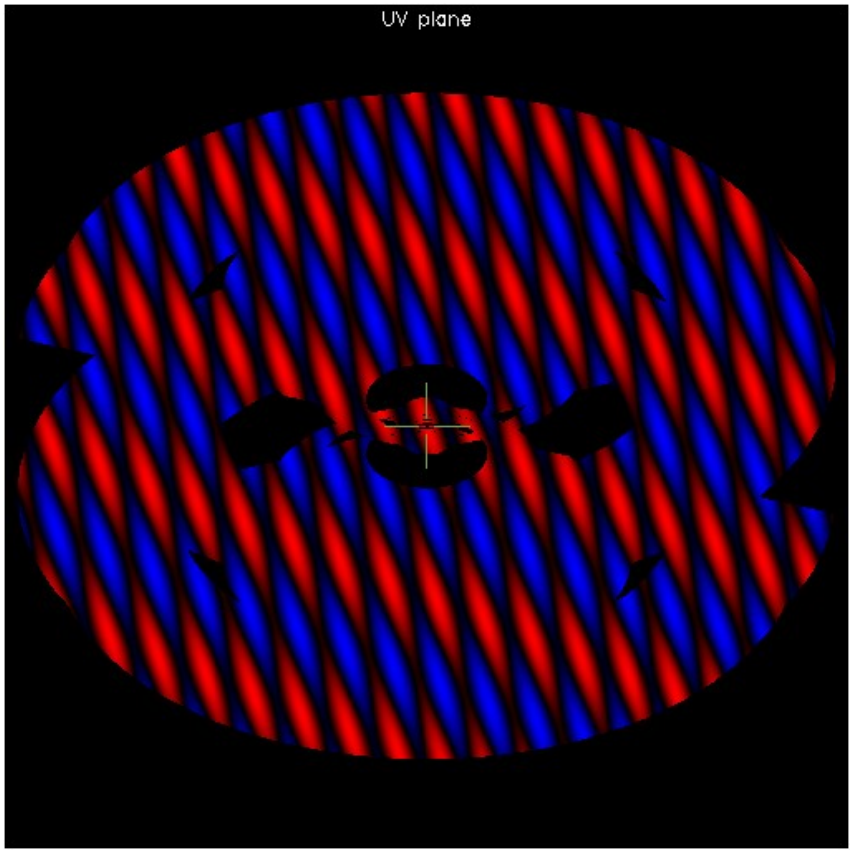
Applications of multi-beam CLEAN

Review of the S-W algorithm

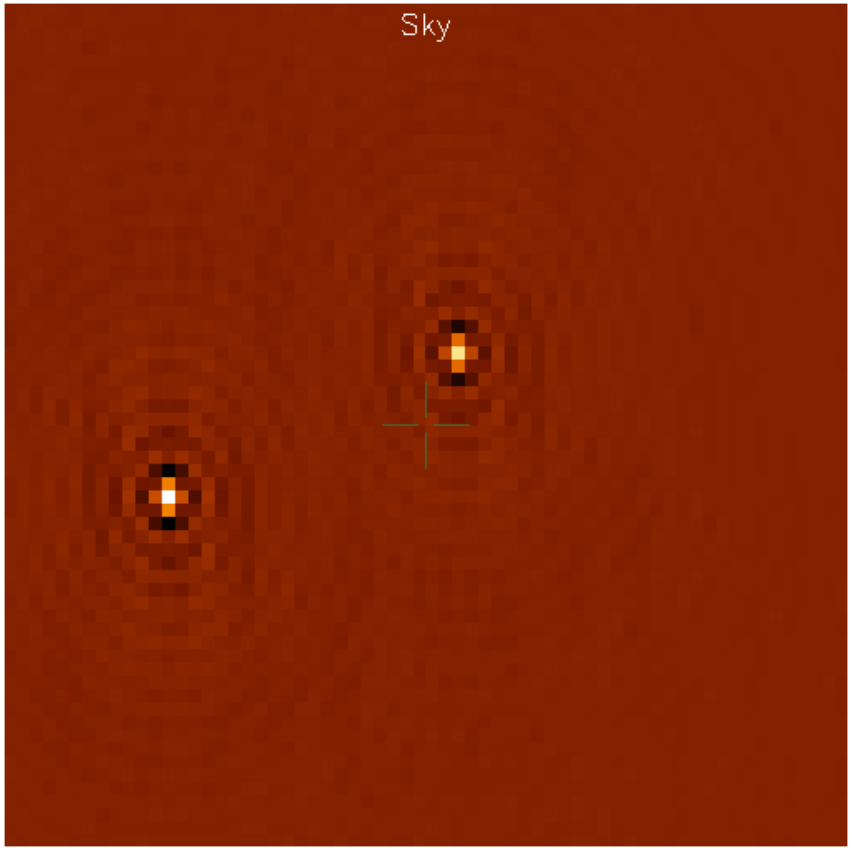
Review of the S-W algorithm

Wide-band frequency synthesis where all sources have flat spectra: standard CLEAN works perfectly*.

*well, *almost* perfectly.



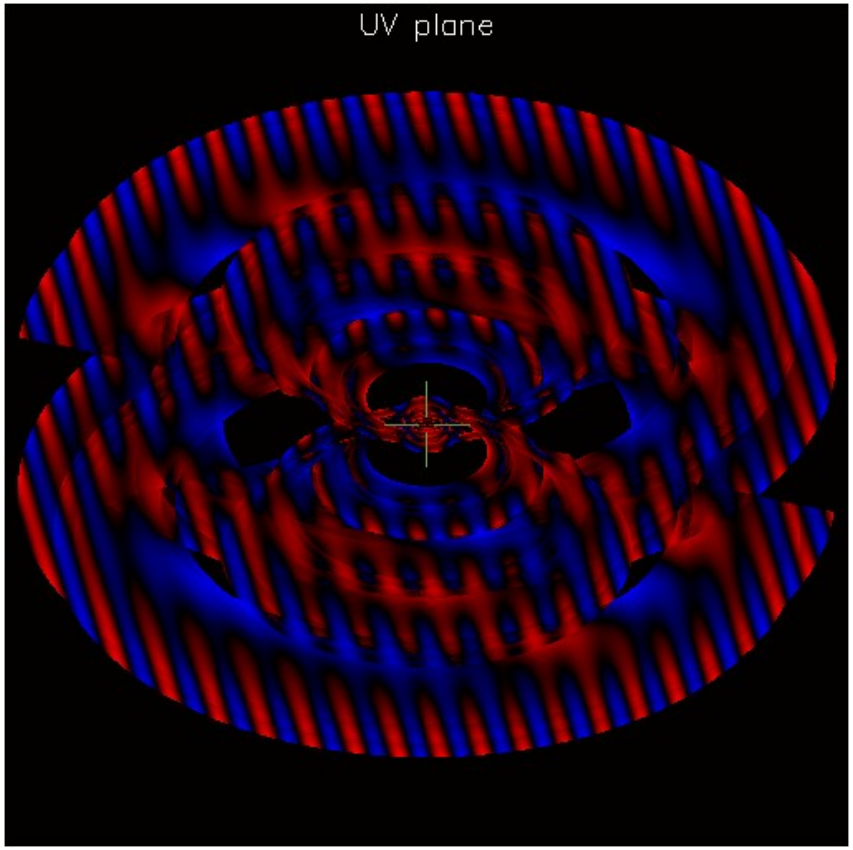
Simulated e-Merlin visibilities, 5 – 7 GHz, δ = +35° , uniform weighting.

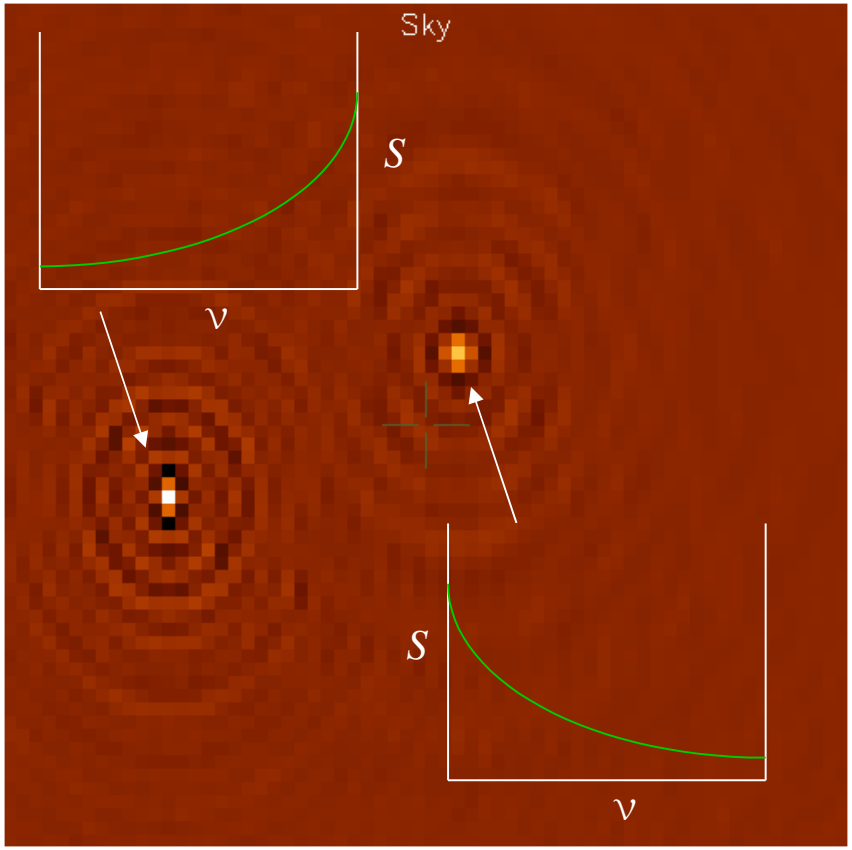


Dirty image.

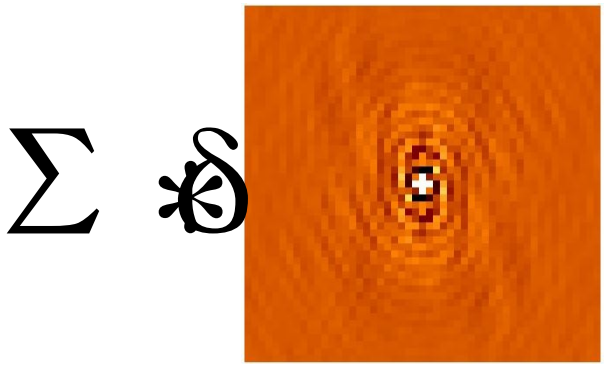
Review of the S-W algorithm

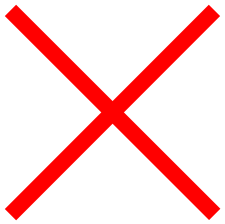
But, in the real world, different sources usually have different spectra.
In this case the CLEAN assumption breaks down.

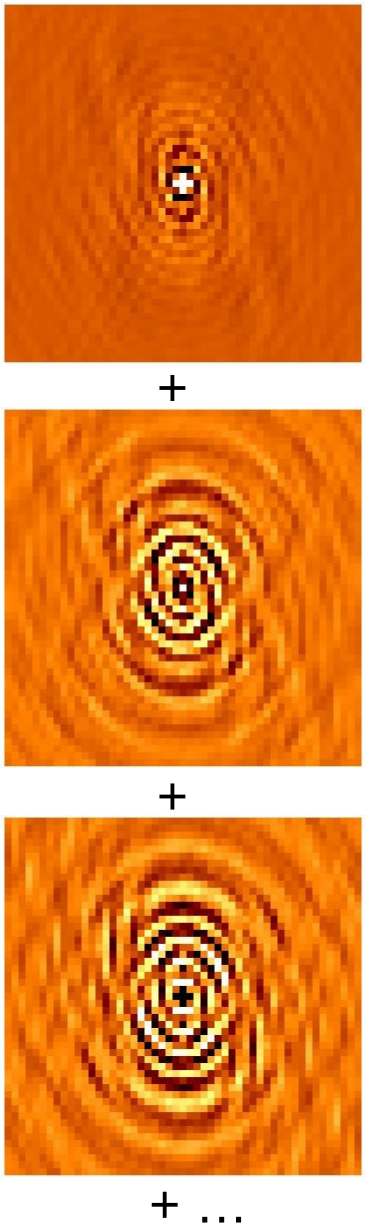




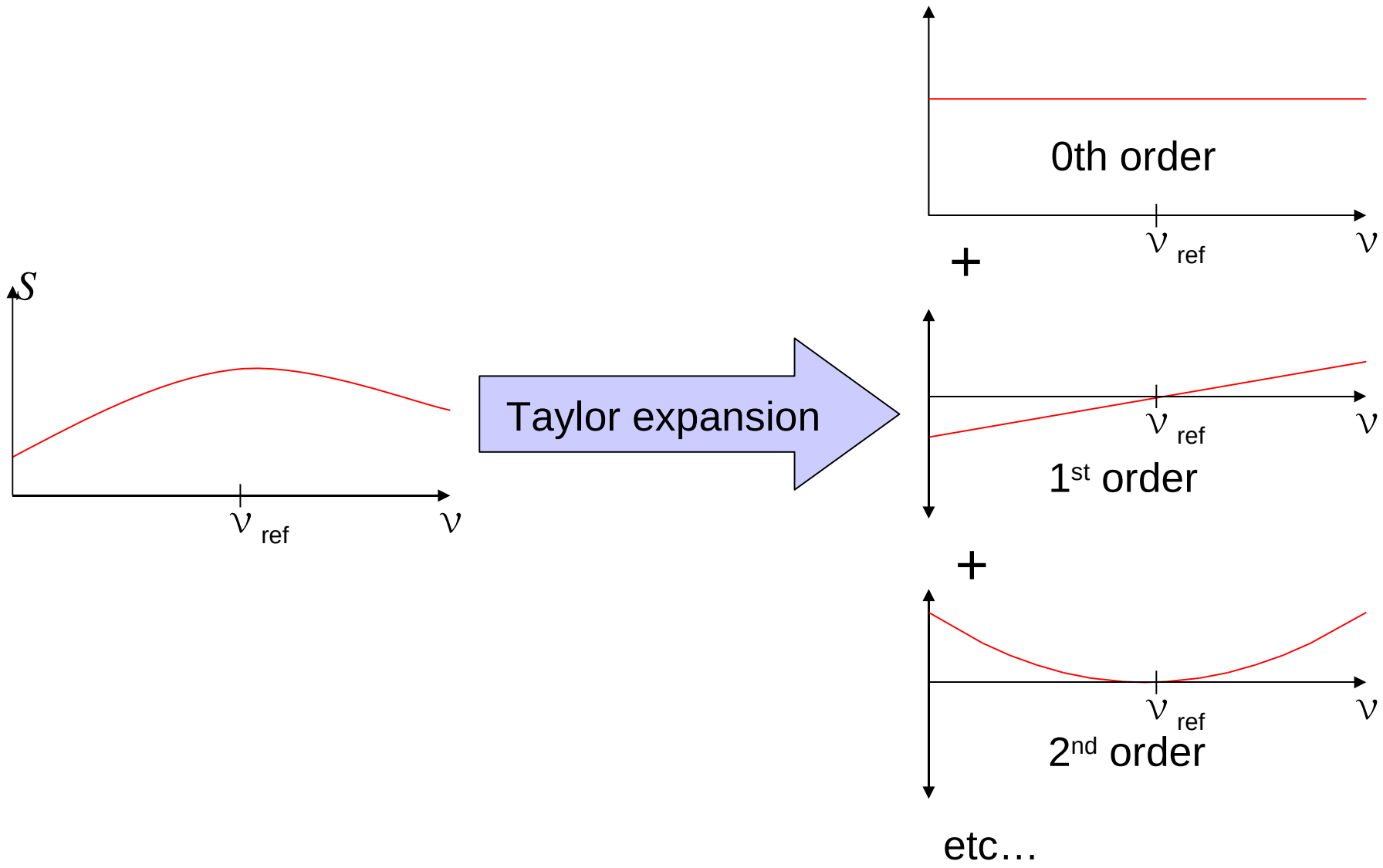
Review of the S-W algorithm





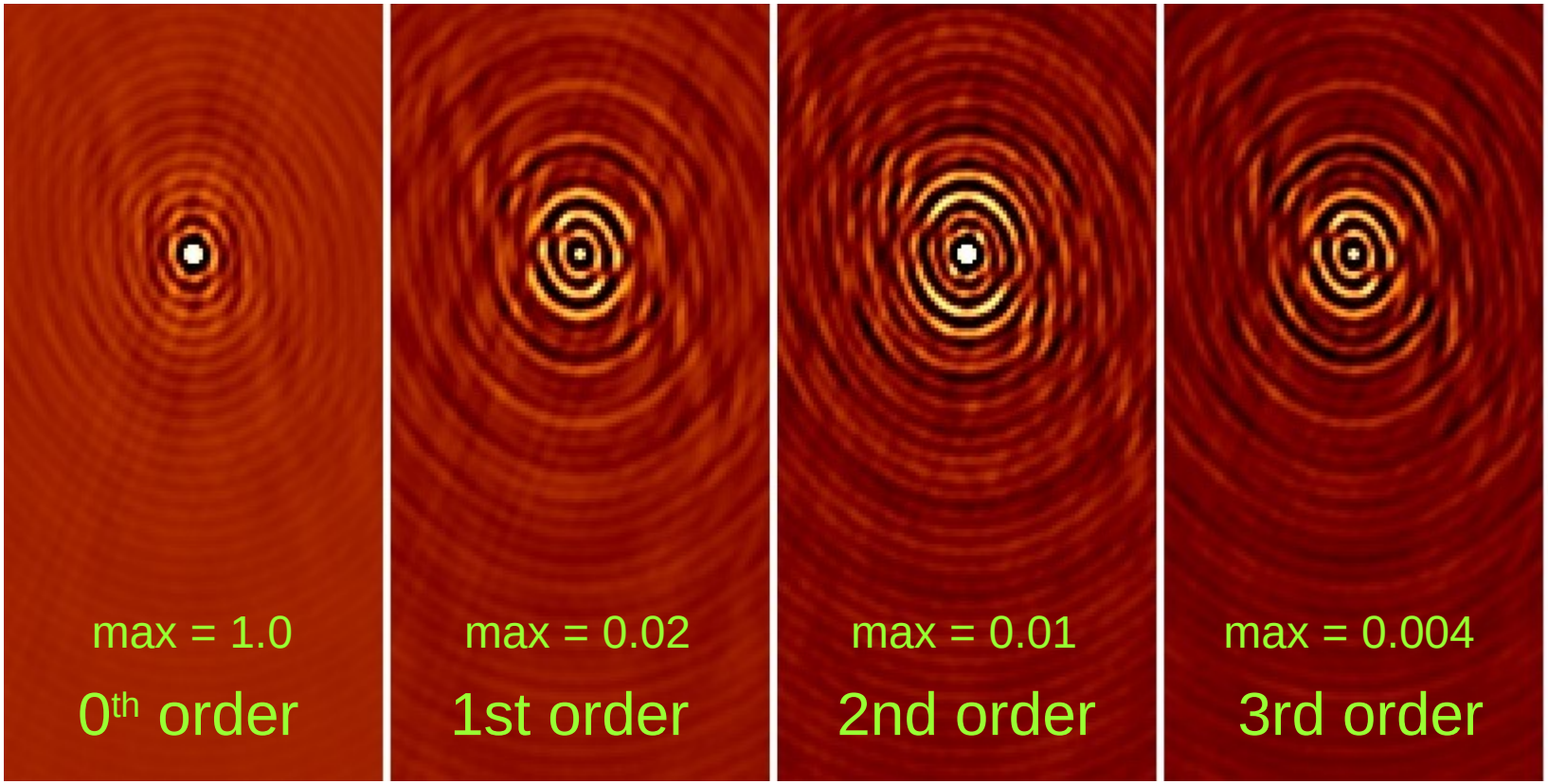


Review of the S-W algorithm



Review of the S-W algorithm

Taylor-series beams for a typical e-Merlin observation.

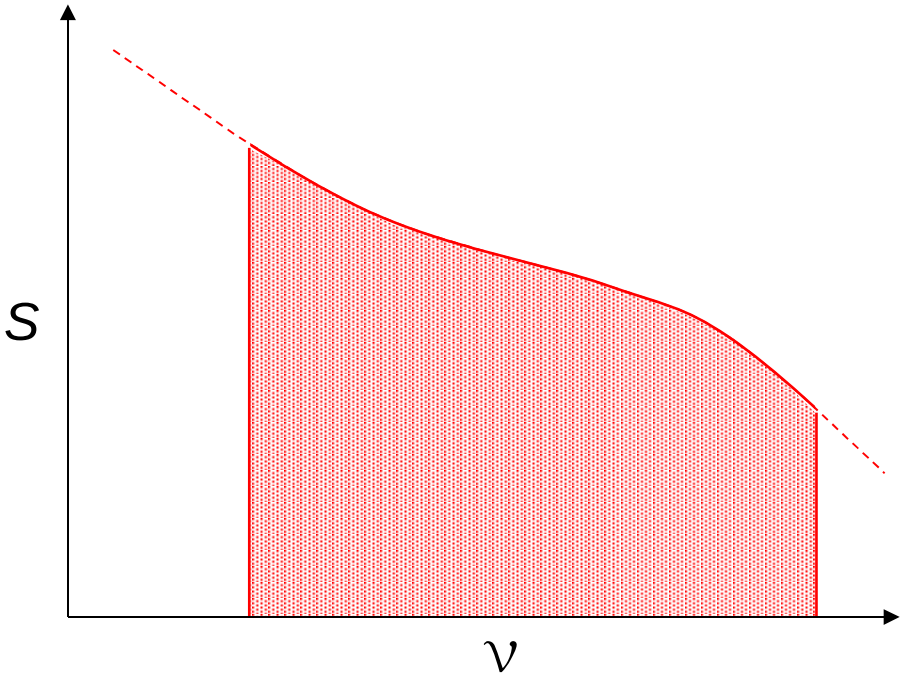


Fundamental aim of this talk:

To convince people that there is more to parallel CLEANing than Taylor expansion in frequency space.

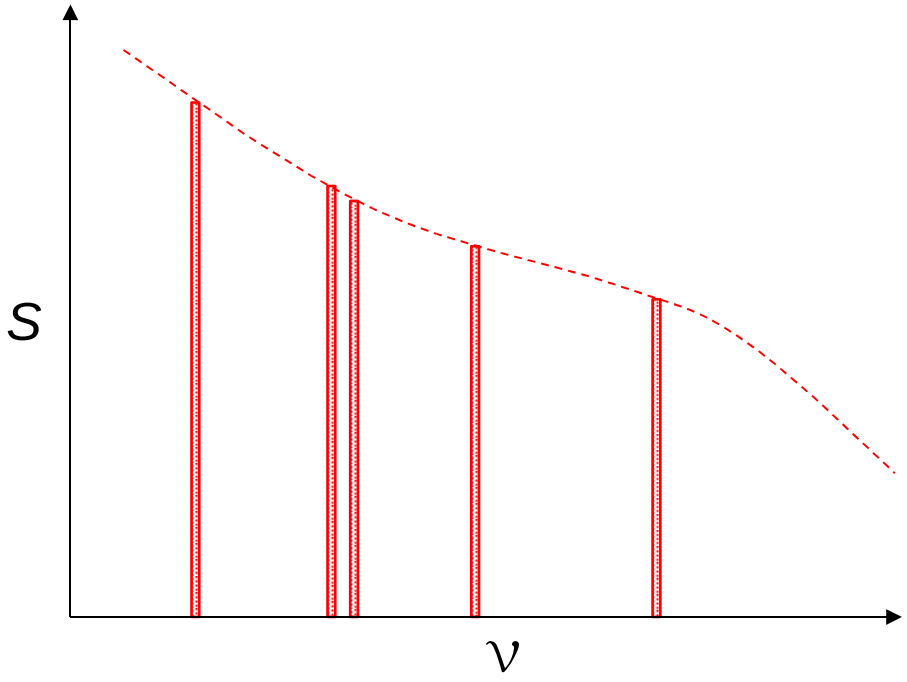
MFS of several narrow-band epochs

Wide-band instruments:



Suitable for Sault-Wieringa
(Taylor expansion)

Several narrow-band epochs:

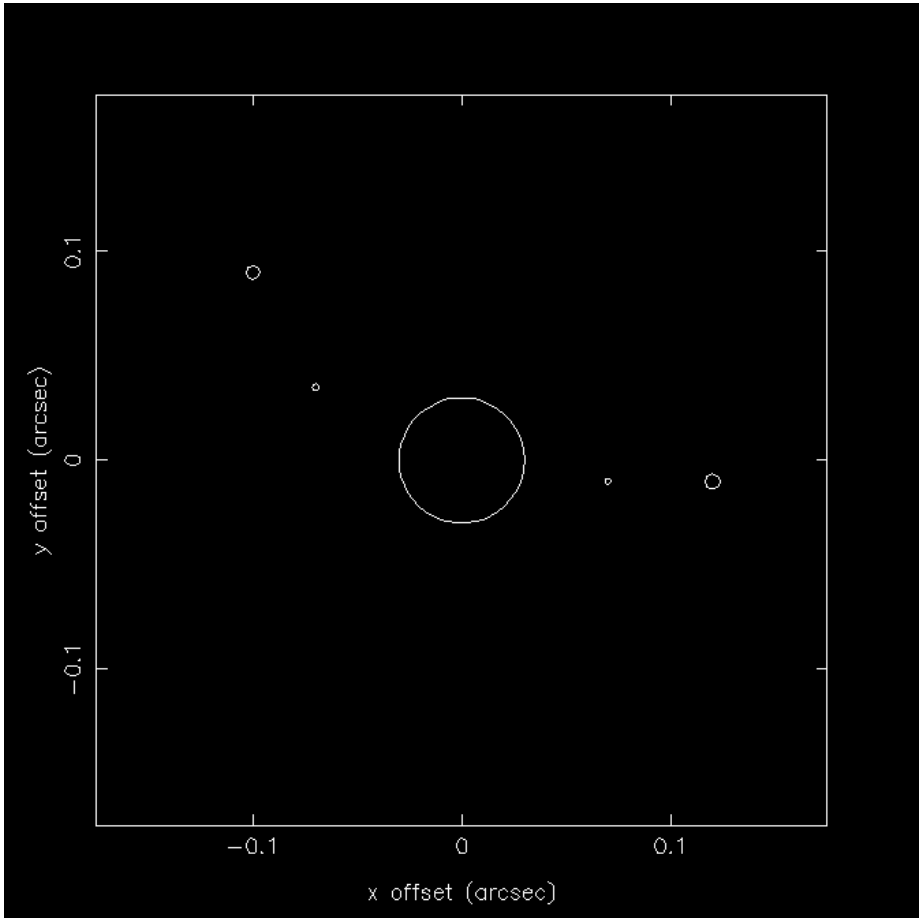


More natural:
1 beam per epoch.

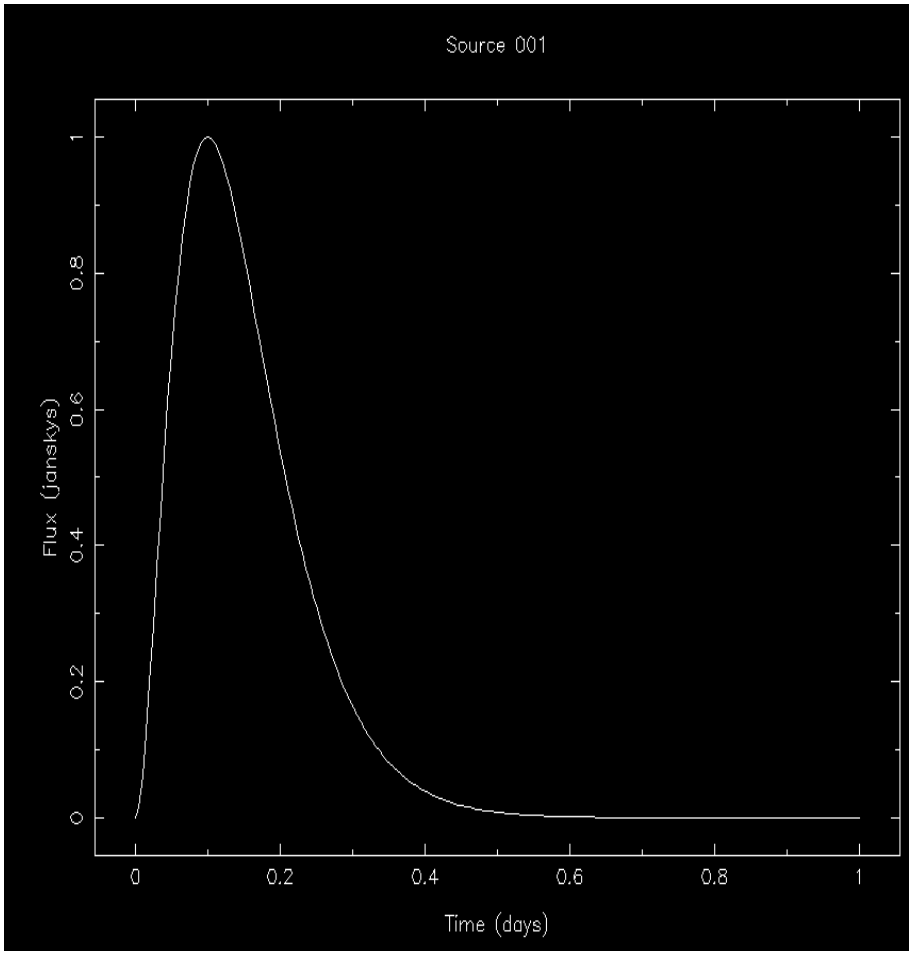
Parallel CLEAN for time synthesis

Parallel CLEAN for time synthesis

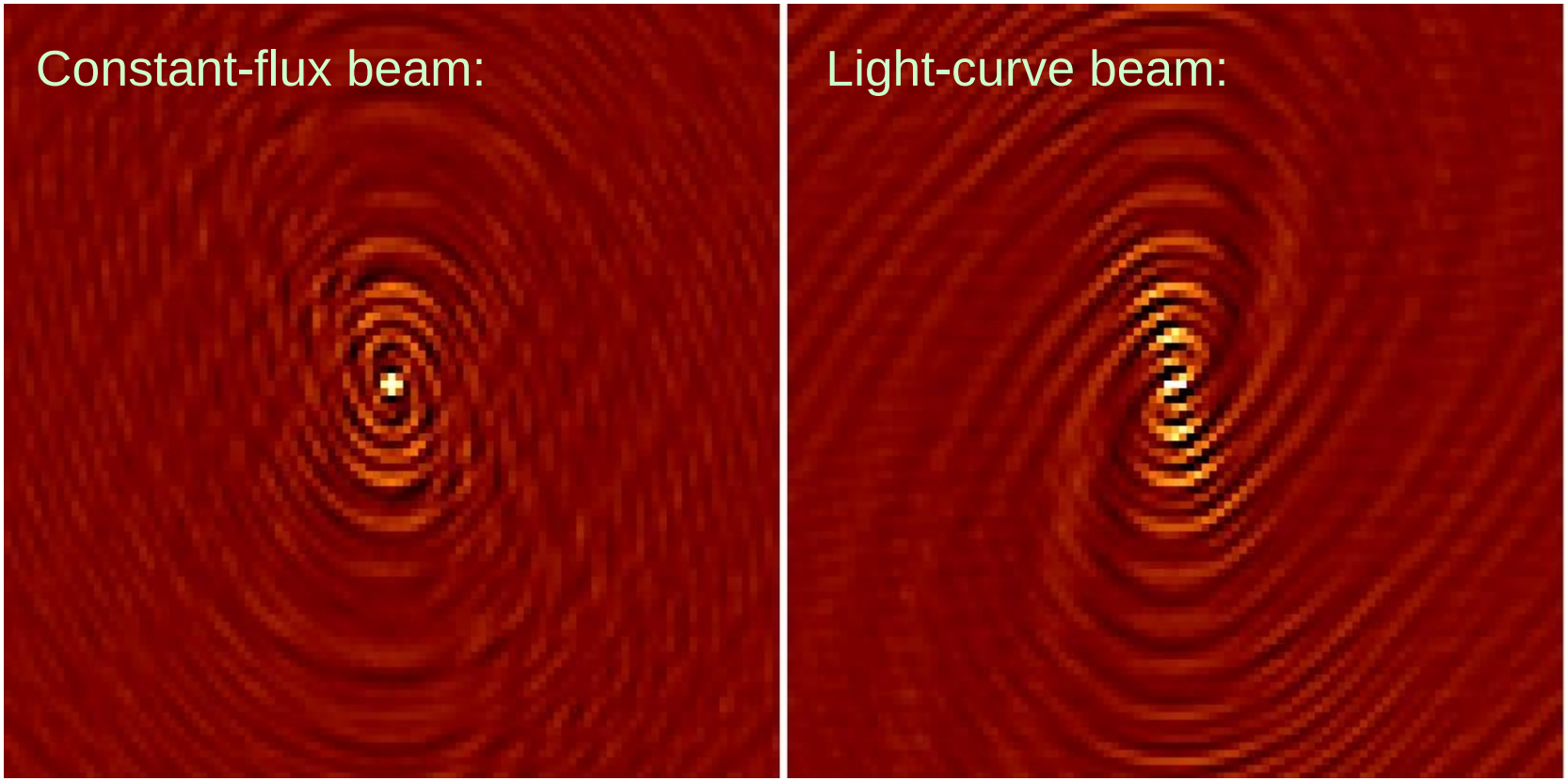
Model (time-averaged flux):



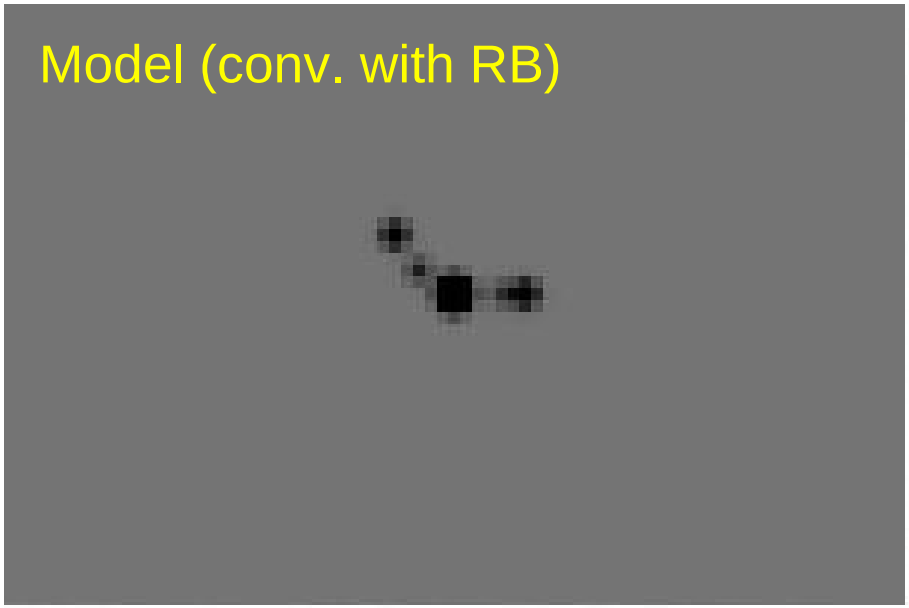
Light-curve of central source:

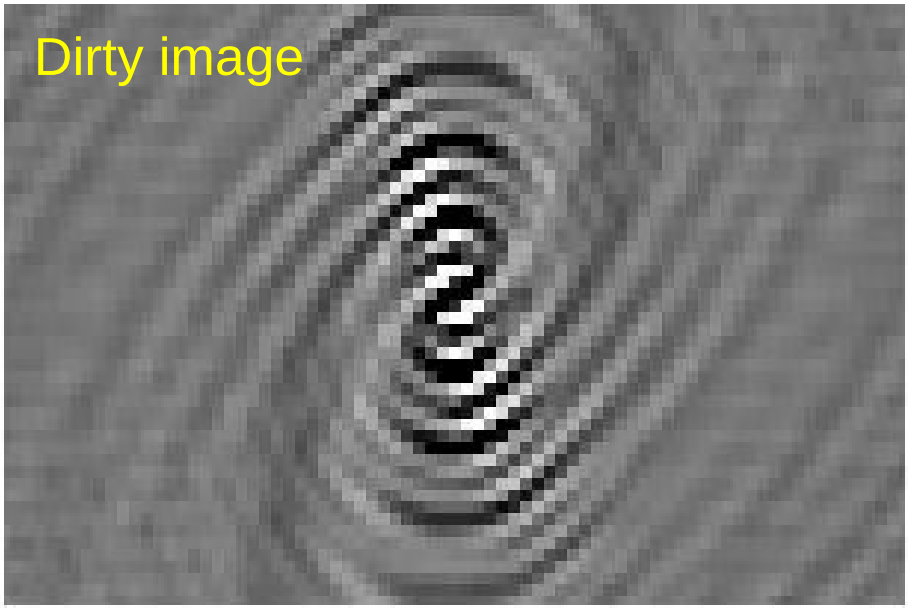


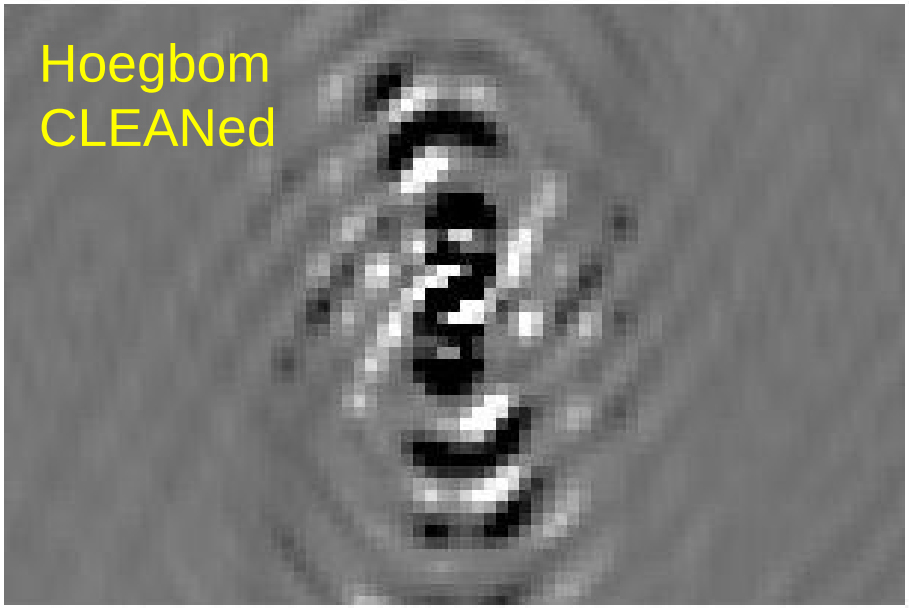
Parallel CLEAN for time synthesis

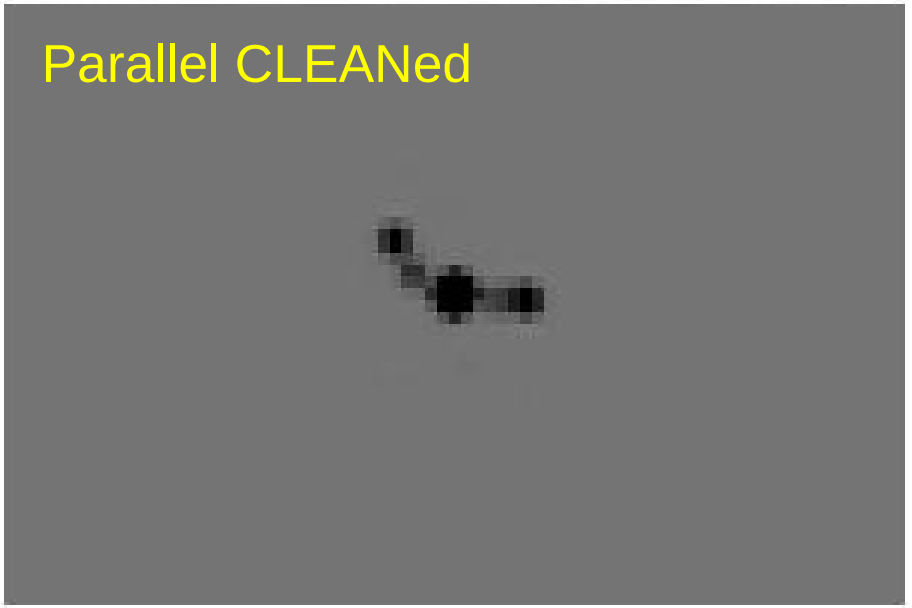


Parallel CLEAN for time synthesis



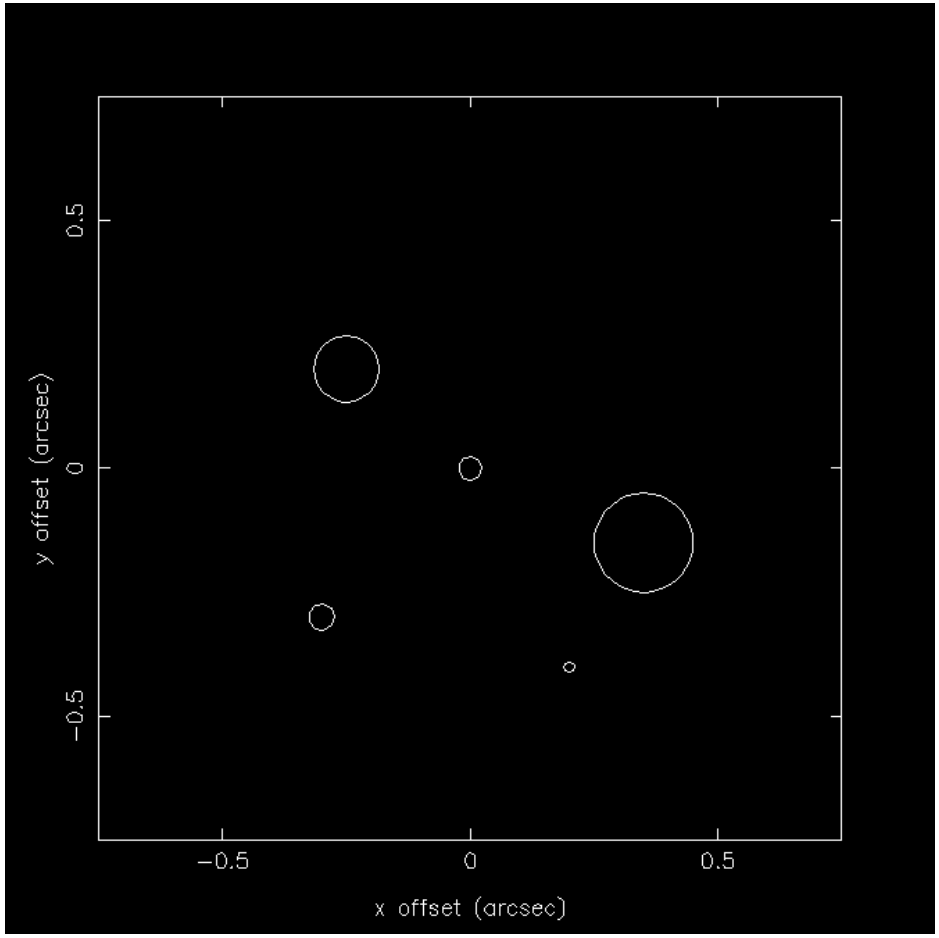




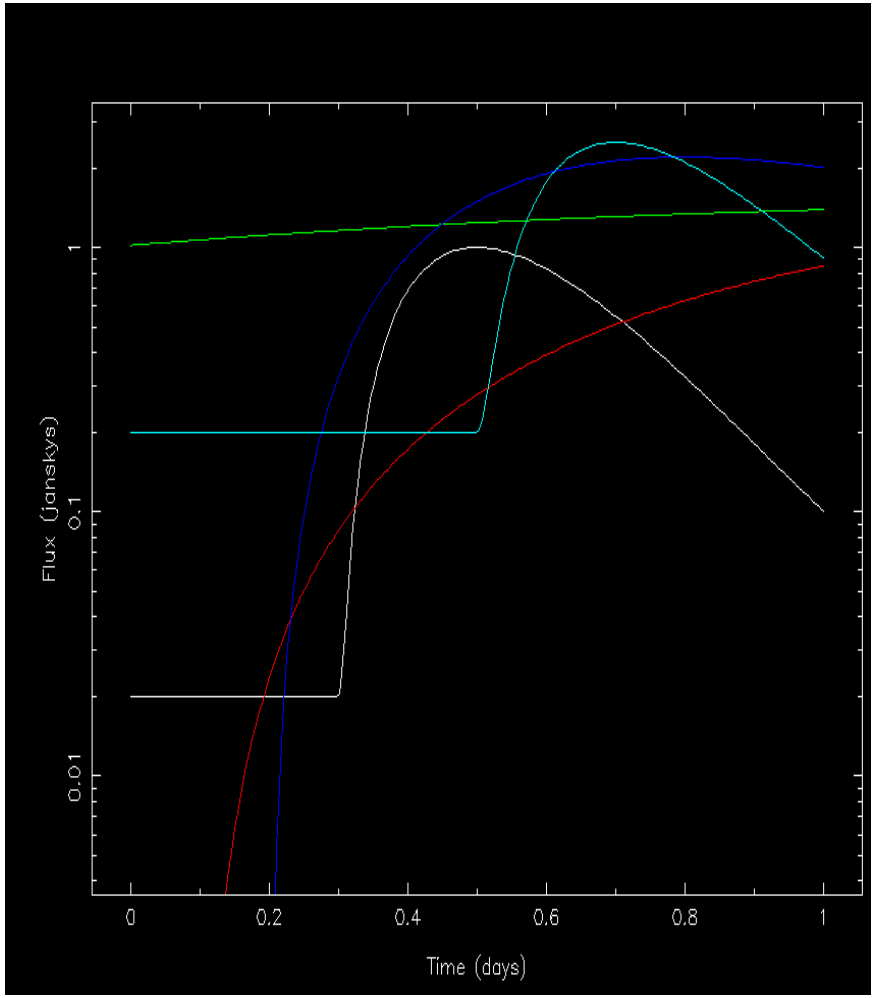


Parallel CLEAN for time synthesis

Model (flux averaged over frequency and time):

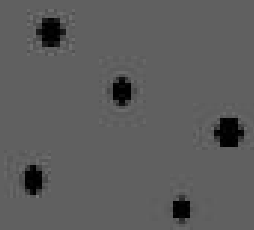


Light-curves:

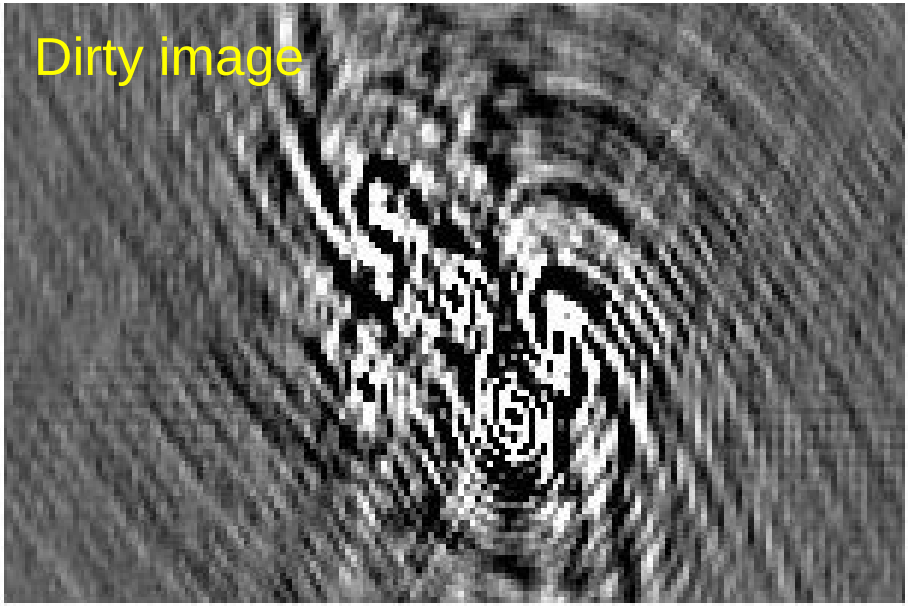


Parallel CLEAN for time synthesis

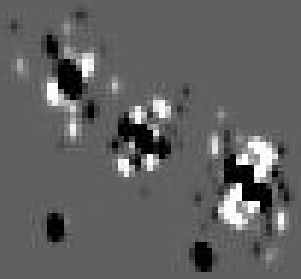
Model (conv. with RB)



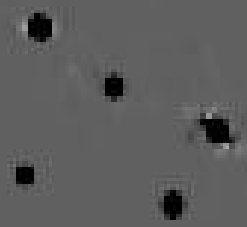
Dirty image



Hoegbom CLEANed



Parallel CLEANed



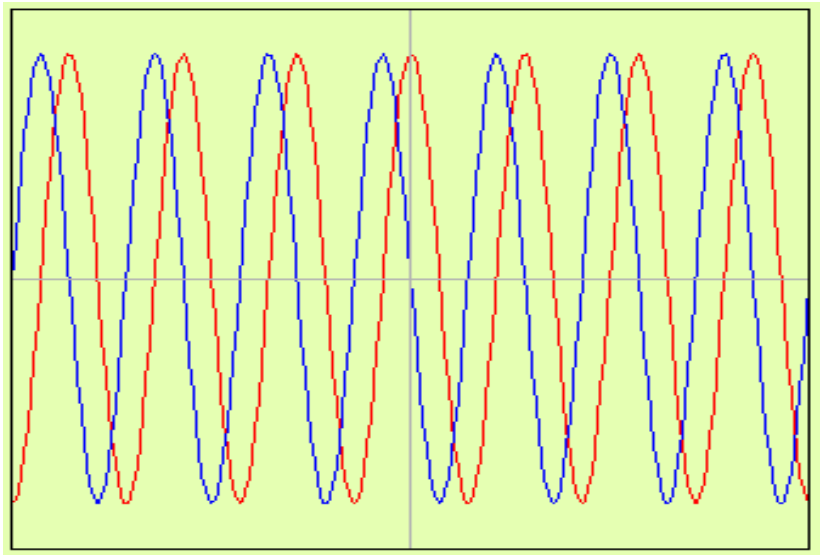
(0-2 freq) x (0-8 time)

Off-pixel-centre sources

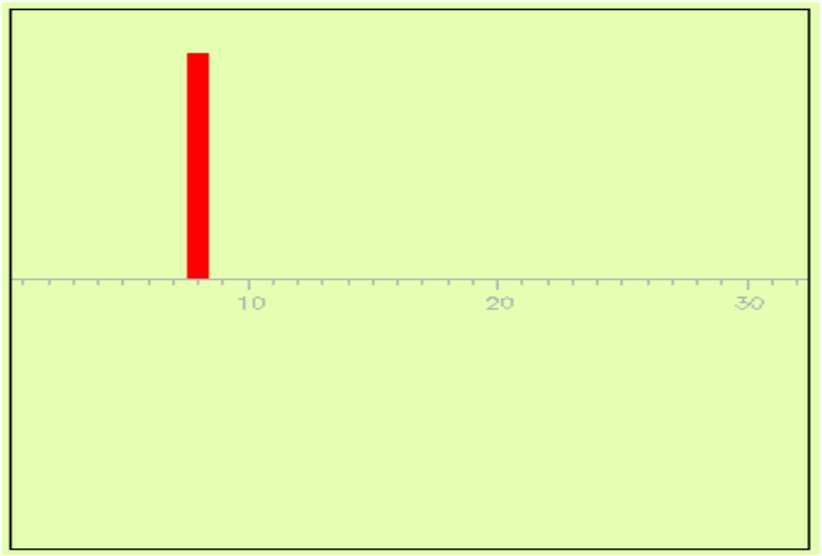
Off-pixel-centre sources

U-V ‘plane’

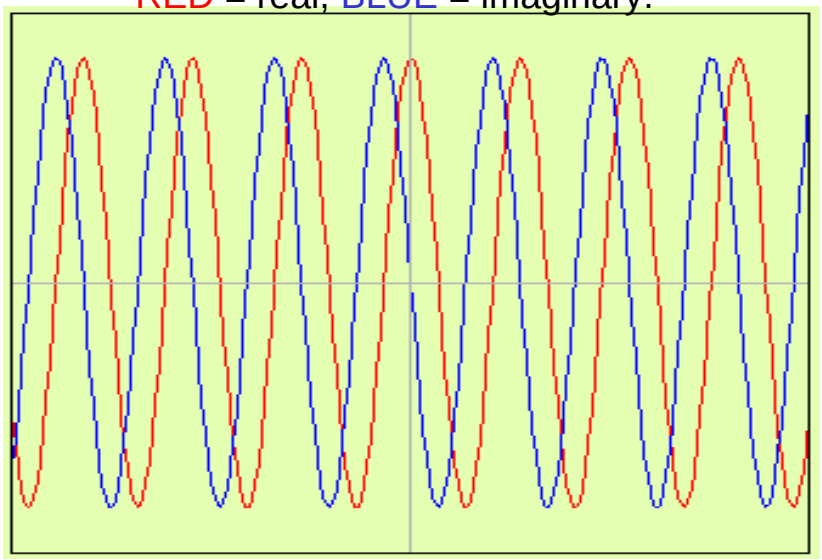
‘Sky’



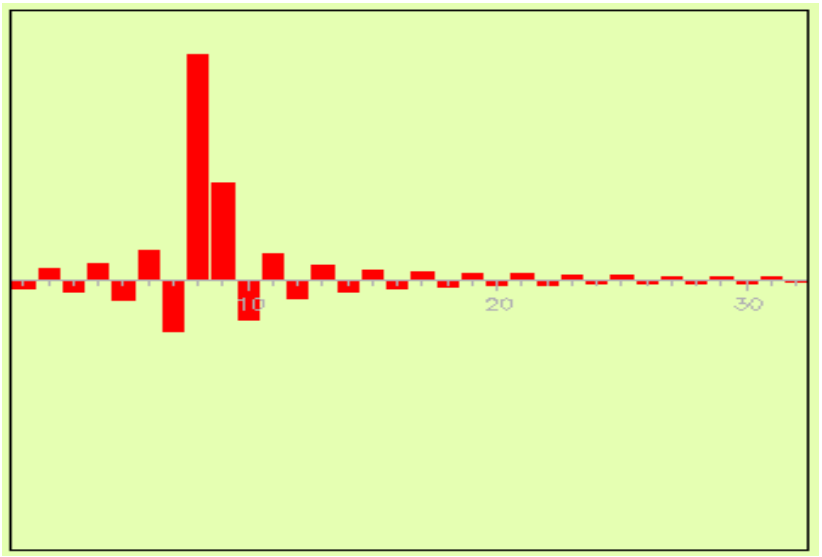
Fourier



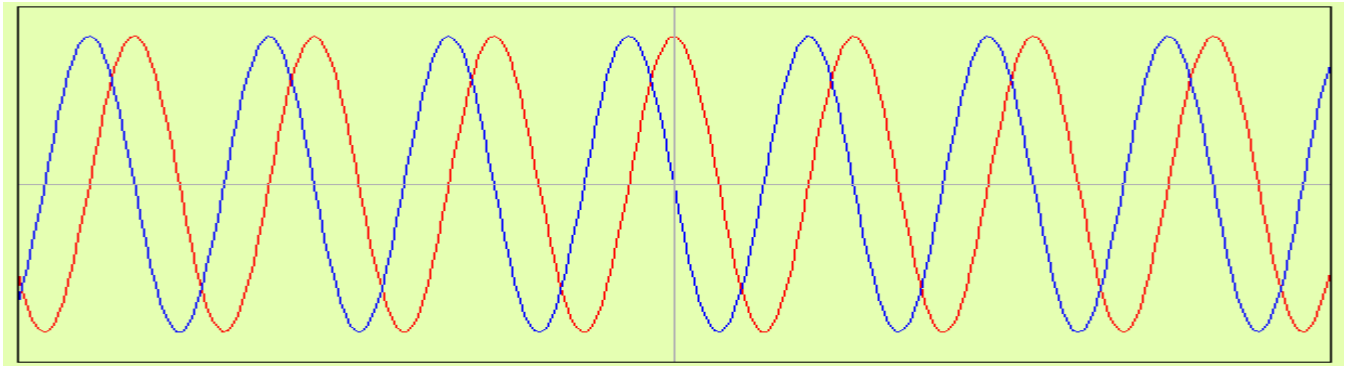
RED = real, BLUE = imaginary.



Fourier

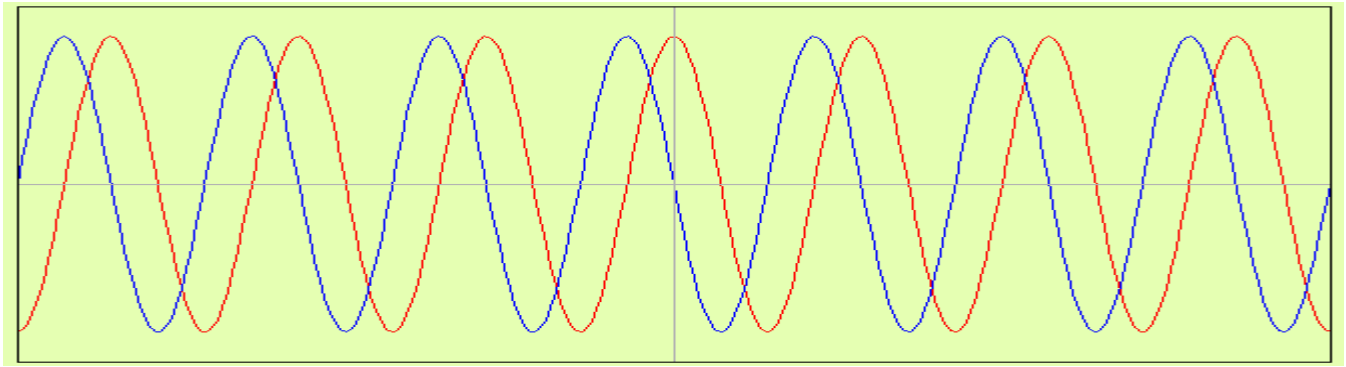


Off-pixel-centre sources



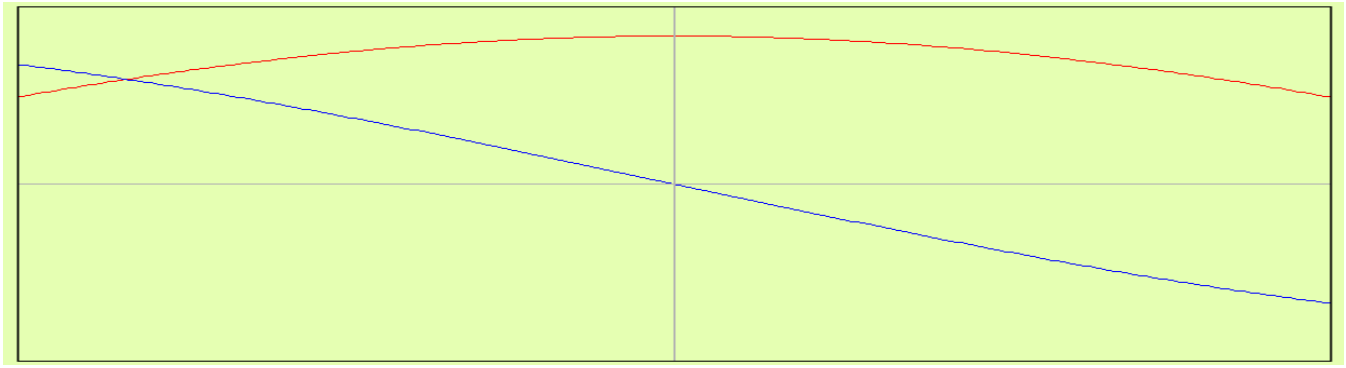
$$\exp\left(-2\,\pi\,\mathrm{i}\left[n+f\right]\frac{t}{T}\right)$$

=



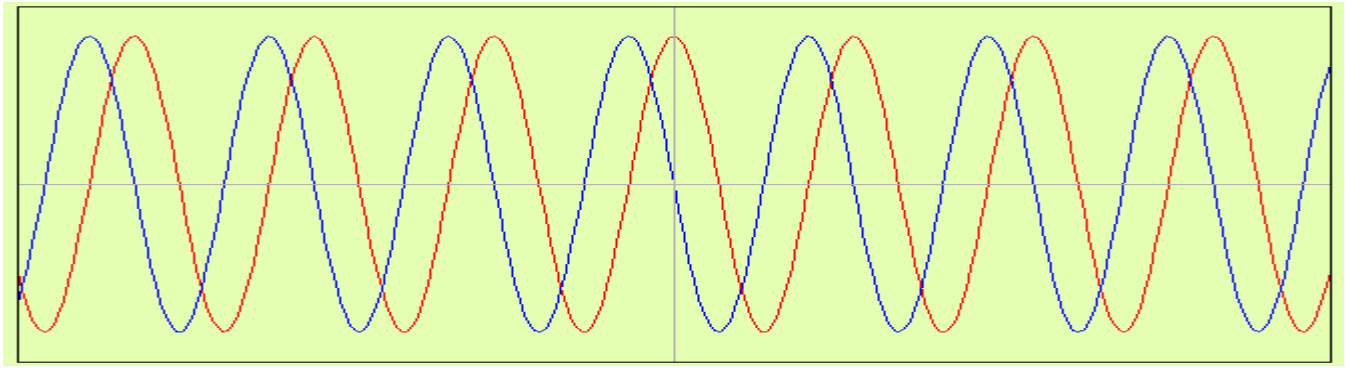
$$\exp\left(-2\,\pi\,in\,\frac{t}{T}\right)$$

X



$$\exp\left(-2\,\pi\,if\,\frac{t}{T}\right)$$

Off-pixel-centre sources



$$\exp\left(-2\,\pi\,\mathrm{i}\left[n+f\right]\frac{t}{T}\right)$$

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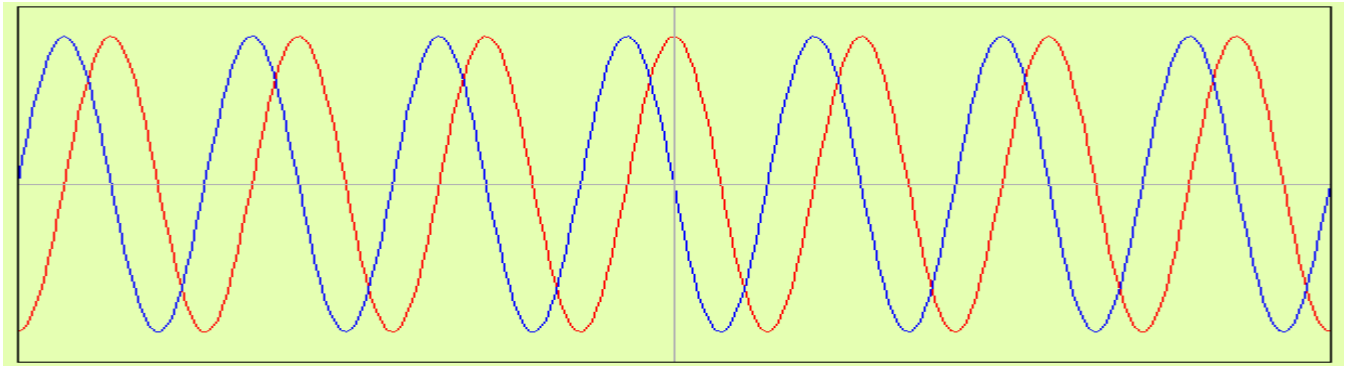

$$\exp\left(-2\,\pi\,in\,\frac{t}{T}\right)$$

X

$$1-2\,\pi\,if\,\frac{t}{T}$$

Off-pixel-centre sources

Lower left source at ($m\,\Delta x$-0.4, $n\,\Delta y$+0.2):