FOREGROUND SIMULATION FOR GMRT 150 MHz OBSERVATION

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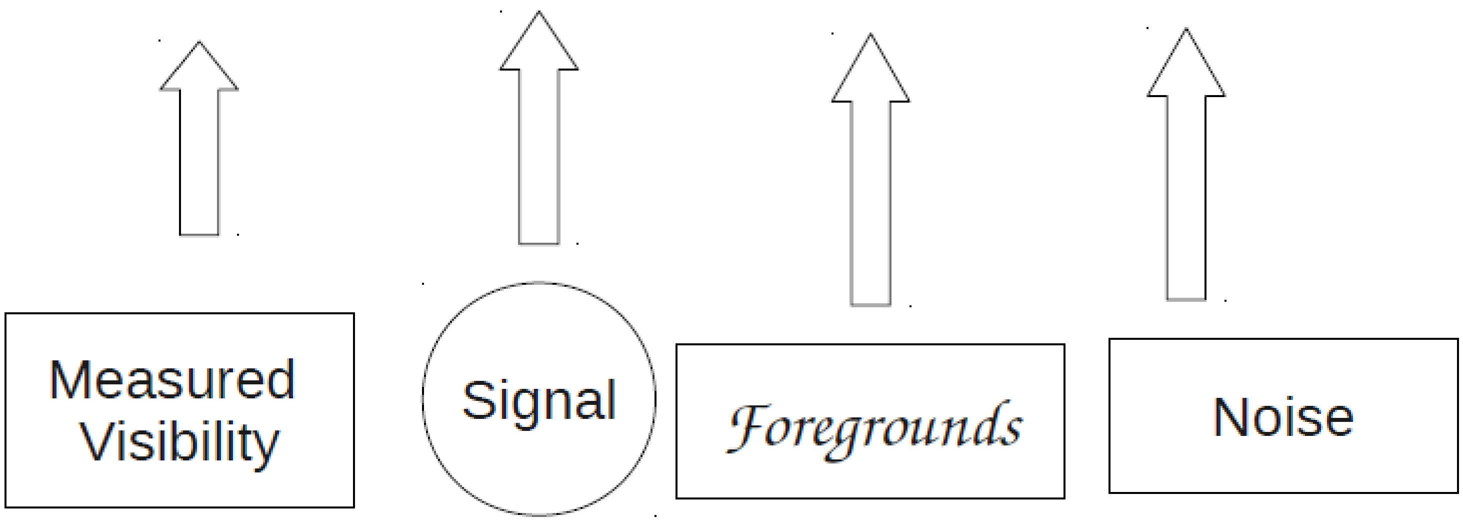
Measurements and Visibility:

$$V(U,\nu)=\iint d^2\theta\, I(\theta,\nu)A(\theta,\nu)e^{-i2\pi U\cdot\theta}$$

$$V(\mathbf{U},\nu)=S(\mathbf{U},\nu)+F(\mathbf{U},\nu)+N(\mathbf{U},\nu)$$



Foreground Components

- Point Sources
- Galactic Synchrotron emission
- Galactic and Extra-galactic free-free emission

We simulate only two Foreground components:

- Point Sources
- Galactic Synchrotron emission

<u>GMRT 150 Parameters</u>:

Field of View ~ 3.8deg

Angular Resolution($\Delta\theta$) ~ 20``

SIMULATING THE POINT SOURCES

The Differential Source count in Flux range (9mJy to 1Jy) is for 150 MHz ,

$$\frac{dN}{dS} = \frac{10^{3.75}}{\mathrm{Jy.Sr}} \left(\frac{S}{\mathrm{Jy}}\right)^{-1.6}$$

S=Flux of the Point Source.

(Ghosh et al. 2012,@ 150 MHz, GMRT)

Total no. of source, $N_{tot} = \int_{S\min}^{S\max} \frac{dN}{dS} dS$

Cumulative Prob. $P(S) = \frac{1}{N_{tot}} \int_{S\min}^{S} \frac{dN}{dS} dS$

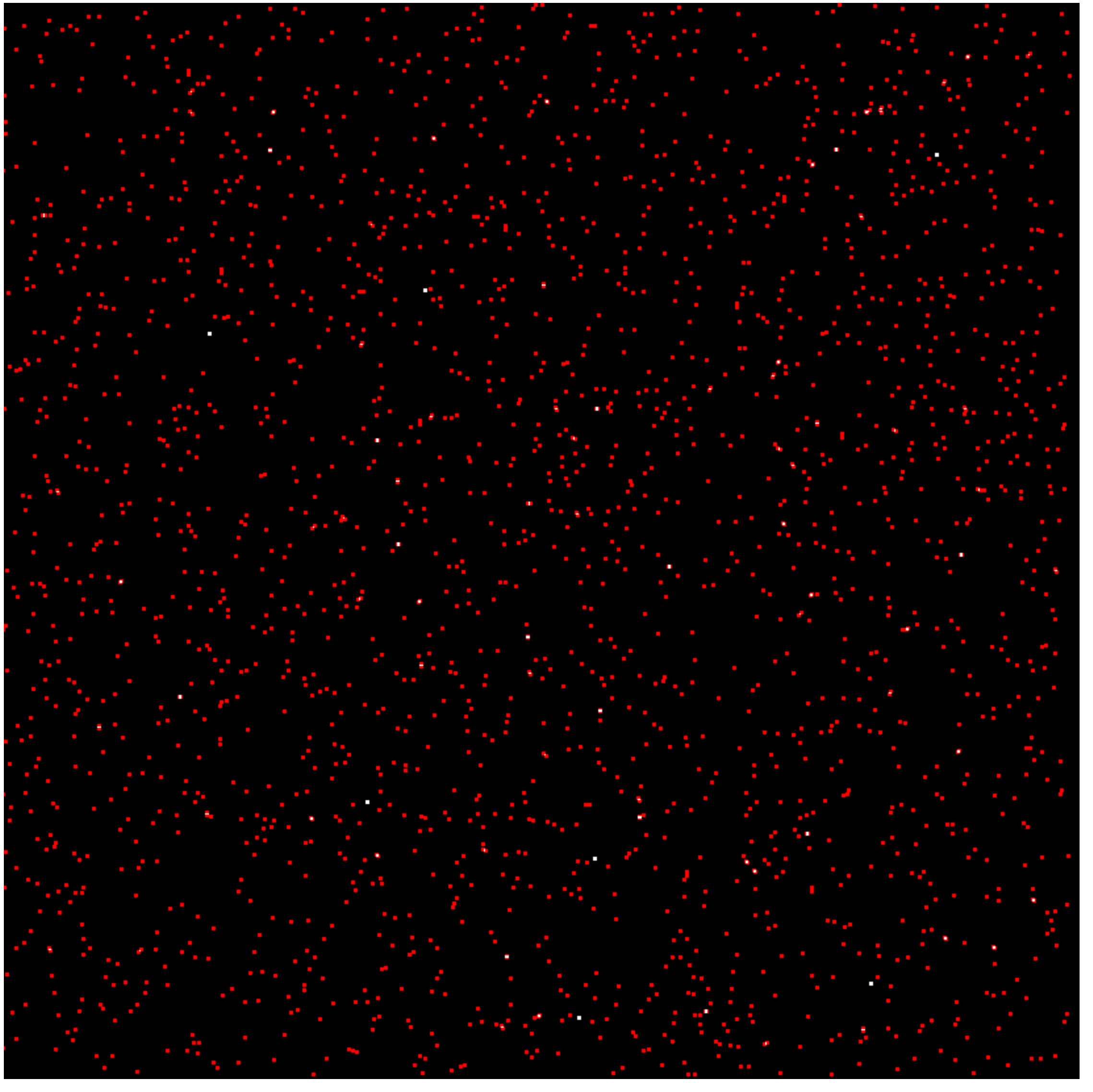
Where, $S_{\min} < S < S_{\max}$ and $0<P(S)<1$.

We give a random no. between 0 to 1 and generate corresponding flux and random position within FoV.

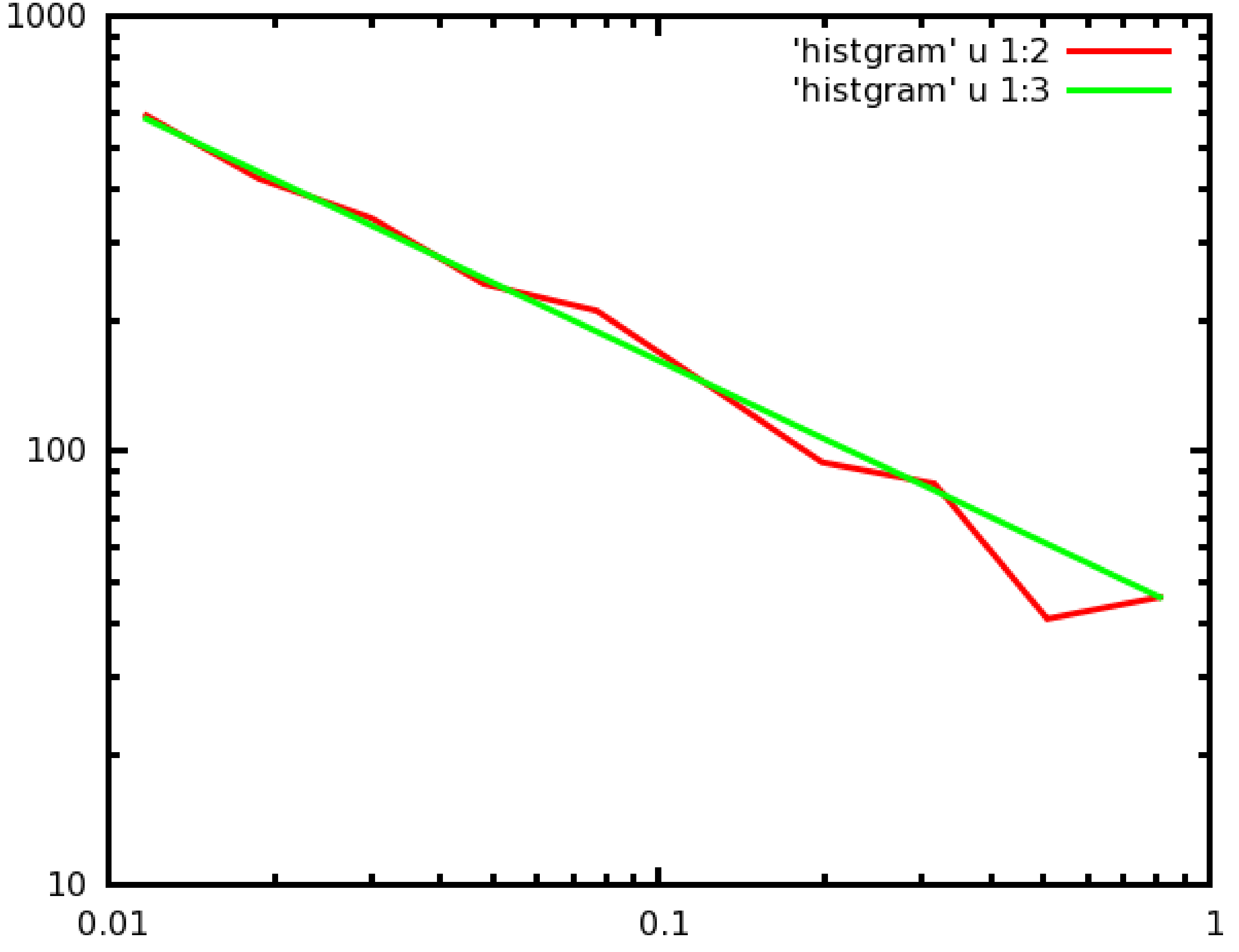
Total number of point sources within 7deg are 2215.
But only 696 sources in our simulation.

>100mJy at the outer region

Point Sources (N_{tot}=696)



No. of Point Source vs Flux(Jy)



SIMULATING THE DIFFUSE SYNCHROTRON RADIATION

Power spectrum is given by,

$$P(U) = \left(\frac{\partial B}{\partial T}\right)^2 C_{2\pi U}$$

$C_{2\pi U}$ is the Angular Power Spectrum.

$$C_{2\pi U}(\nu) = A_{150}\left(\frac{150}{\nu}\right)^{2\alpha}\left(\frac{1000}{2\pi U}\right)^{\beta}$$

$$A_{150} = 513 mK^2, \alpha = 2.8, \beta = 2.34$$

Ghosh et. al. 2012MNRAS.426.3295-3314

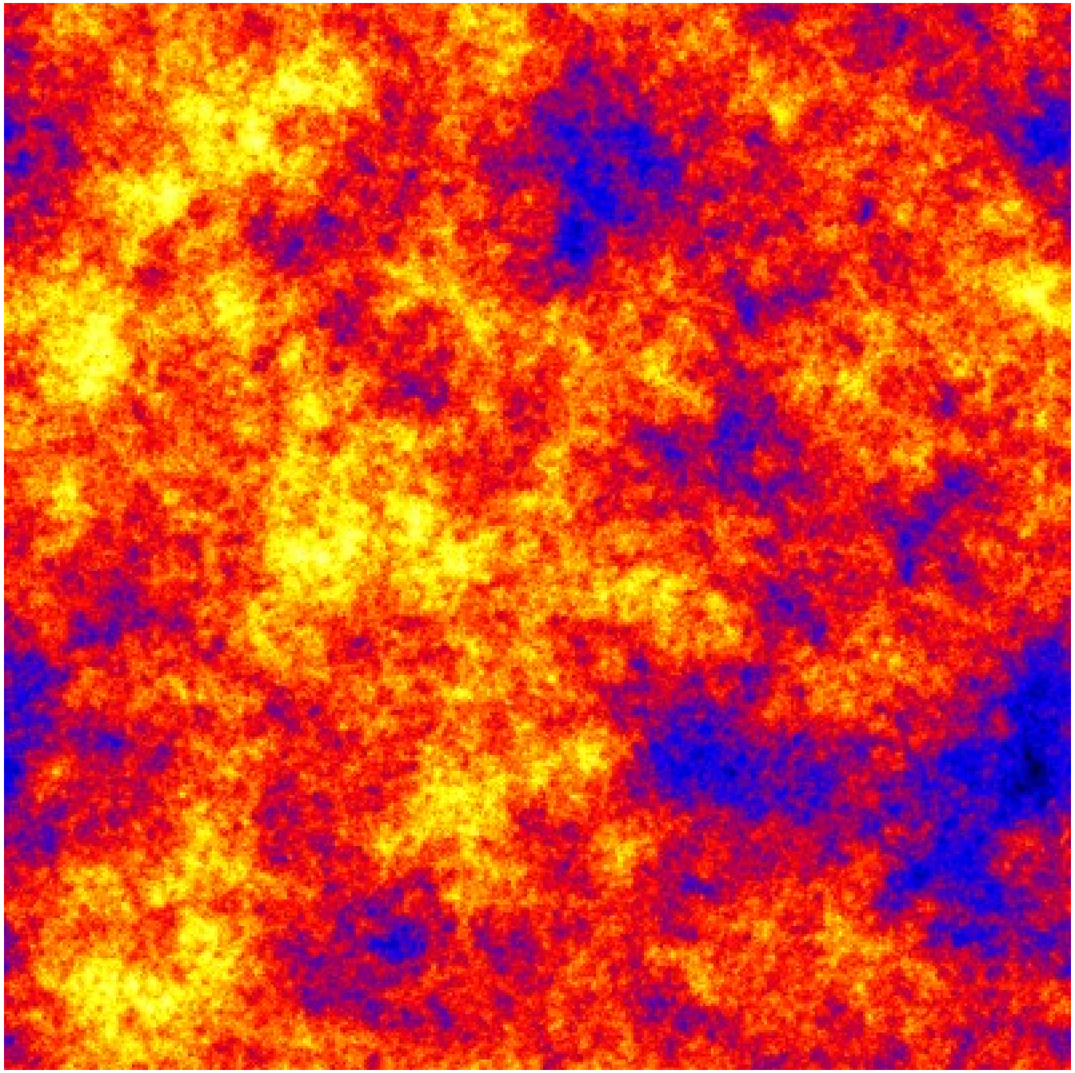
$$\Delta I(U,\upsilon) = \sqrt{AP(U)}\,\frac{x+iy}{\sqrt{2}}$$

$\Delta I(U,\upsilon)$ is the FT of $\Delta I(\theta,\upsilon)$

A is the solid angle, x and y Gaussian random variable.

So, by Inverse FT we will get $\Delta I(\theta)$.

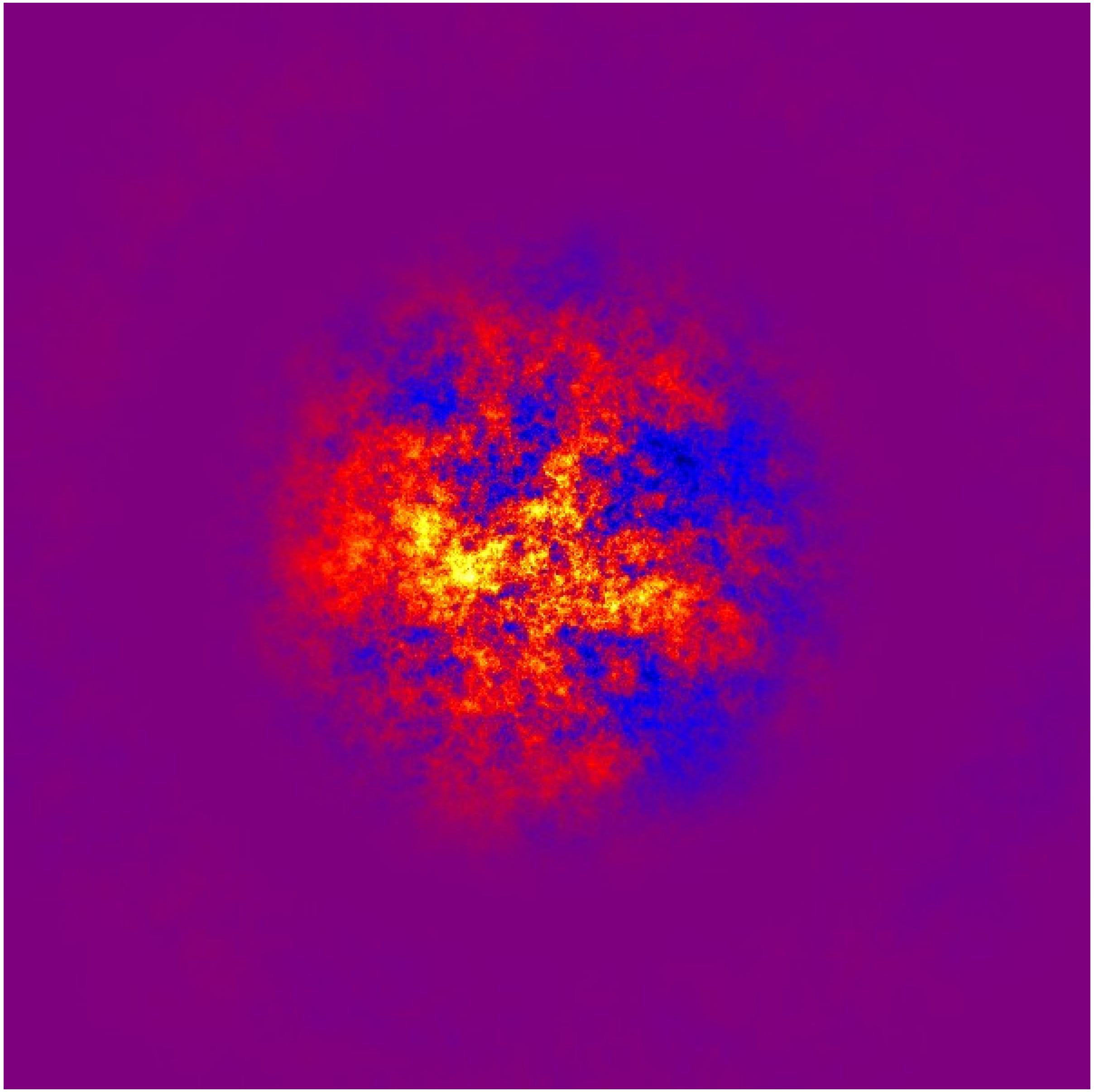
Simulated Diffuse Synchrotron Radiation



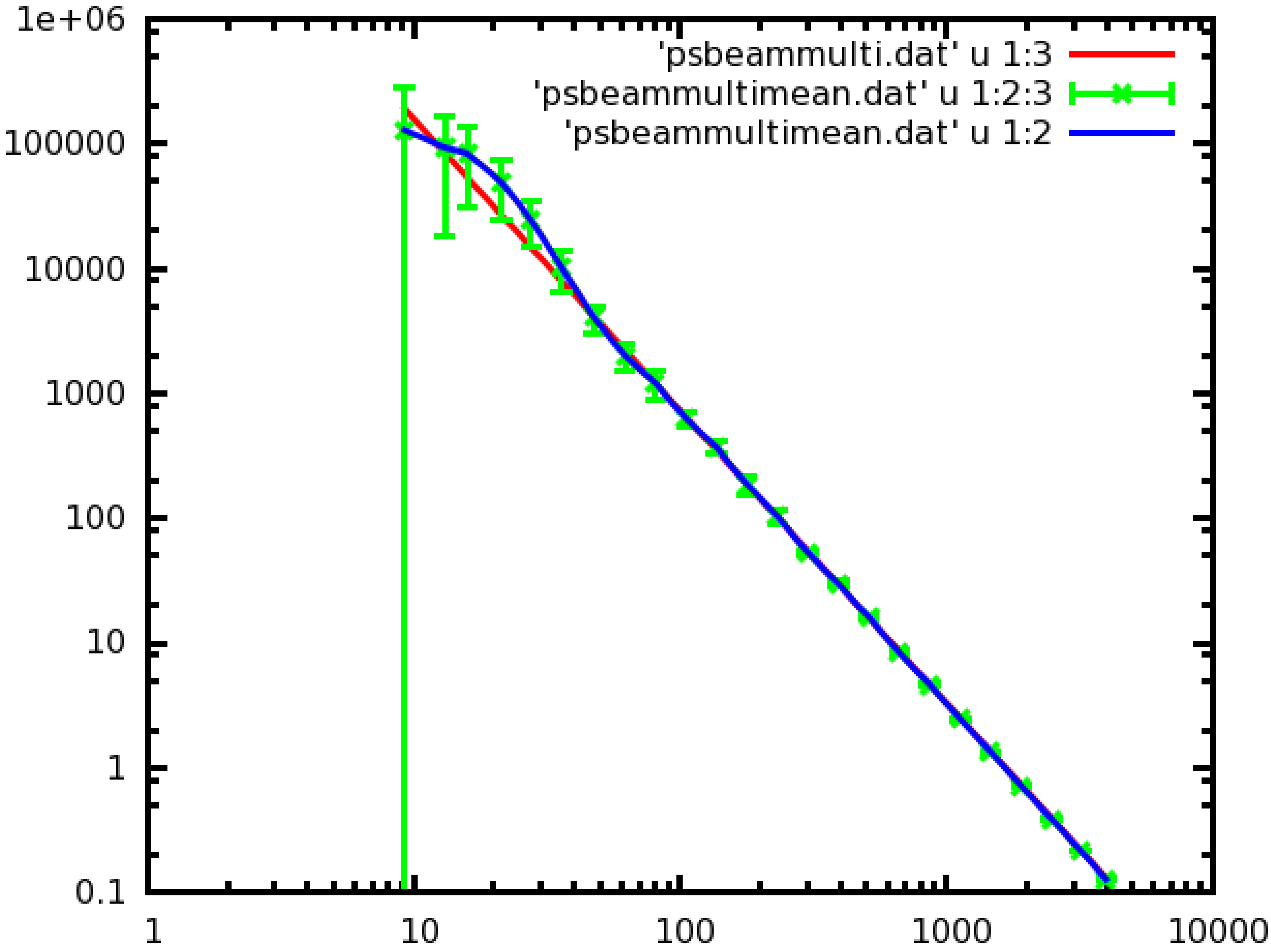
Grid Size=1024 Pixel Size= 0.5'×0.5'

GMRT Primary Beam

$$\mathcal{A}(\vec{\theta},\, \nu) = \left[\left(\frac{2\lambda}{\pi\theta D} \right) J_1 \left(\frac{\pi\theta D}{\lambda} \right) \right]^2$$



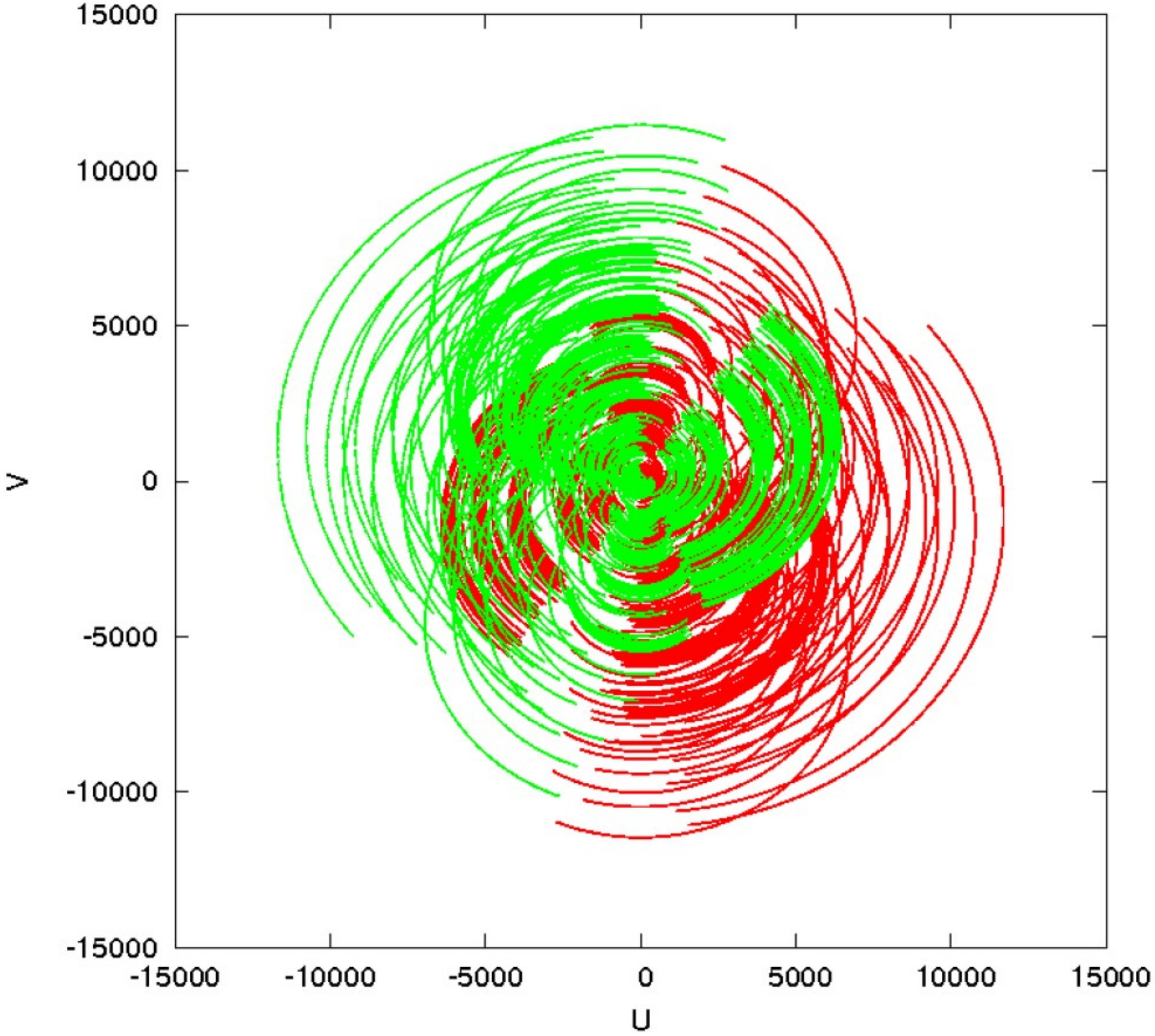
Power Spectrum vs. Baseline(Diffuse)



Simulated GMRT Obsevation

Parameter	Value (GMRT)
R.A.	10h46m00s
Dec	$59^\circ 00' 59''$
N_{ant}	30
Bandwidth	16 MHz
N_{chan}	128
$\Delta\nu$	125 kHz per channel
Δt	16 sec
T_{obs}	8 hr

Simulated GMRT Observation



U-V Distribution

Simulated GMRT Observation

We add Gaussian Random Noise for each Polarization with zero mean and standard deviation:

$$\sigma = \frac{\sqrt{2} k_B T_{sys}}{A_{eff} \sqrt{\Delta\nu \Delta t}}$$

$$\sigma_n = 1.03\,\mathrm{Jy}$$

U-V Distribution

THANK YOU