Noise power spectrum for different array configurations

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Outline

- Noise power spectrum calculation
- Transfer function
- NPS for different regular configurations
- Cylinder case
- Different declination

Computation

- NPS from reconstructed map with pure noise on visibilities.

$$C(l) = \langle Alm\ Alm^{*} \rangle$$

- NPS from noise covariance matrix.

$$C(l) = \Sigma_{m}\sigma(l,m)\ ; \qquad \sigma = (B\ N^{-1}\ B^{*})$$

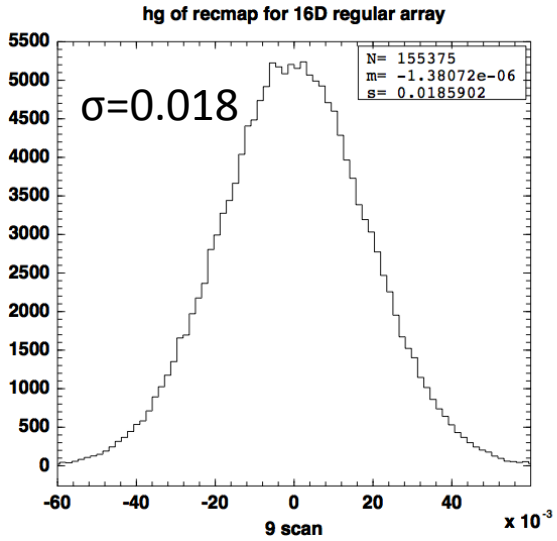
- TF from input white noise map $P_{in}(l)$ and its reconstructed map $P_{rec}(l)$.

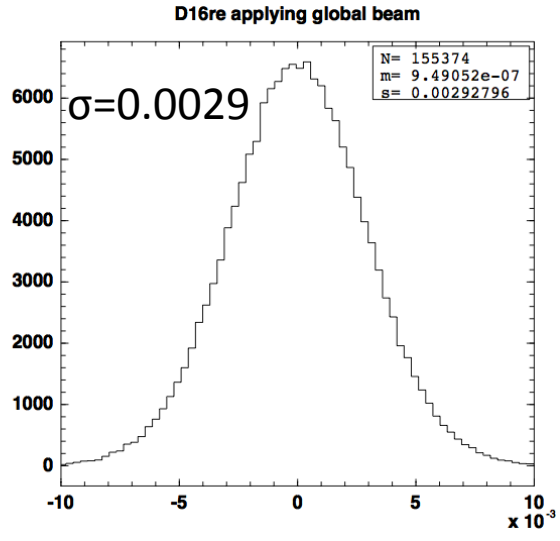
$$T(l) = P_{rec}(l)/P_{in}(l)$$

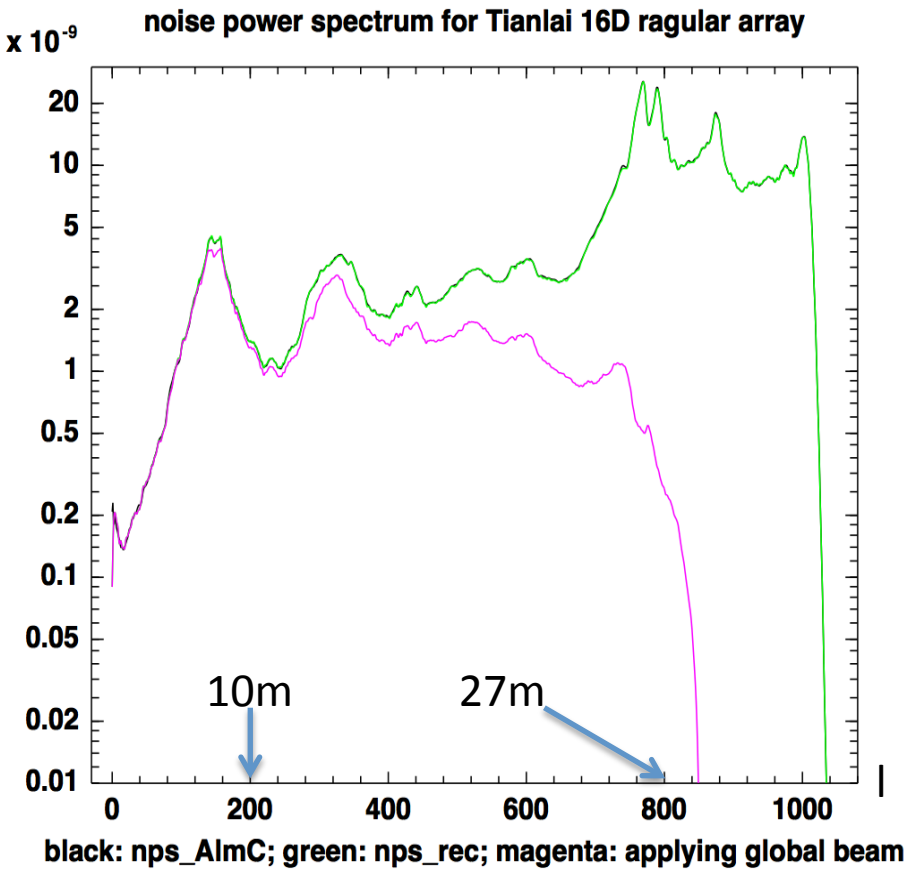
Parameters

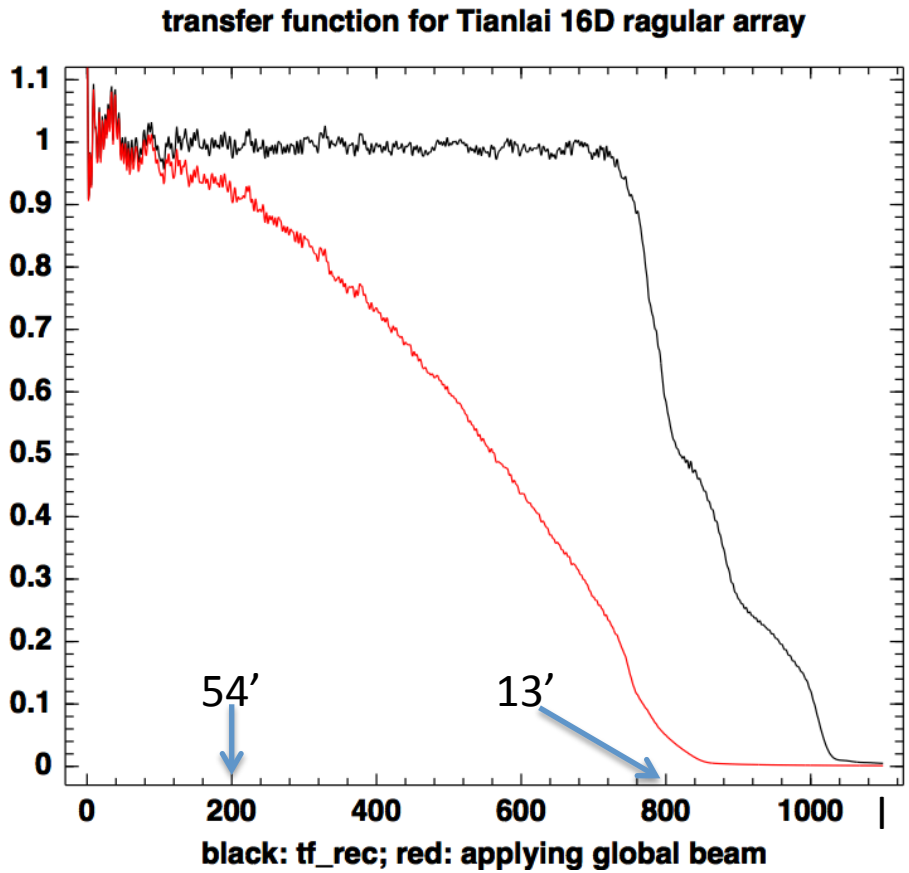
- 9 scans per degree, covering about 12 degrees band. The central of scans band is 45 deg in declination except the case for different declination.
- Total survey time is one month. Frequency bandwidth ~ 1MHz. t_{int}=60sec/visib. Mheal = 512. D=5.4m.

Noise power spectrum for Tianlai D16 regular array



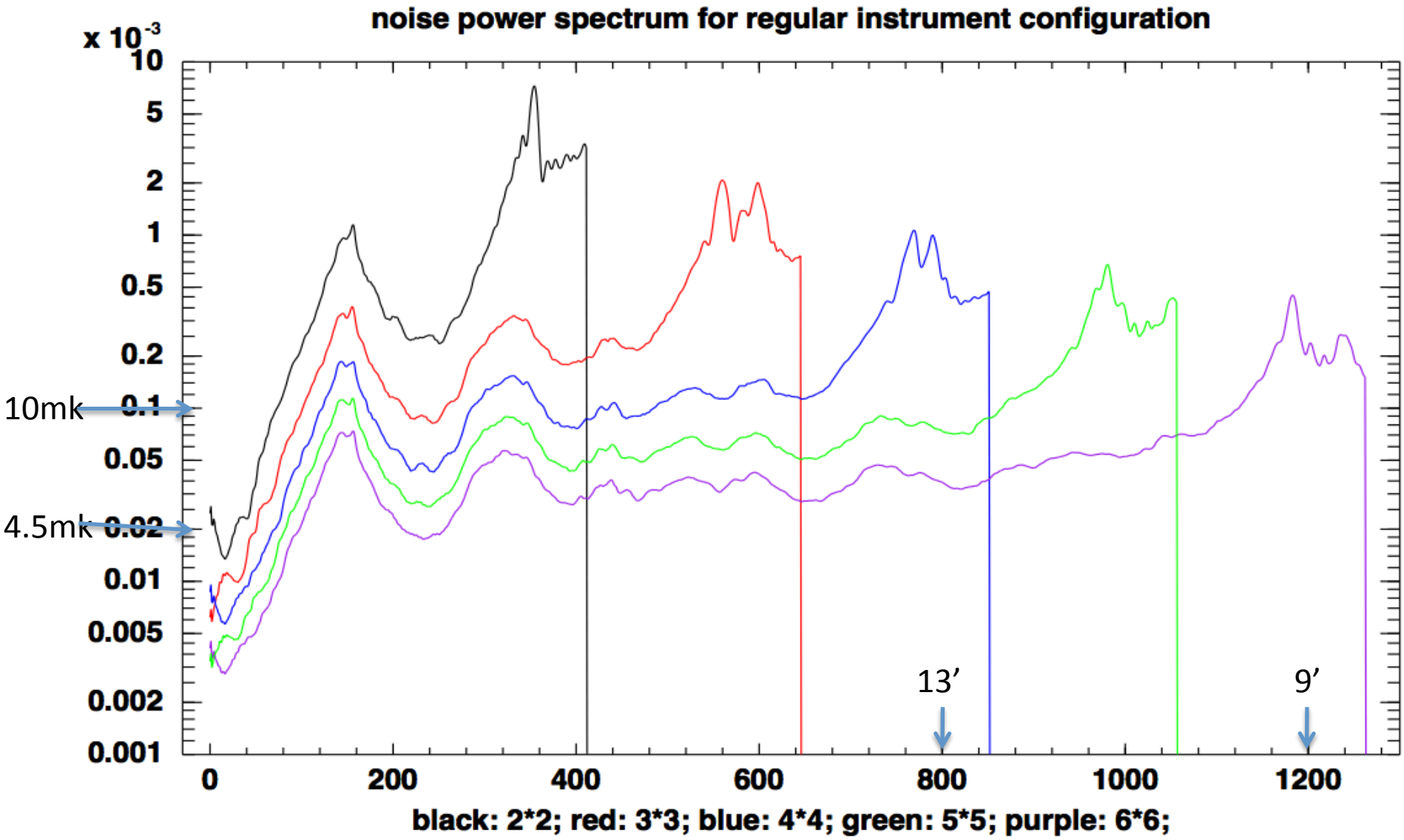




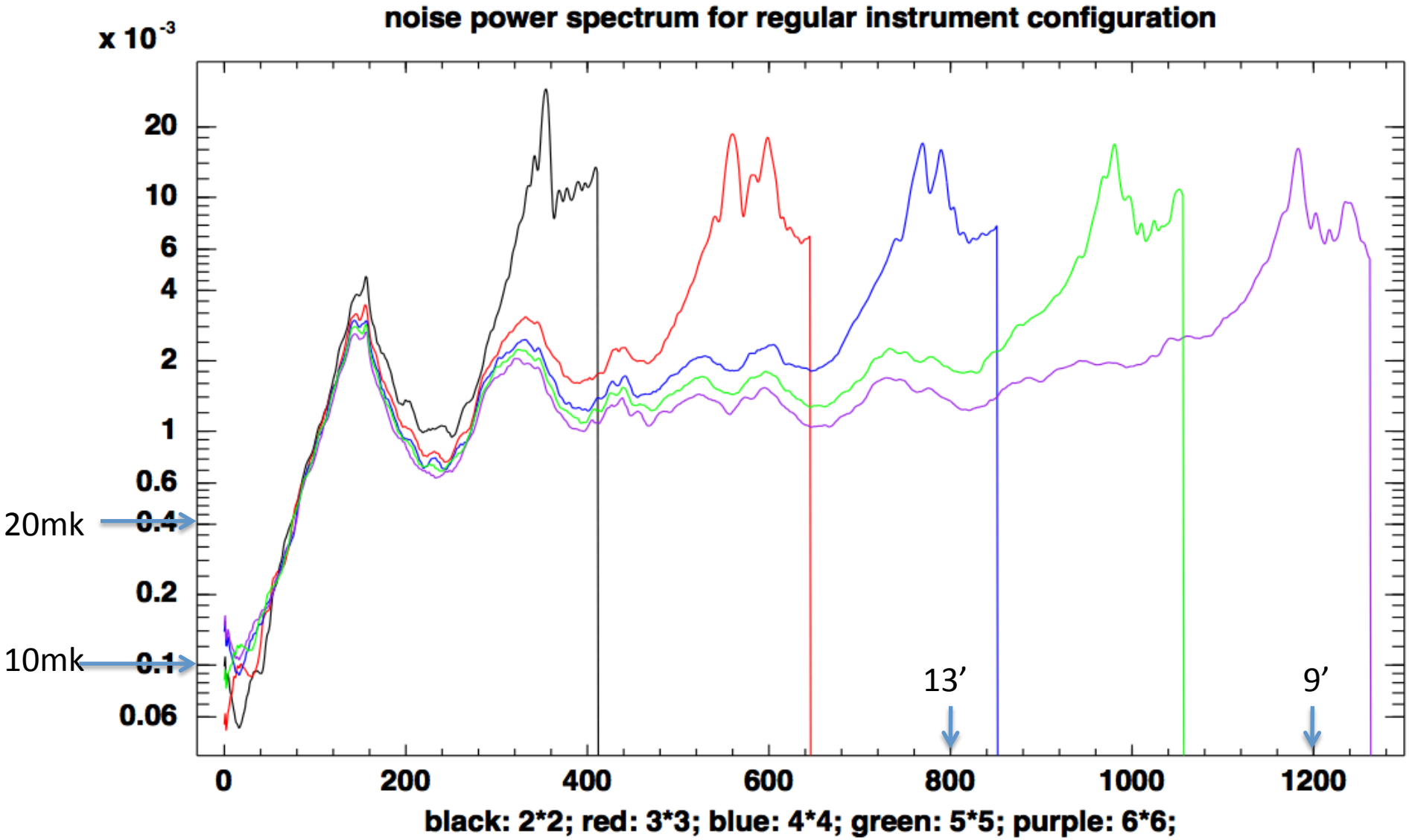


Noise power spectrum for regular dish array

9 scans; resolution: 6.87arcmin; covered areas: 2038 deg^2



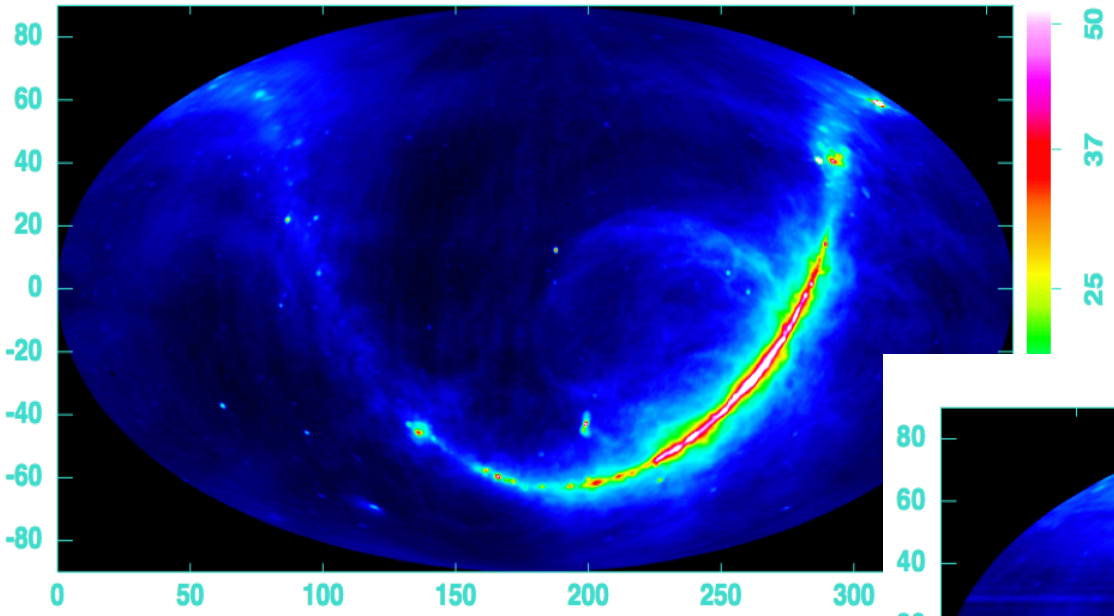
Reconstruct sky map using noise weighted pseudo-inverse matrix.
It means that the more redundant baseline, the less corresponding σ_{noise}.
For regular dish arrays, the noise power spectrum for low l should be same if we multiply them by dish number, and their size should be expanded as array size increase.



Cylinder case

- Cylinder1 : 3 cylinders, each one with size Lx=8m, Ly=4.8m; 16 feeds per cylinder; feed size : lx=7m, ly=0.2m;

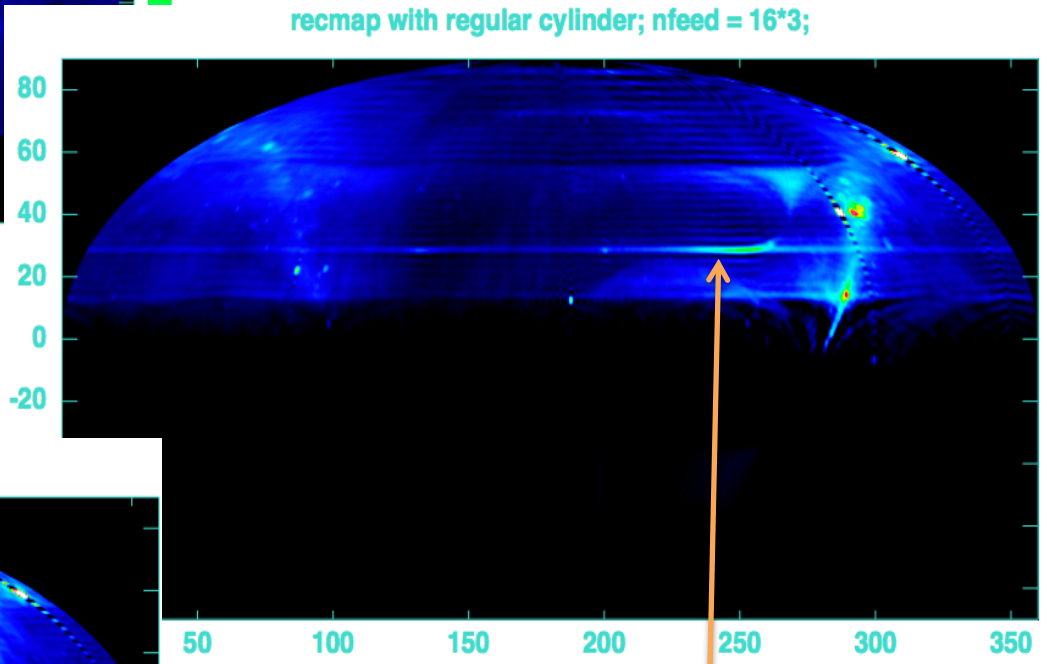
- Cylinder2 : 3 cylinders, each one with size Lx=8m, Ly=4.8m; 15 feeds, 16 feeds, 17 feeds on cylinders respectively. feed size : lx=7m, ly=0.2m;



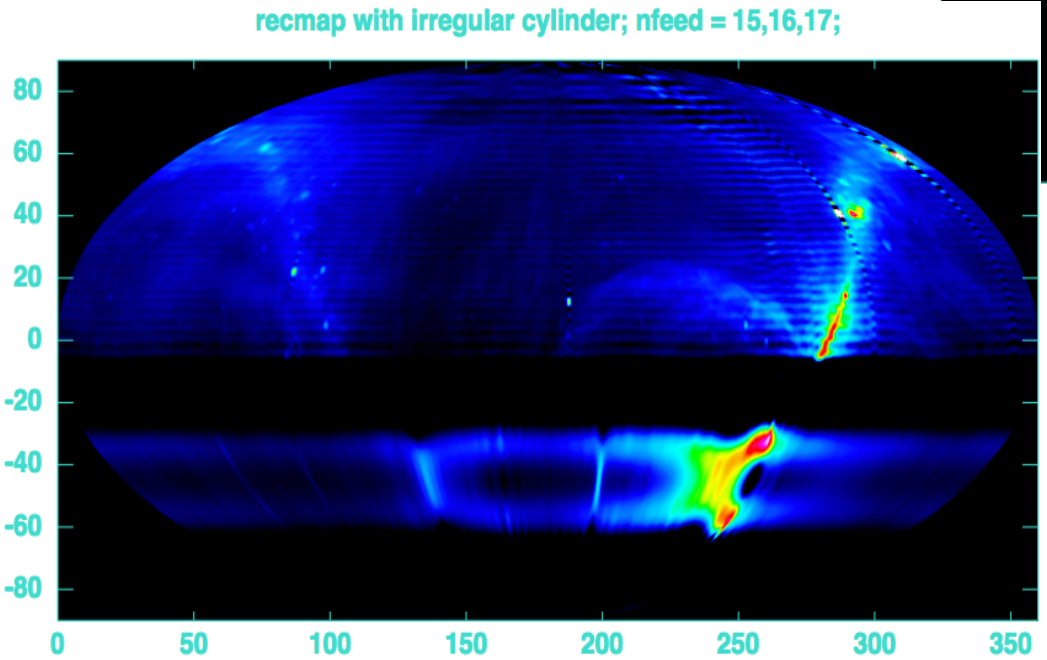
Inmap synchrotron map

Reconstructed map from cylinder

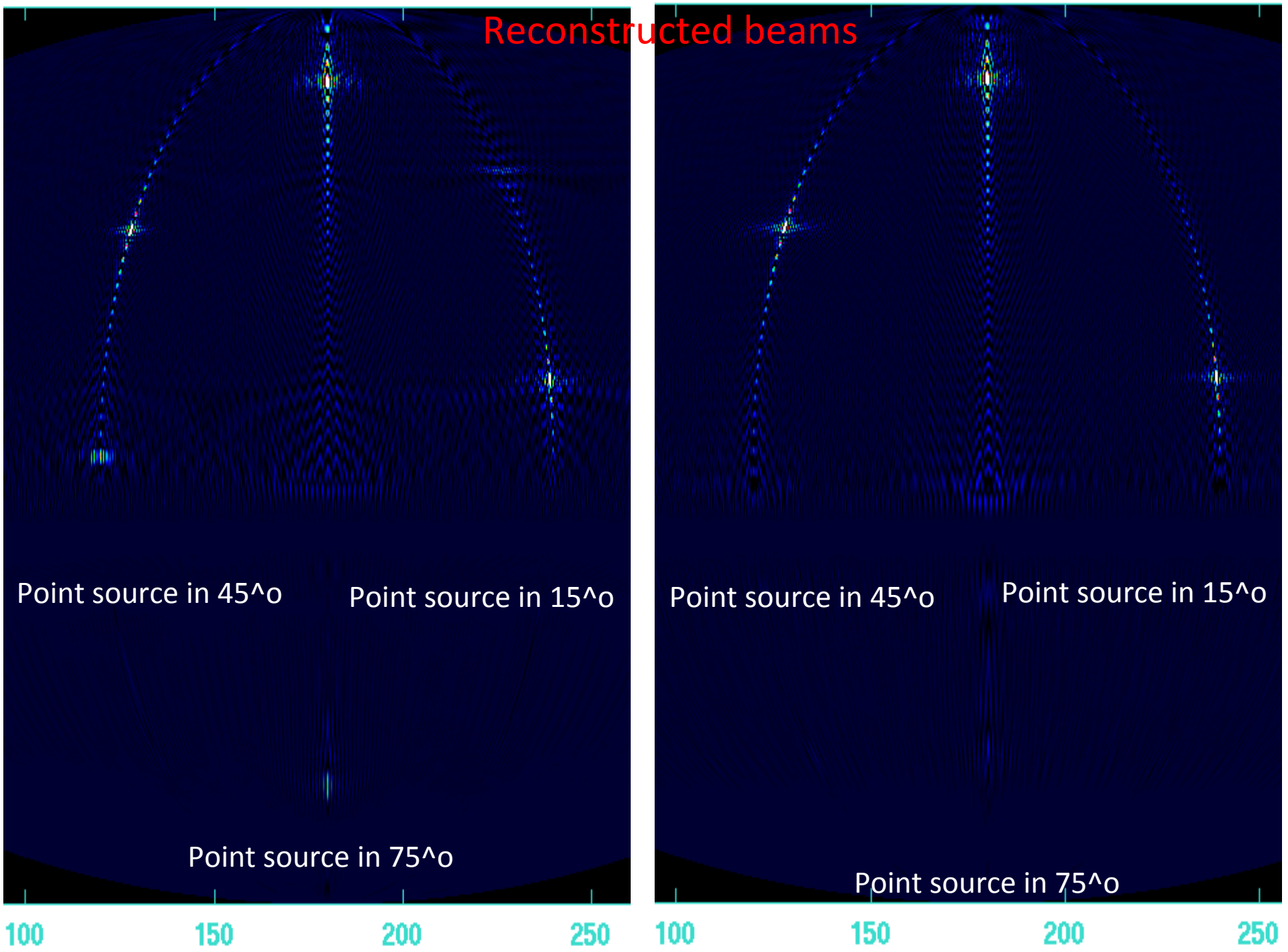
cylinder1

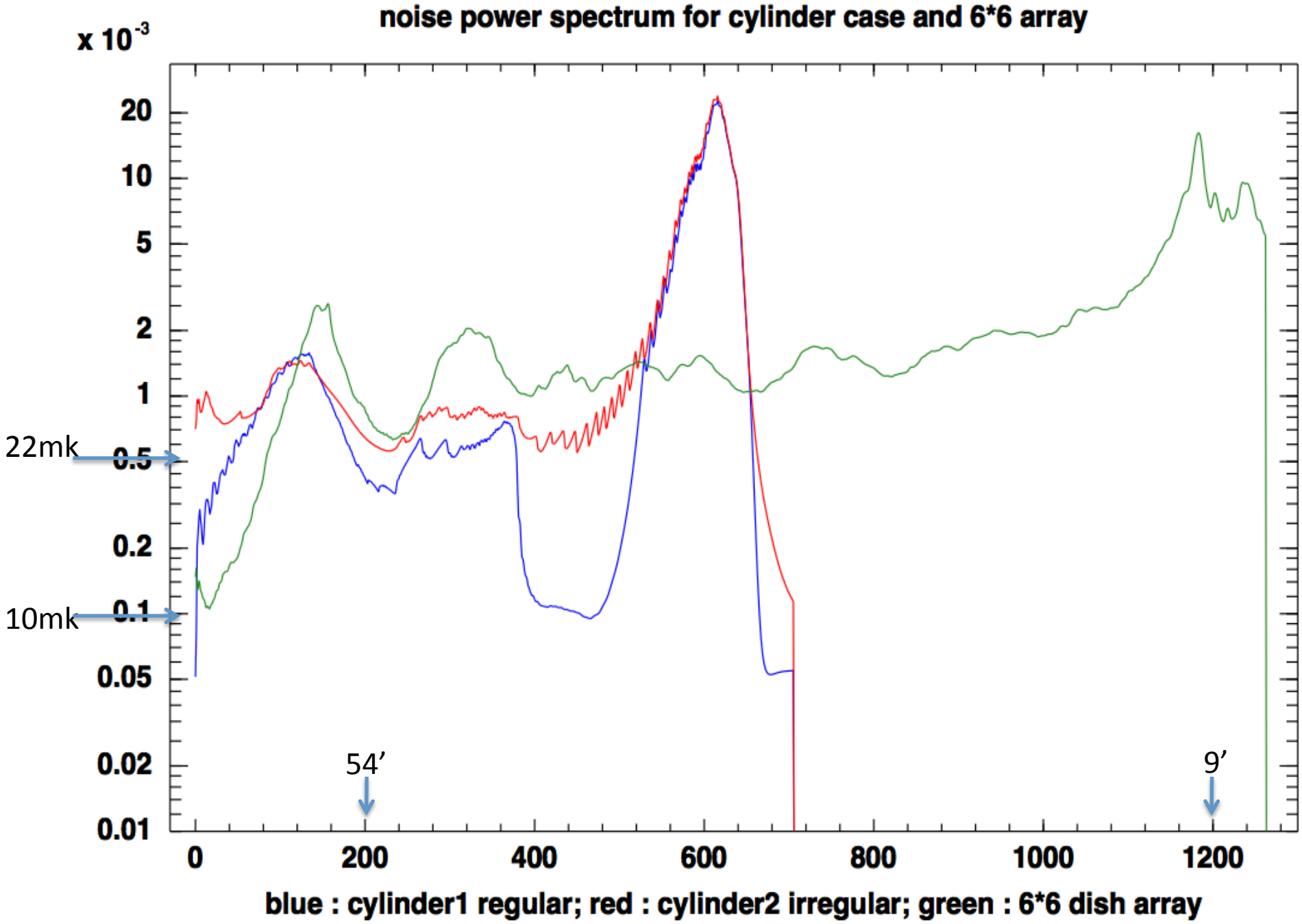


Spurious structures



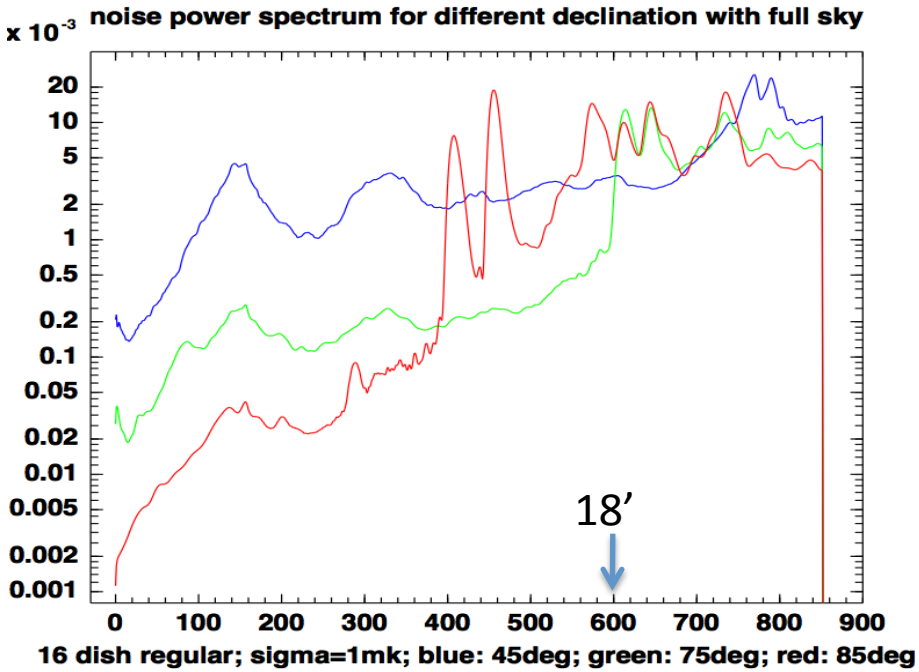
cylinder2

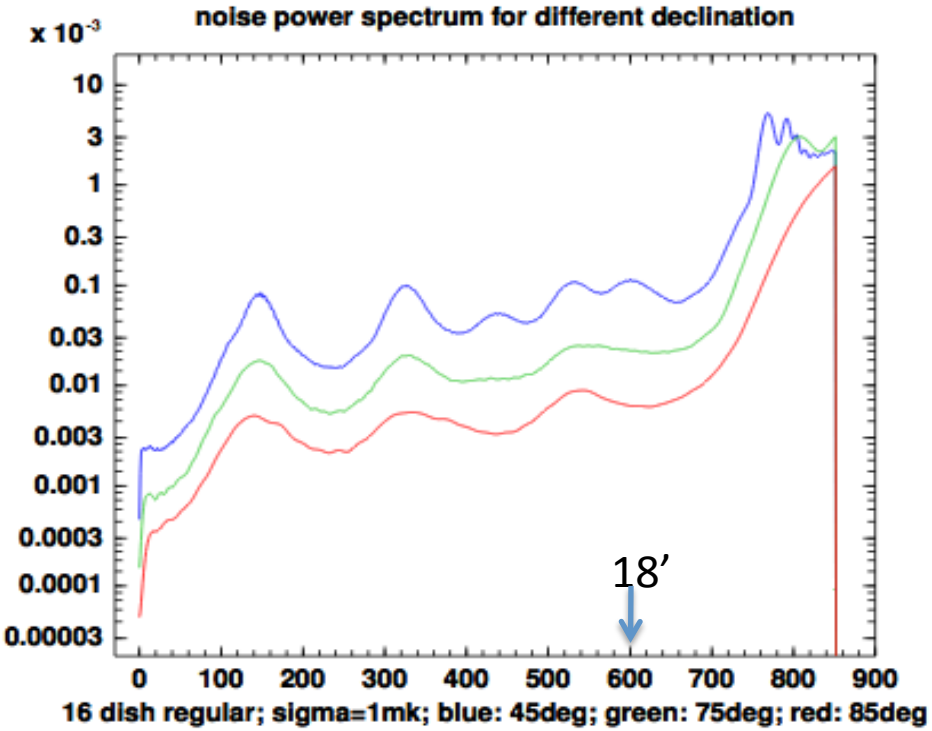

Reconstructed beams
Point source in 45^o
Point source in 15^o
Point source in 75^o
100
150
200
250
Point source in 45^o
Point source in 15^o
Point source in 75^o
100
150
200
250

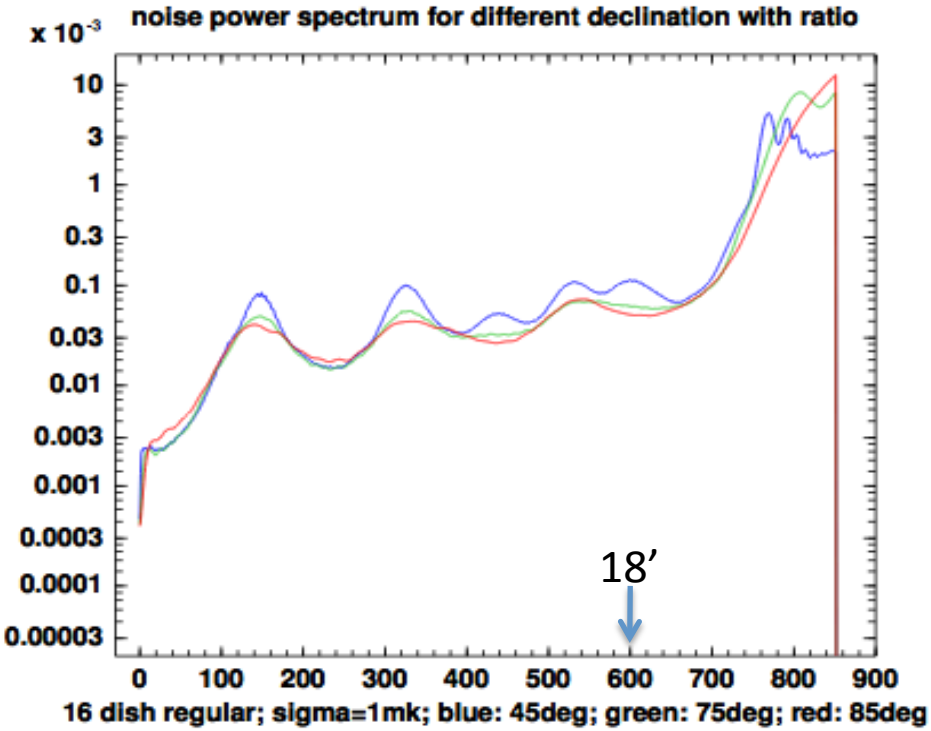

noise power spectrum for cylinder case and 6*6 array
x 10^-3
20
10
5
2
1
0.5
0.2
0.1
0.05
0.02
0.01
22mk
10mk
54’
9’
0
200
400
600
800
1000
1200
blue : cylinder1 regular; red : cylinder2 irregular; green : 6*6 dish array

Noise power spectrum for different declination

In spherical space, for same scan band,
the covered areas depend on the central declination.
Noise power spectrum have relationship
with covered areas.







Transfer function for different declination