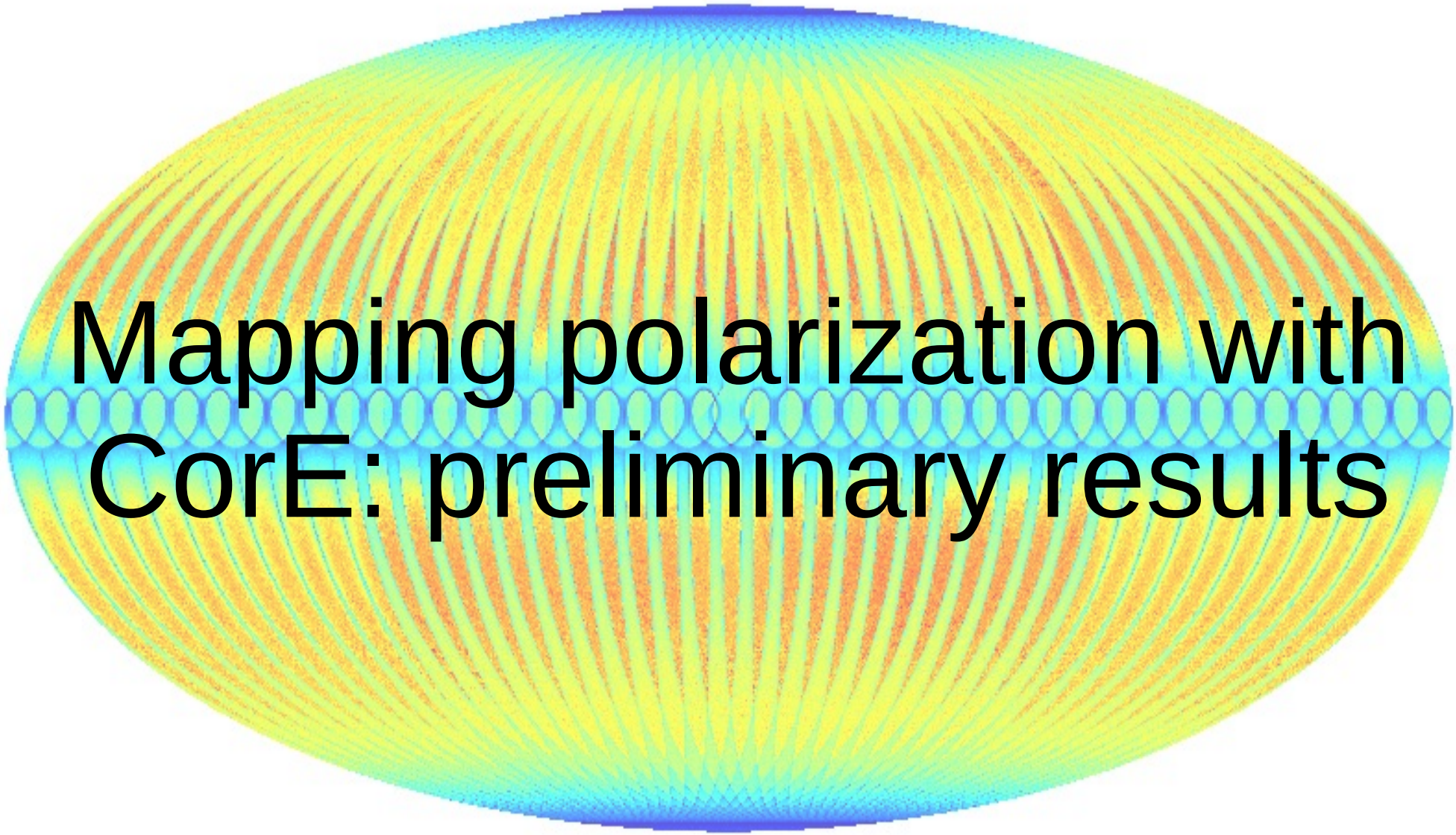


Mapping polarization with CorE: preliminary results

Linda Polastri
University of Ferrara

LiteCOrE

Fast Scan

Precession period = 4 days
Spin rate = 1rpm
Angular rate = 2π sin(45π/180)/(1*60) =
= 7.40480e-2 rad/s
Beam size = 1.6842427e-3 rad
Beam crossing time = 2.274528e-2s
4 hits per beam: samplerate = 175.86 Hz

Slow Scan

Precession period = 8 days
Spin rate = 0.5rpm
Angular rate = 2π sin(45π/180)/(0.5*60)=
= 3.70240e-2 rad/s
Beam size = 1.6842427e-3 rad
Beam crossing time = 4.549057e-2s
4 hits per beam: samplerate = 87.93 Hz

200 mHz 1/f knee, slope = 1, precession angle = 50°,
spin angle= 45°, NET = 52.3 μK ·√ s, 5.79' FWHM (150 cm aperture)

LiteBird

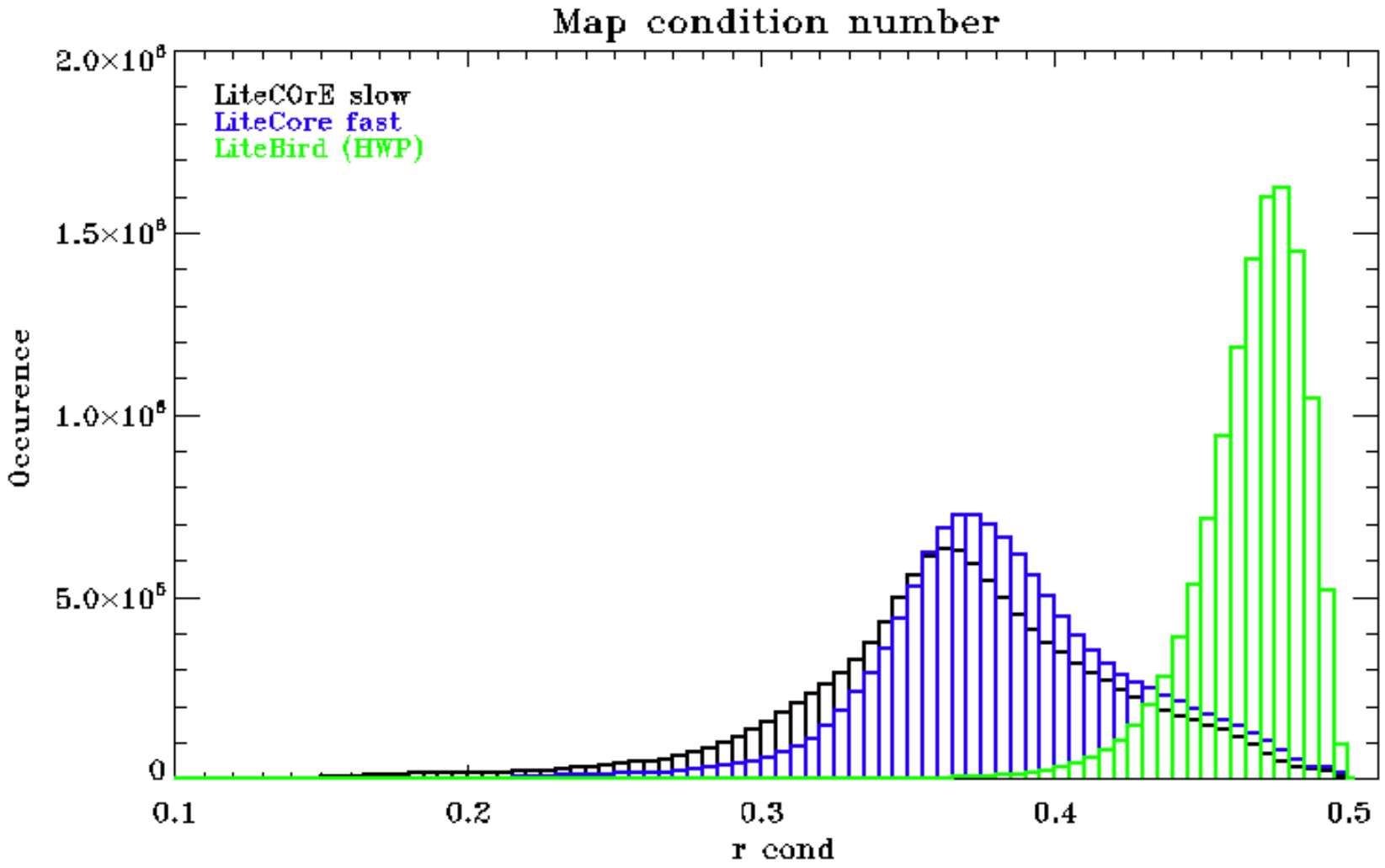
Focal plane:

Single detector at the focalplane boresight
NET = 60 μK · √s.
Knee frequency = 50 mHz
Slope = 1
Sample rate = 23 Hz
HWP rotating at 88 rpm

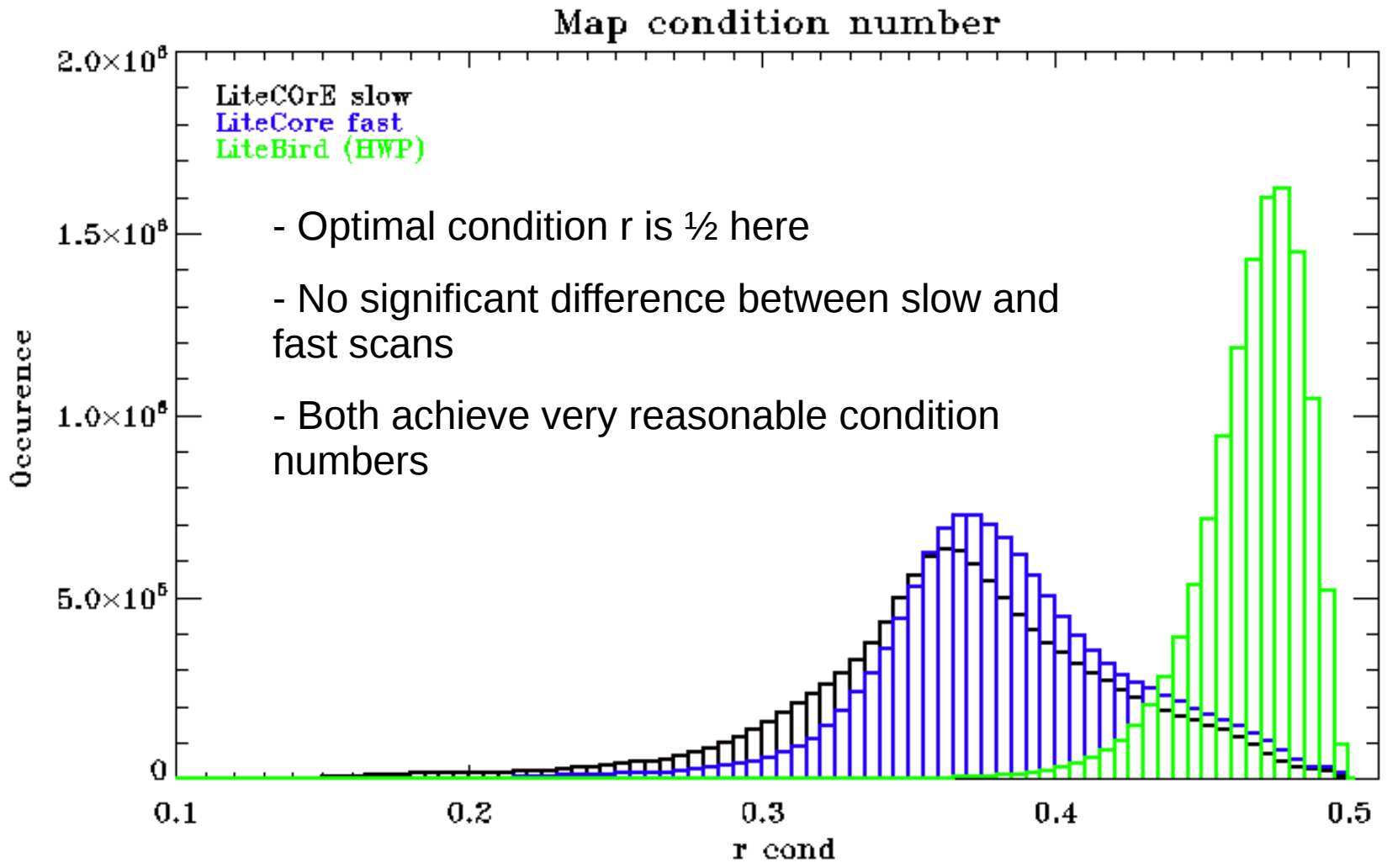
Scan strategy:

Precession opening angle = 65°
Spin opening angle = 30°
Constant slewing of precession axis for 365 days
Precession period = 93 minutes
Spin period = 10 minutes

Map condition number



Map condition number

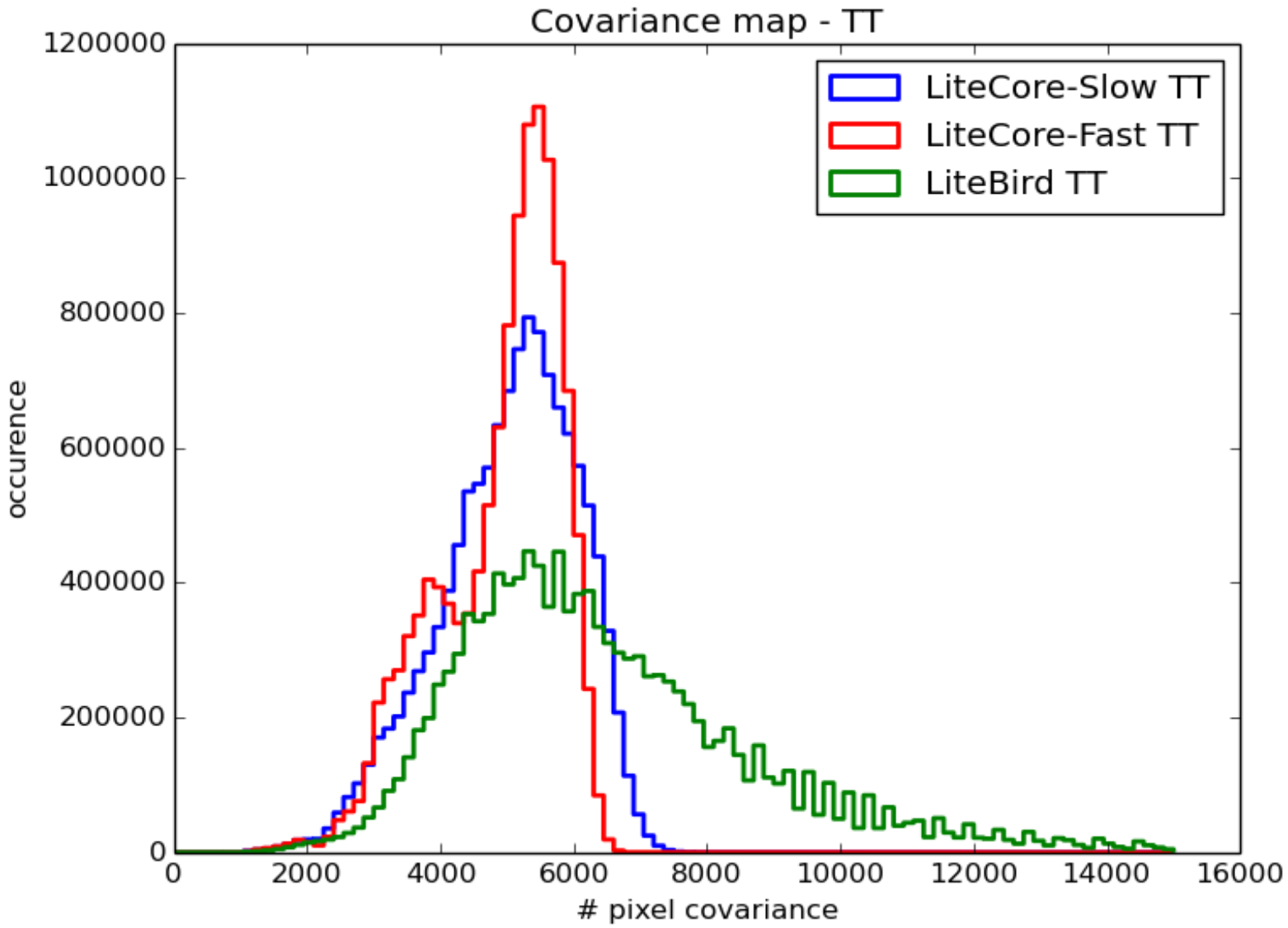


- Optimal condition r is ½ here
- No significant difference between slow and fast scans
- Both achieve very reasonable condition numbers

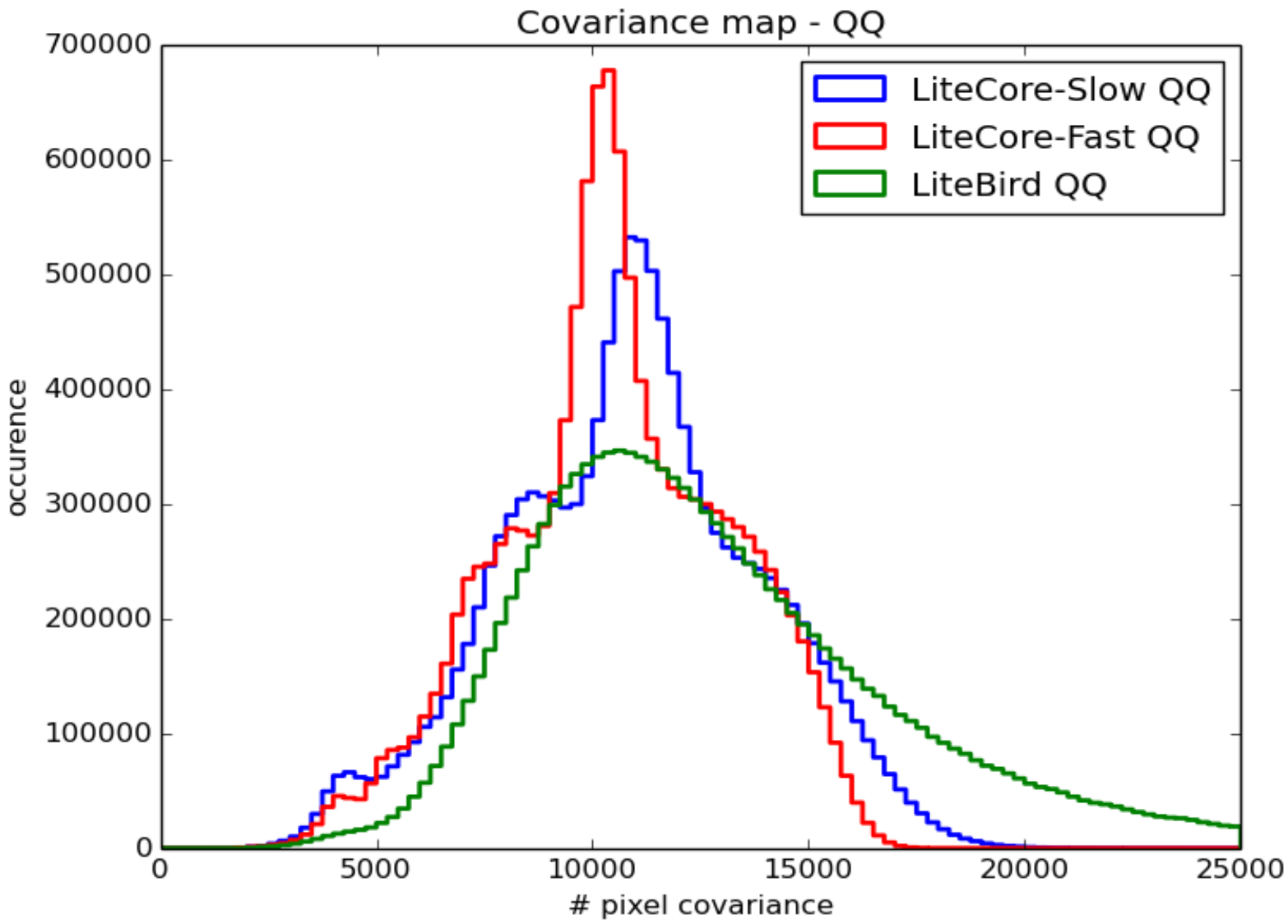
Below the histograms obtained for madam_wcov.fits maps computed by Berkeley (PyTOAST)

Units are μK^2 and Nside=1024 for all plots

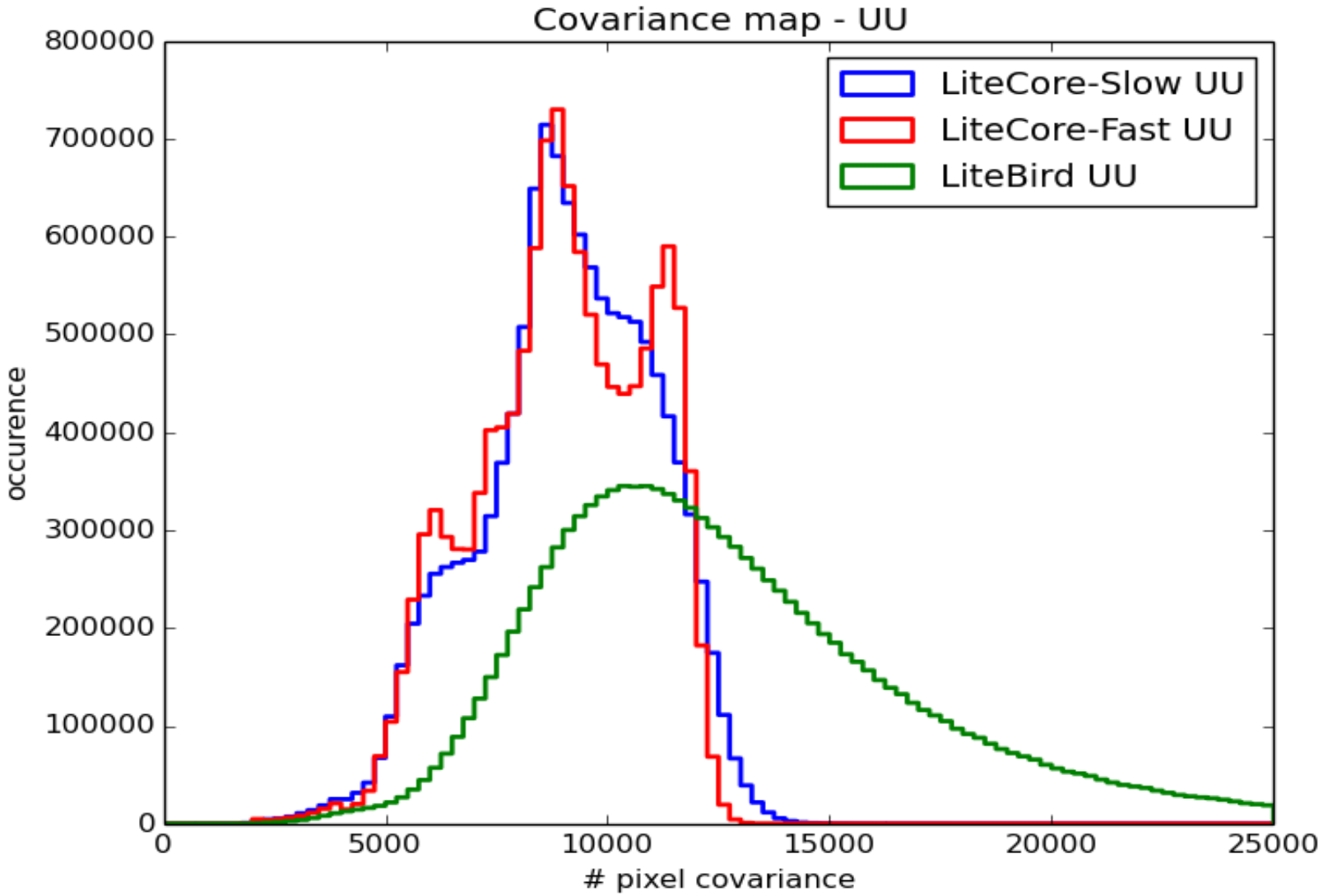
TT


Covariance map - TT
LiteCore-Slow TT
LiteCore-Fast TT
LiteBird TT
occurence
pixel covariance
0
200000
400000
600000
800000
1000000
1200000
0
2000
4000
6000
8000
10000
12000
14000
16000

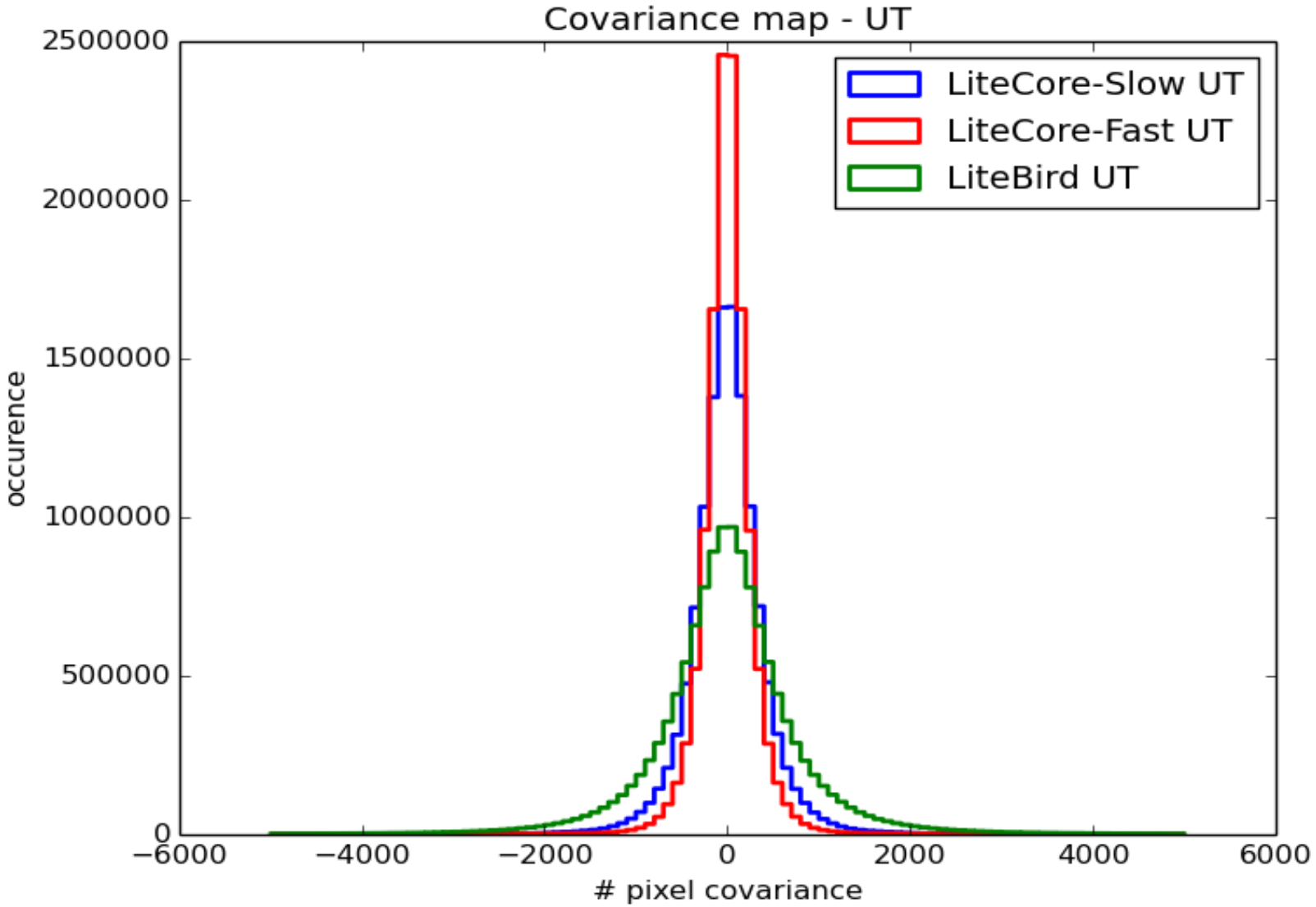
QQ


Covariance map - QQ
LiteCore-Slow QQ
LiteCore-Fast QQ
LiteBird QQ
occurence
pixel covariance
0
100000
200000
300000
400000
500000
600000
700000
0
5000
10000
15000
20000
25000

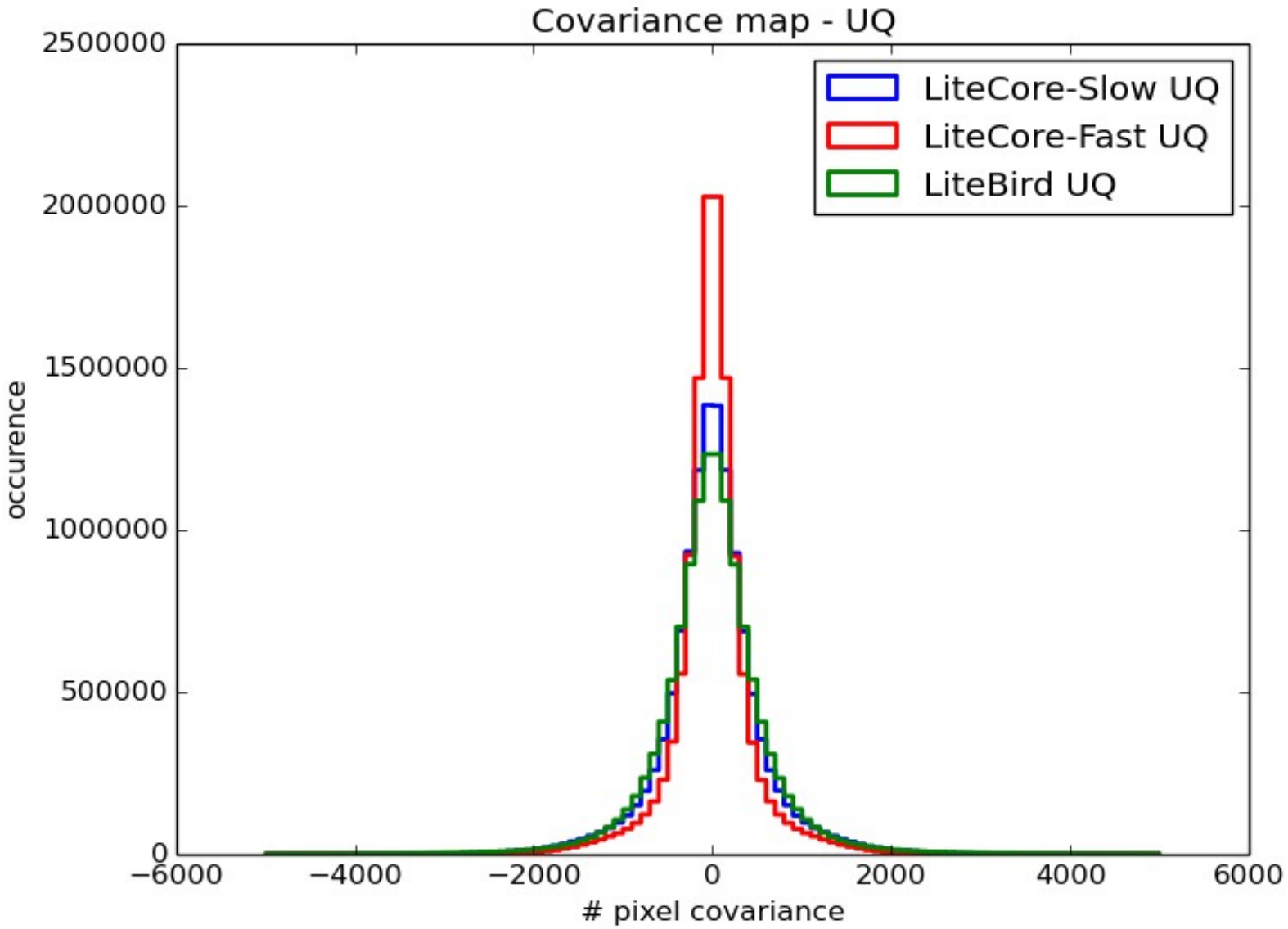
UU


Covariance map - UU
LiteCore-Slow UU
LiteCore-Fast UU
LiteBird UU
occurence
pixel covariance
0
100000
200000
300000
400000
500000
600000
700000
800000
0
5000
10000
15000
20000
25000

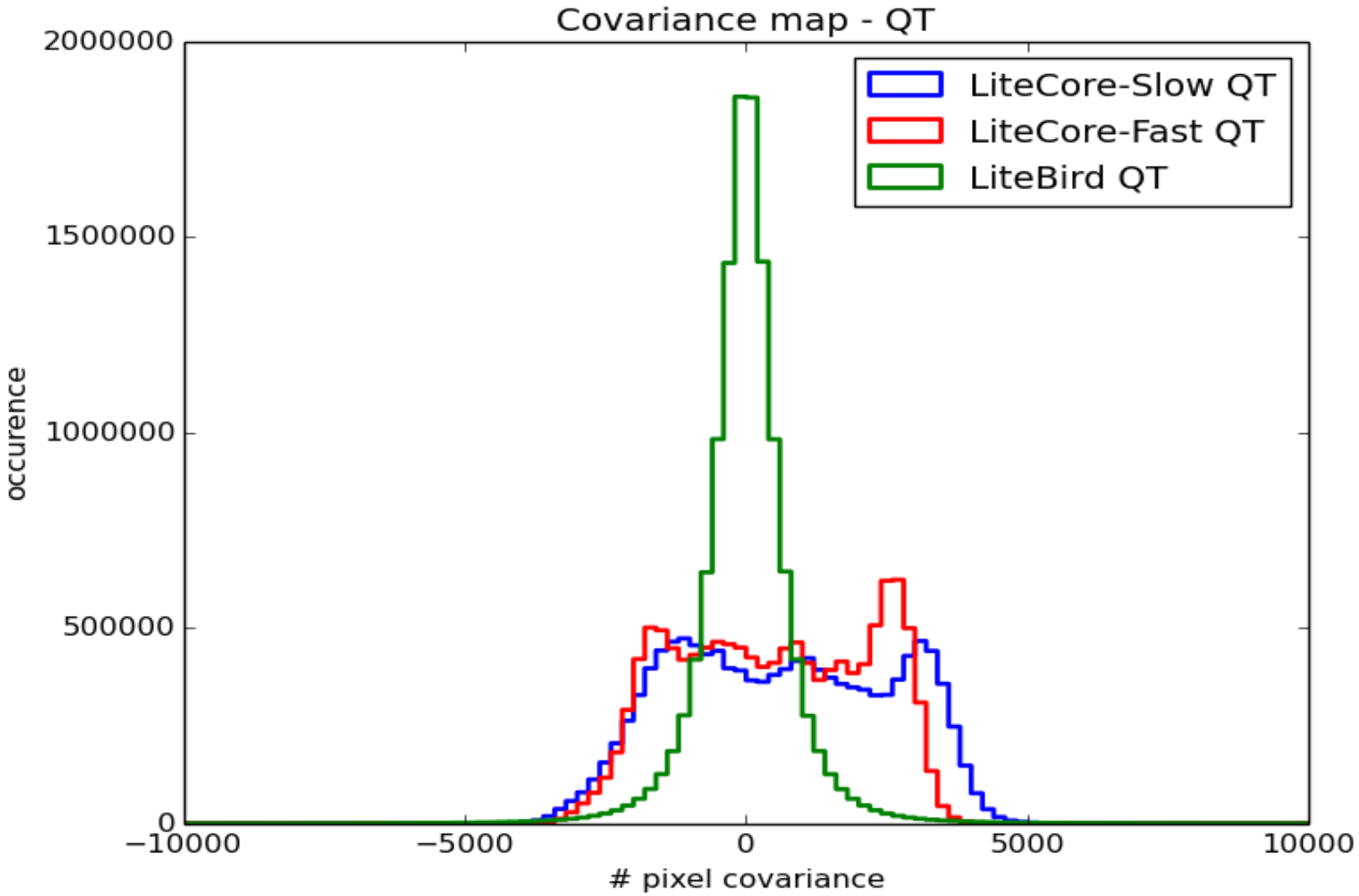
UT


Covariance map - UT
LiteCore-Slow UT
LiteCore-Fast UT
LiteBird UT
occurence
2500000
2000000
1500000
1000000
500000
0
−6000
−4000
−2000
0
2000
4000
6000
pixel covariance

UQ


Covariance map - UQ
LiteCore-Slow UQ
LiteCore-Fast UQ
LiteBird UQ
occurence
2500000
2000000
1500000
1000000
500000
0
−6000
−4000
−2000
0
2000
4000
6000
pixel covariance

QT


Covariance map - QT
LiteCore-Slow QT
LiteCore-Fast QT
LiteBird QT
occurence
2000000
1500000
1000000
500000
0
−10000
−5000
0
5000
10000
pixel covariance

Conclusions about the first analysis

→ Results obtained for LiteCOrE (Slow/Fast) and LiteBird seem reasonable.

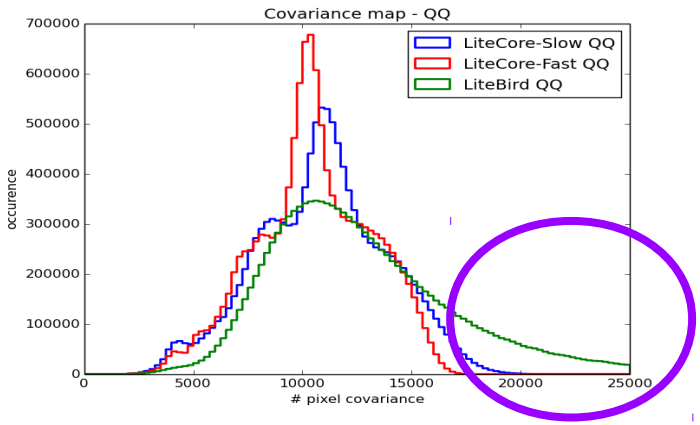
→ No significant differences between slow and fast spinning for LiteCOrE.

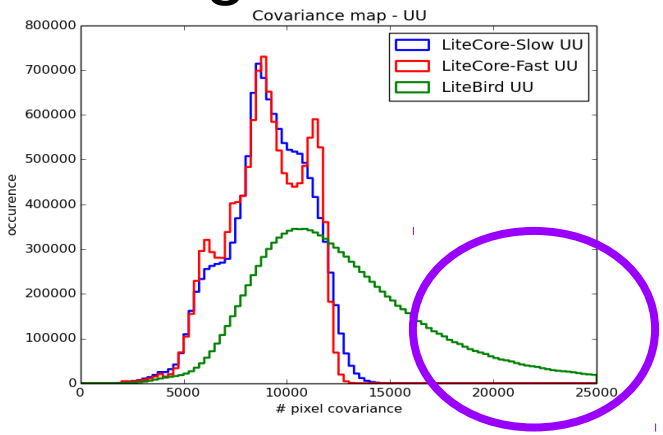
→ The LiteBird values seem to be more regular, thanks to the HWP, but also exhibit larger spread.

→Notice the long tails in some plots and the behaviour of QQ and QT.

Issues:

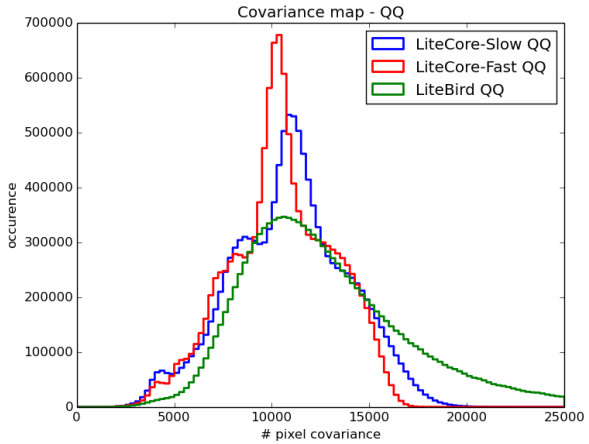
1) Long tails into the histograms

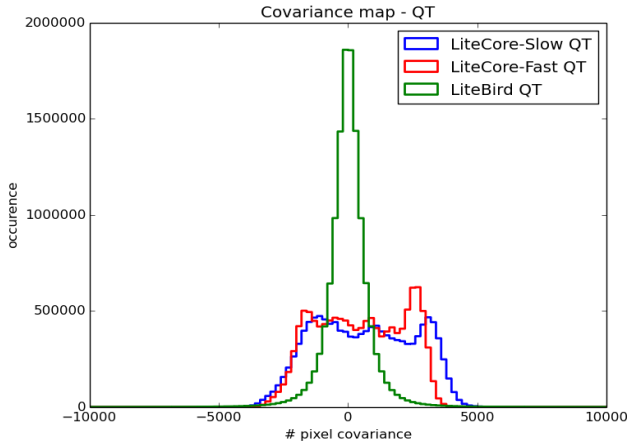




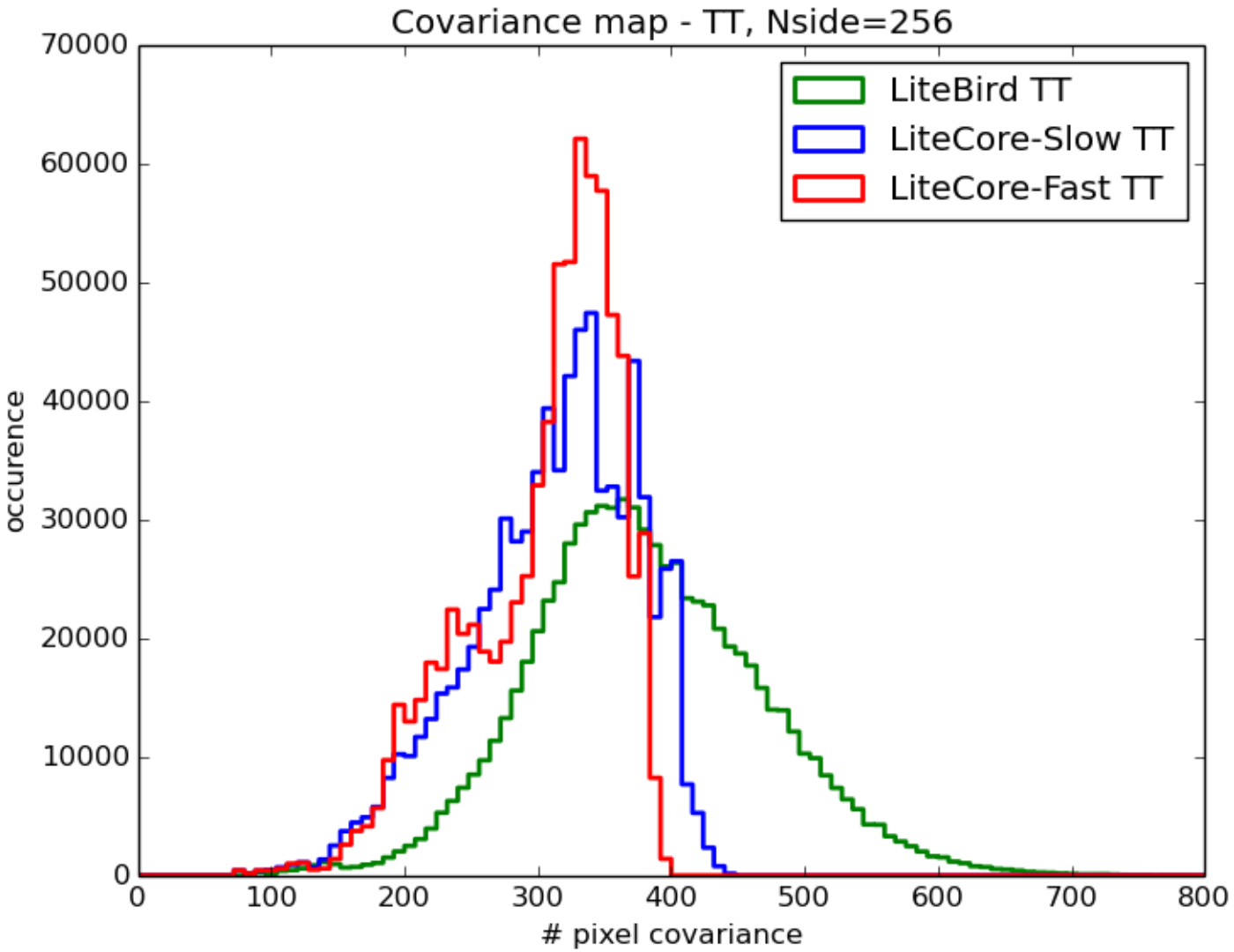
We downgrade the maps to Nside=256

2) Strange behaviour of QQ and QT

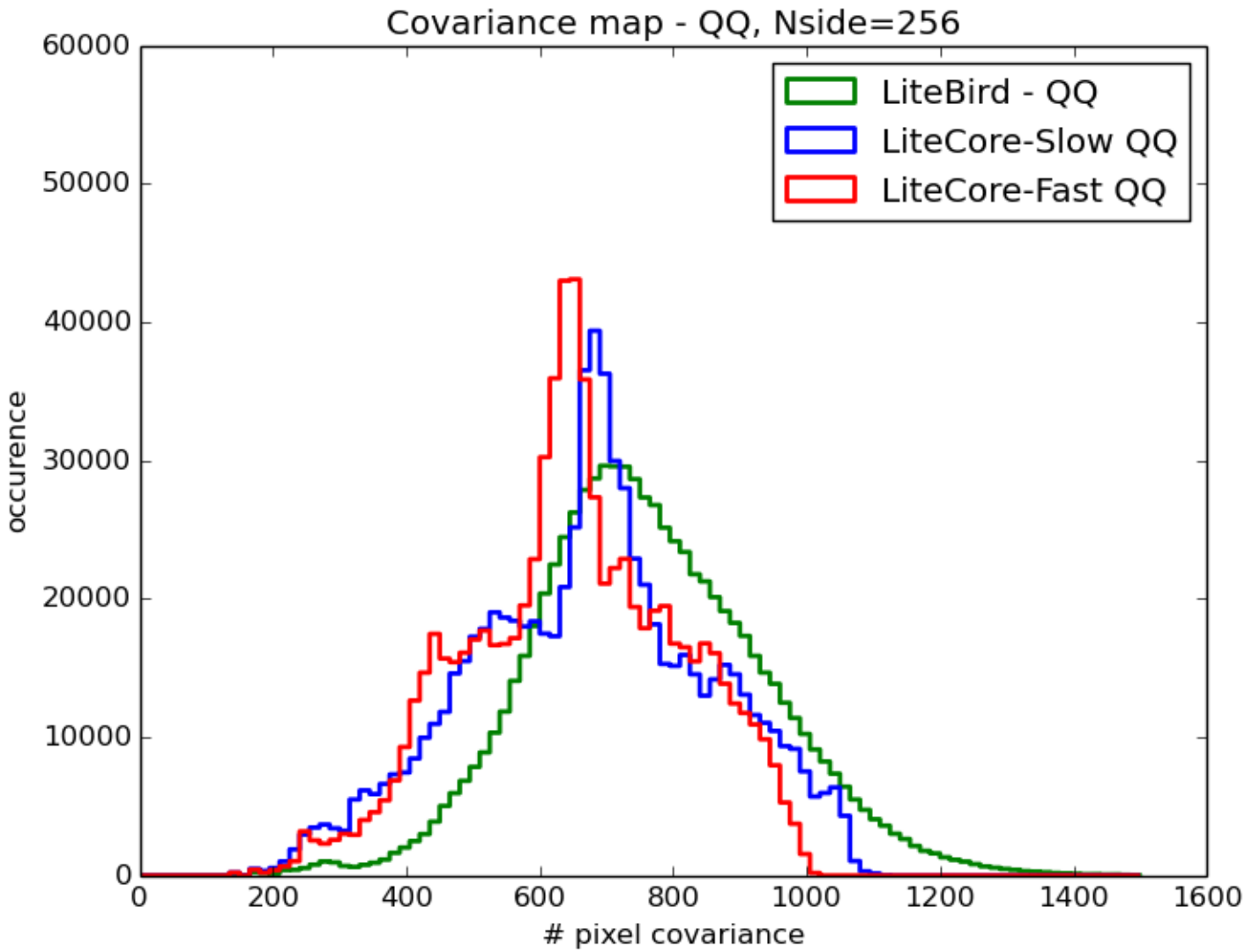




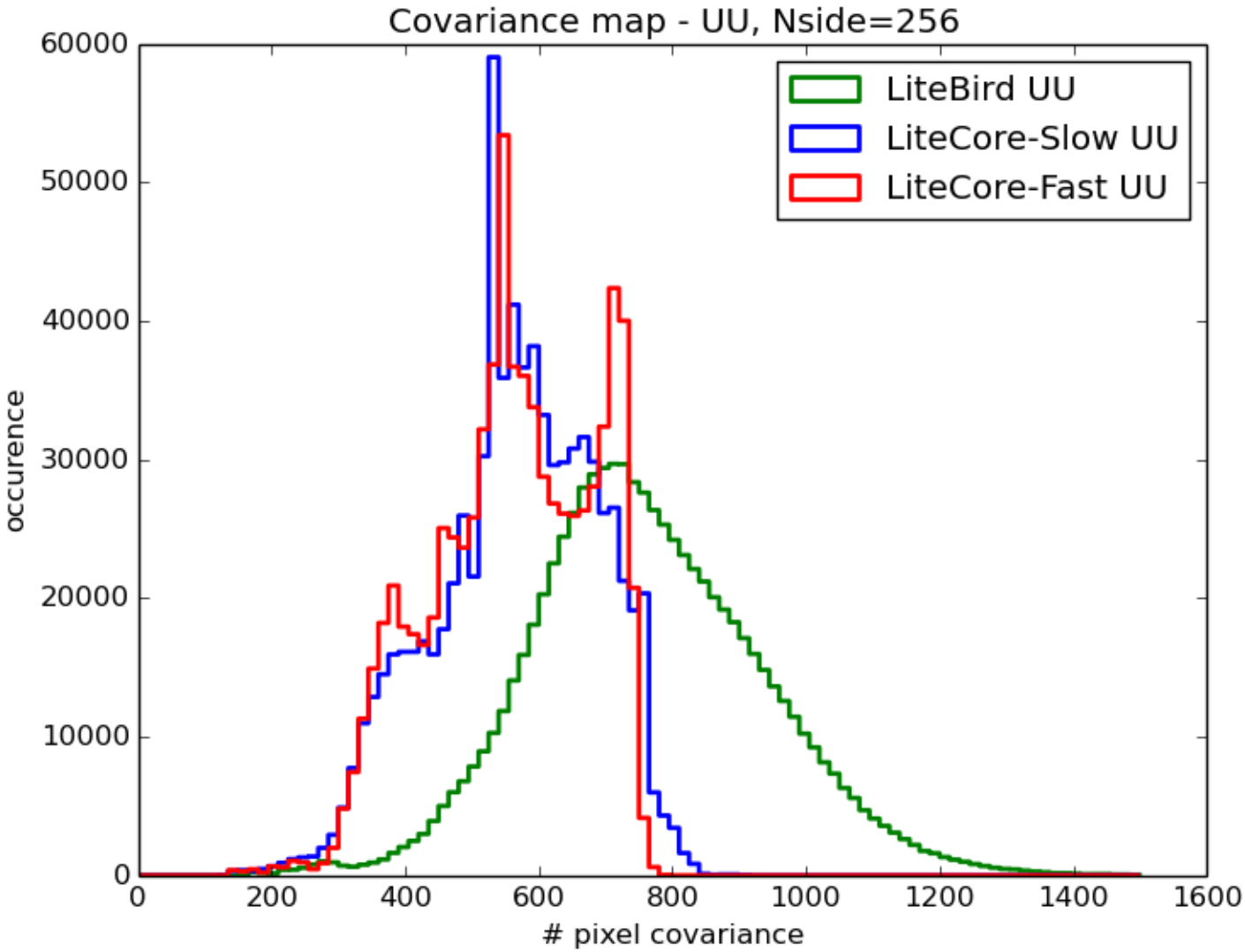
TT


Covariance map - TT, Nside=256
LiteBird TT
LiteCore-Slow TT
LiteCore-Fast TT
occurence
pixel covariance
0
10000
20000
30000
40000
50000
60000
70000
0
100
200
300
400
500
600
700
800

QQ


Covariance map - QQ, Nside=256
LiteBird - QQ
LiteCore-Slow QQ
LiteCore-Fast QQ
occurence
pixel covariance
0
10000
20000
30000
40000
50000
60000
0
200
400
600
800
1000
1200
1400
1600

UU


Covariance map - UU, Nside=256
LiteBird UU
LiteCore-Slow UU
LiteCore-Fast UU
occurence
pixel covariance
0
10000
20000
30000
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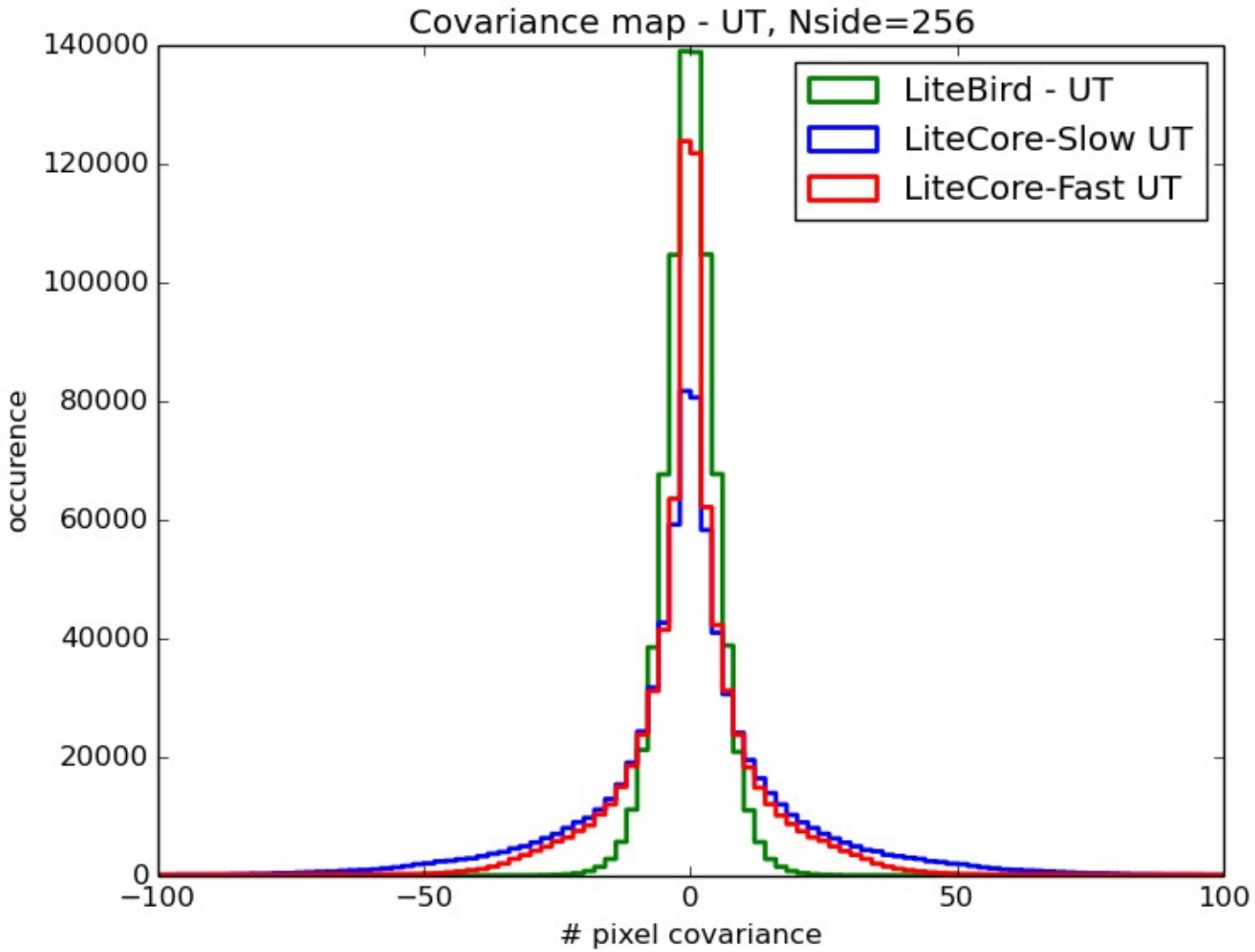
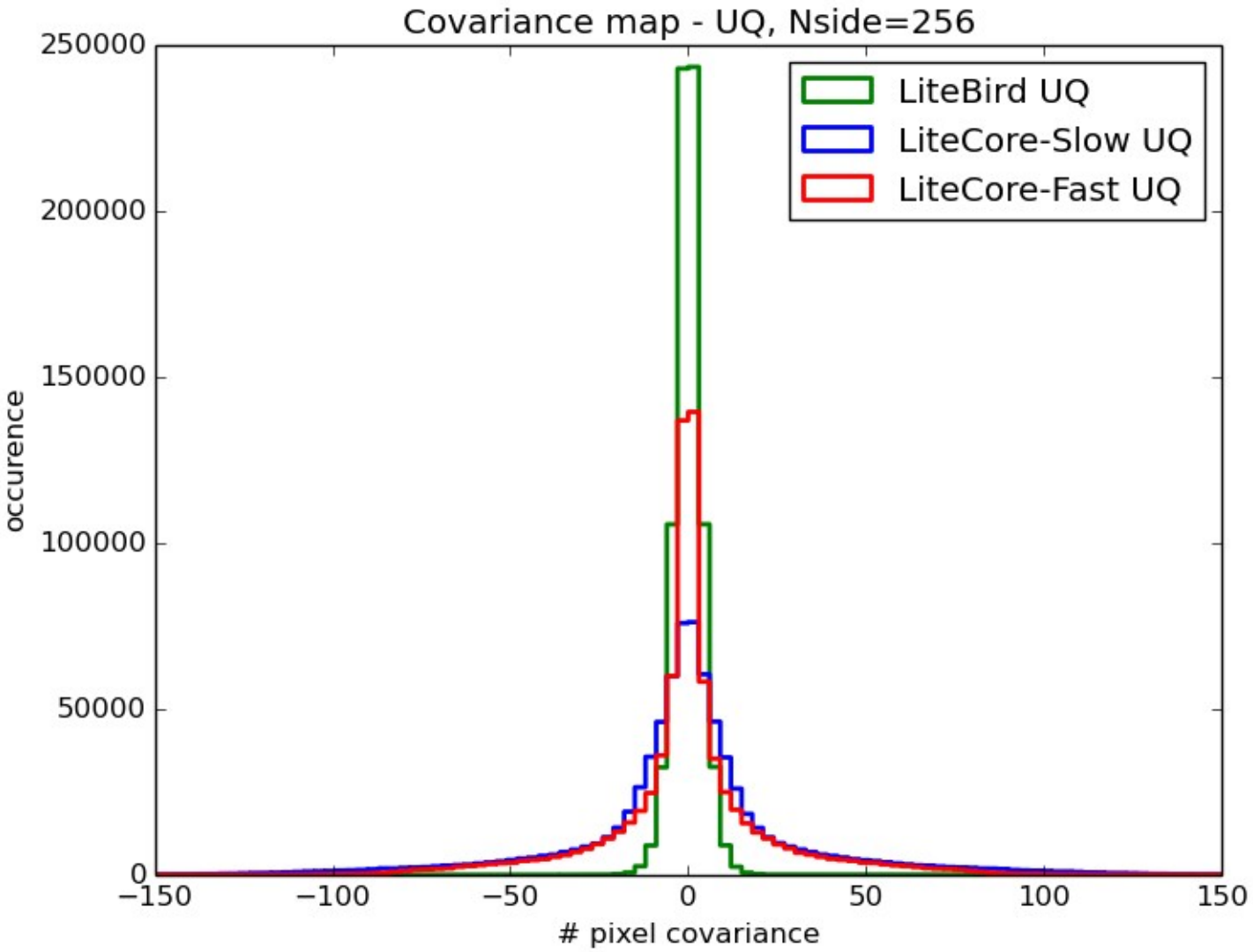
200
400
600
800
1000
1200
1400
1600

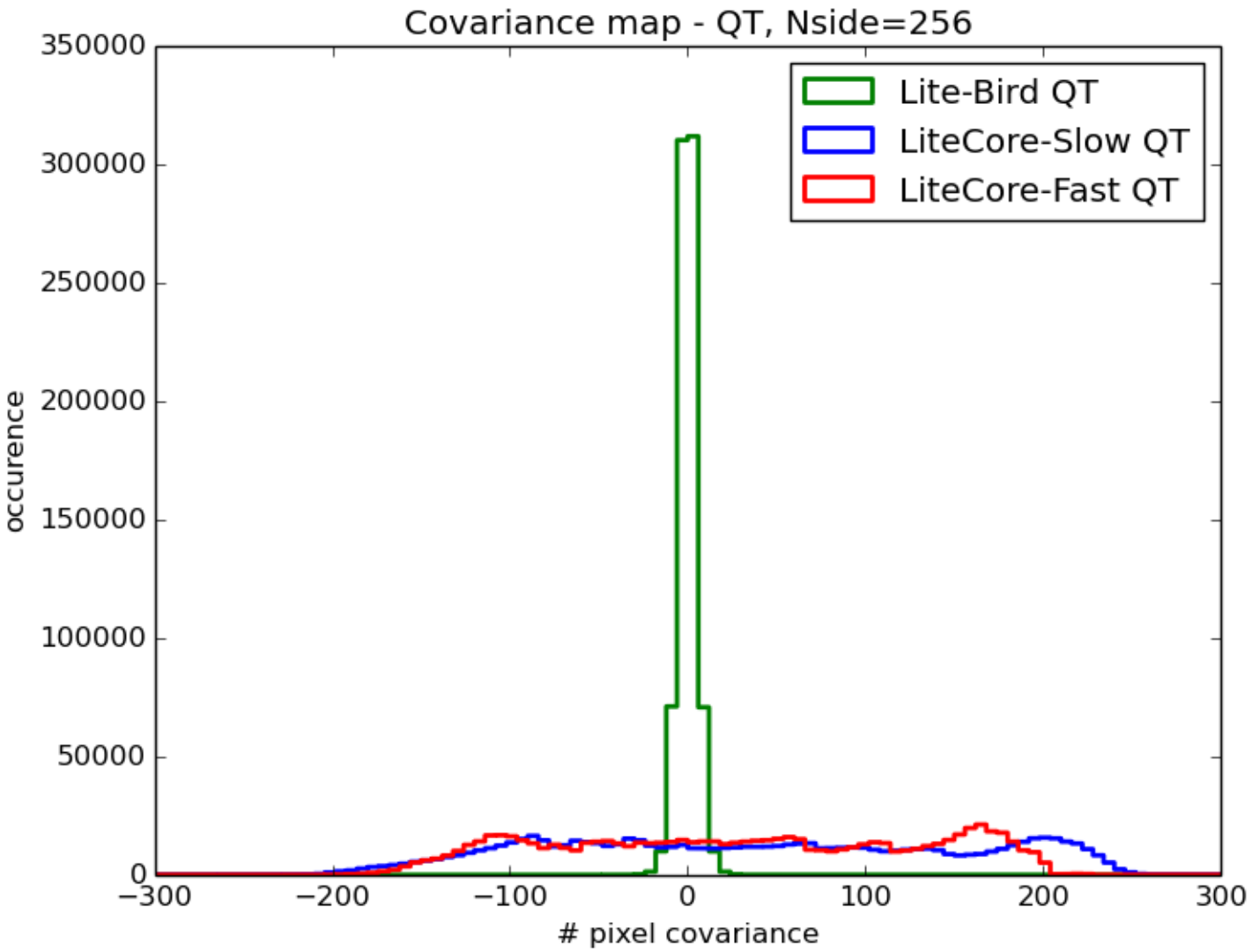
UT


Covariance map - UT, Nside=256
LiteBird - UT
LiteCore-Slow UT
LiteCore-Fast UT
occurence
pixel covariance
140000
120000
100000
80000
60000
40000
20000
0
−100
−50
0
50
100

UQ


Covariance map - UQ, Nside=256
LiteBird UQ
LiteCore-Slow UQ
LiteCore-Fast UQ
occurence
pixel covariance
250000
200000
150000
100000
50000
0
−150
−100
−50
0
50
100
150

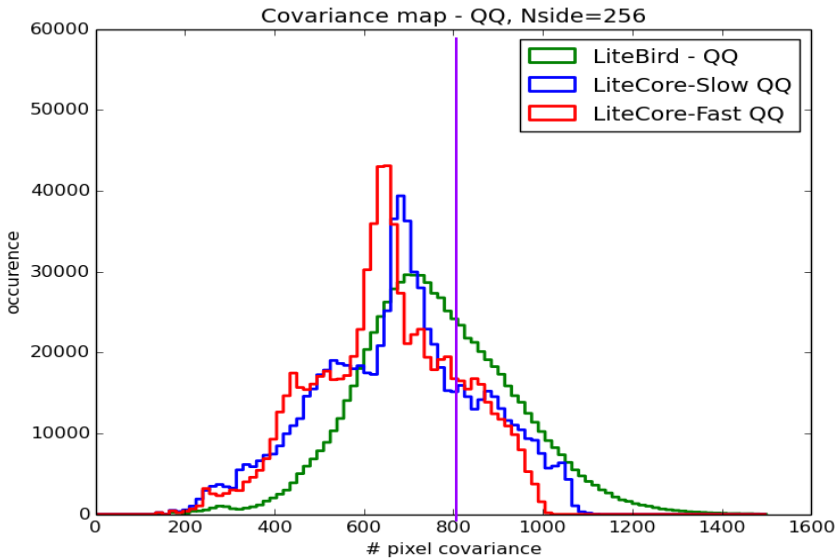
QT


Covariance map - QT, Nside=256
Lite-Bird QT
LiteCore-Slow QT
LiteCore-Fast QT
occurence
pixel covariance
350000
300000
250000
200000
150000
100000
50000
0
−300
−200
−100
0
100
200
300

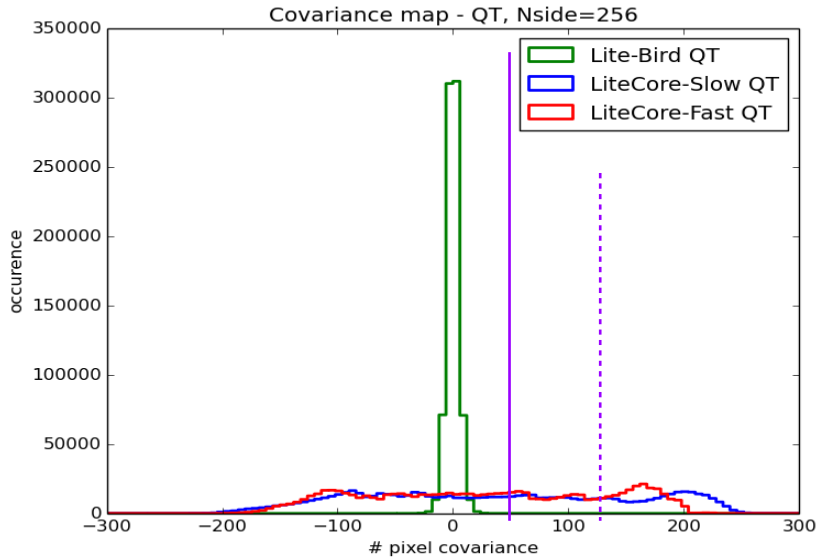
Investigating second issue

It seems related to the lack of angle redundancy in this single detector mock scanning strategy.

To check what happens we consider different thresholds on the histograms and see to what pixels they correspond.



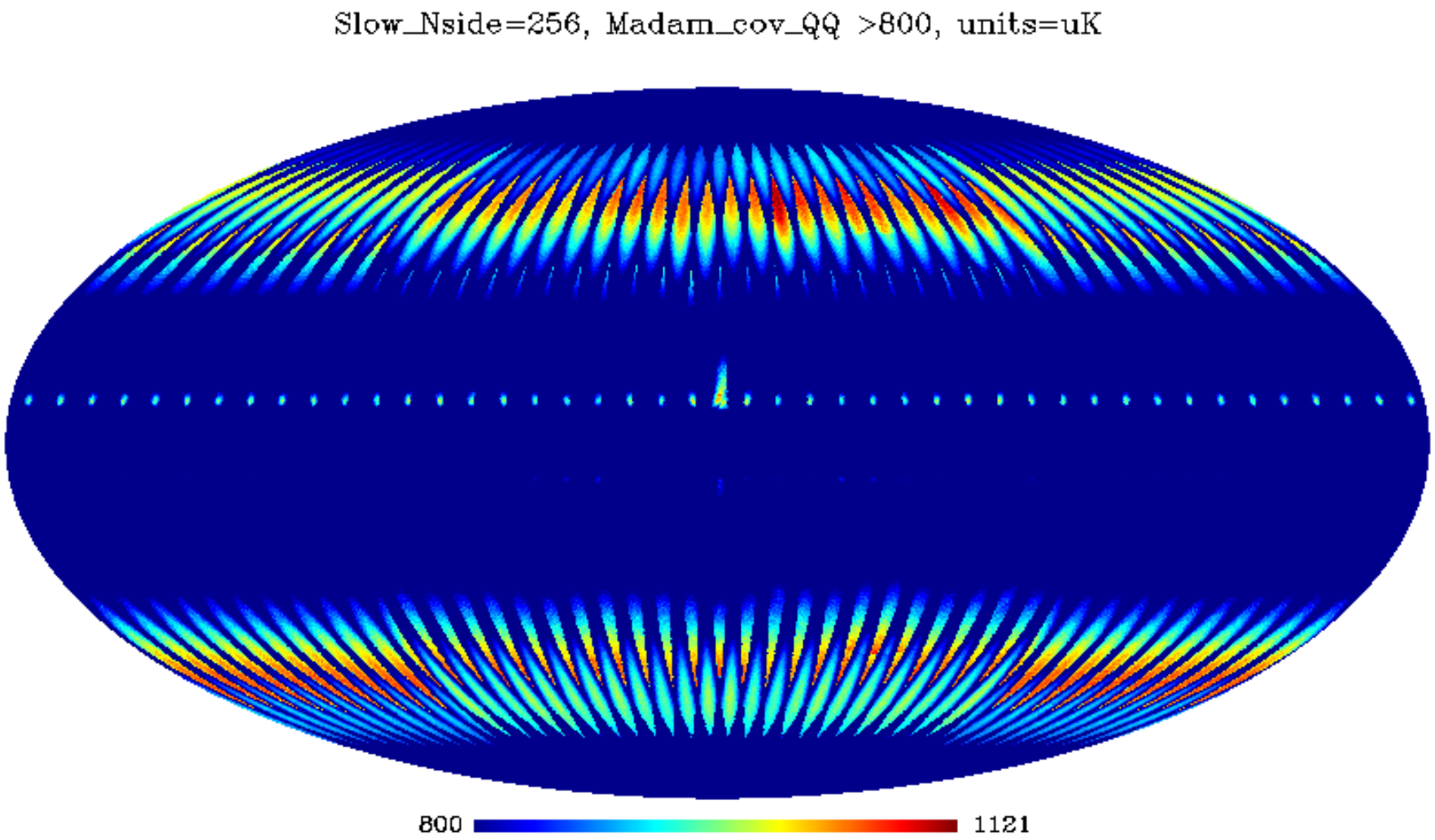
Thresholds > 800 μK²



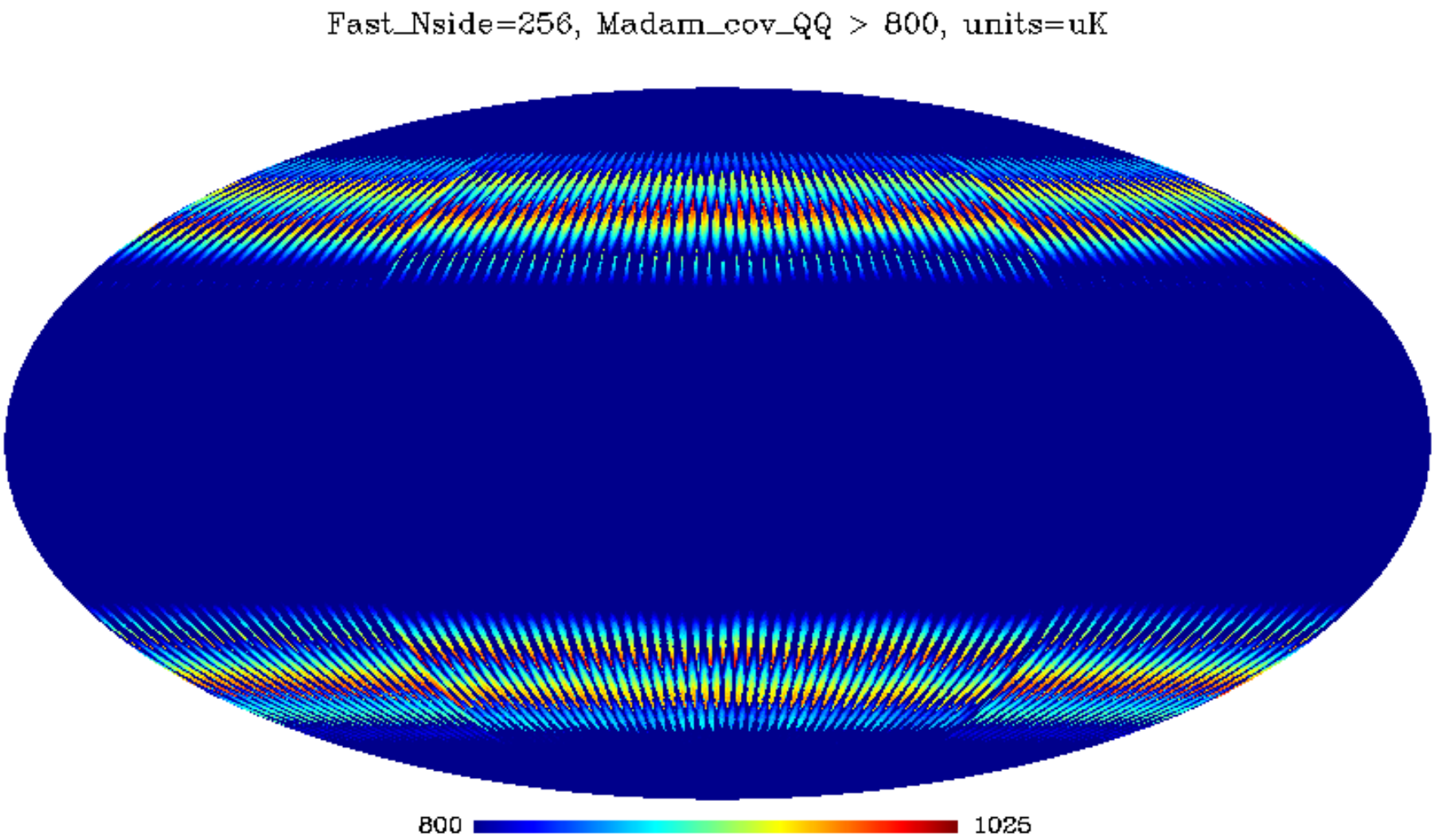
Thresholds > 50 μK²

Thresholds > 125 μK²

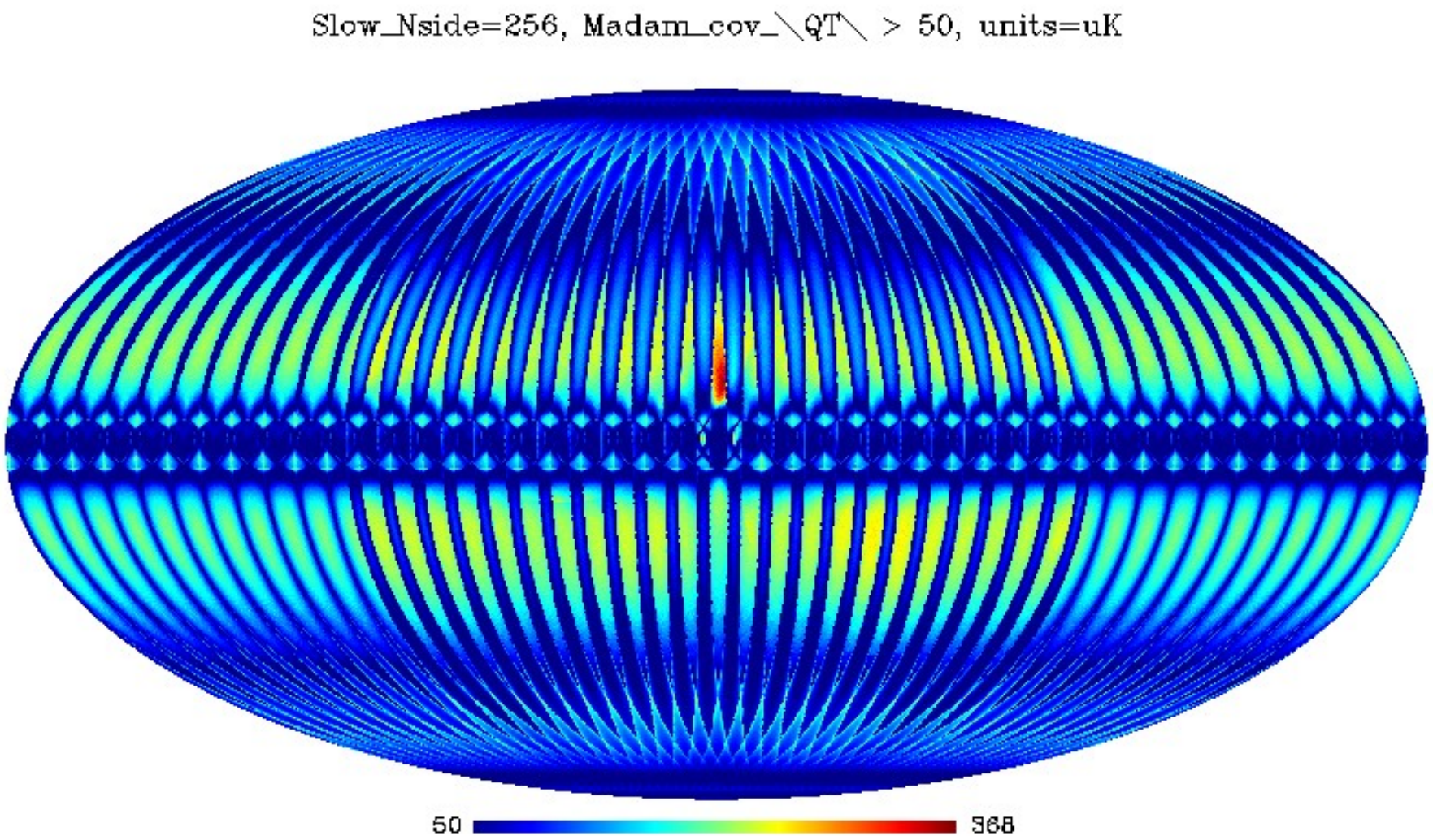
QQ – LiteCOrE Slow



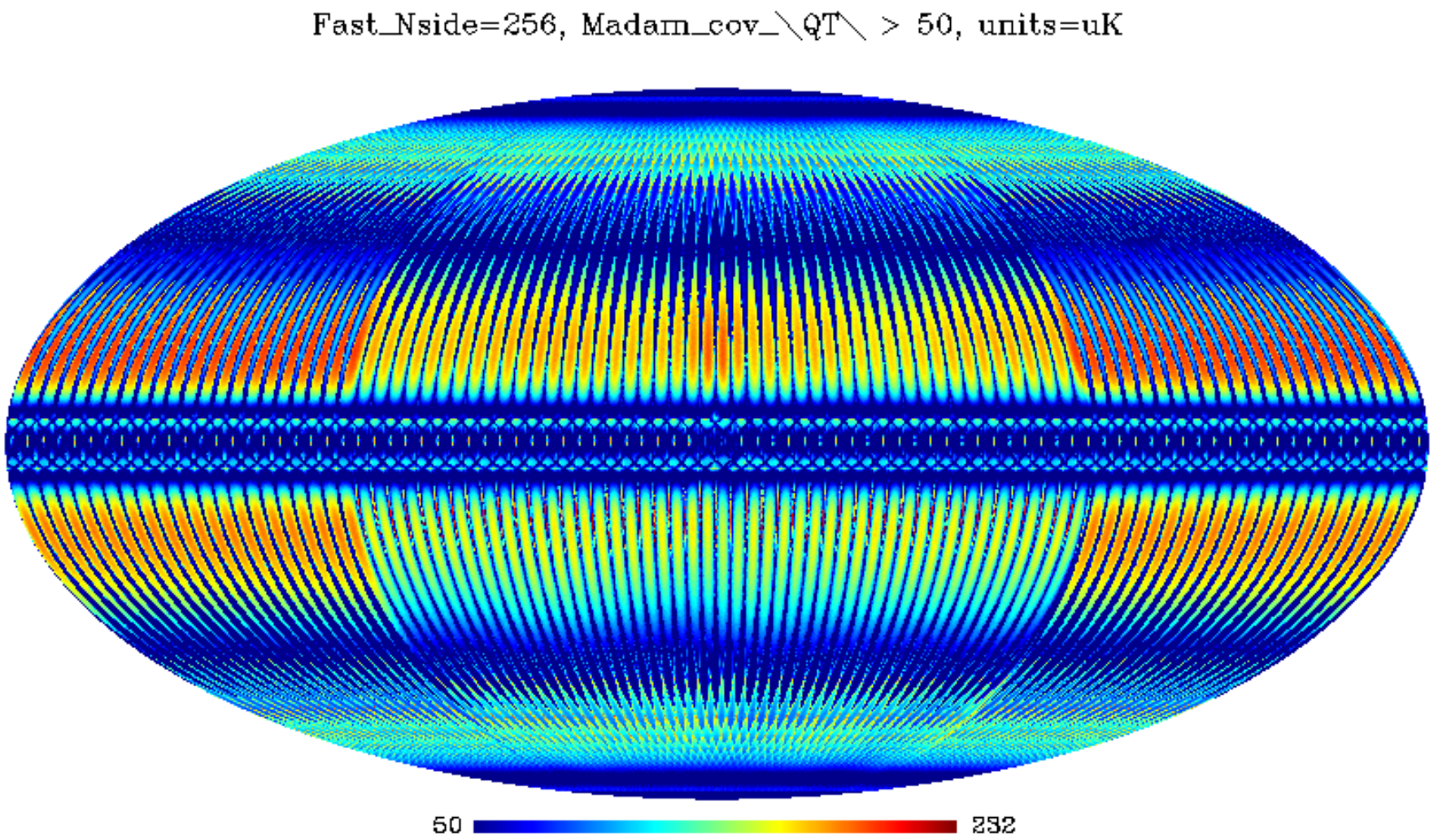
QQ – LiteCOrE Fast



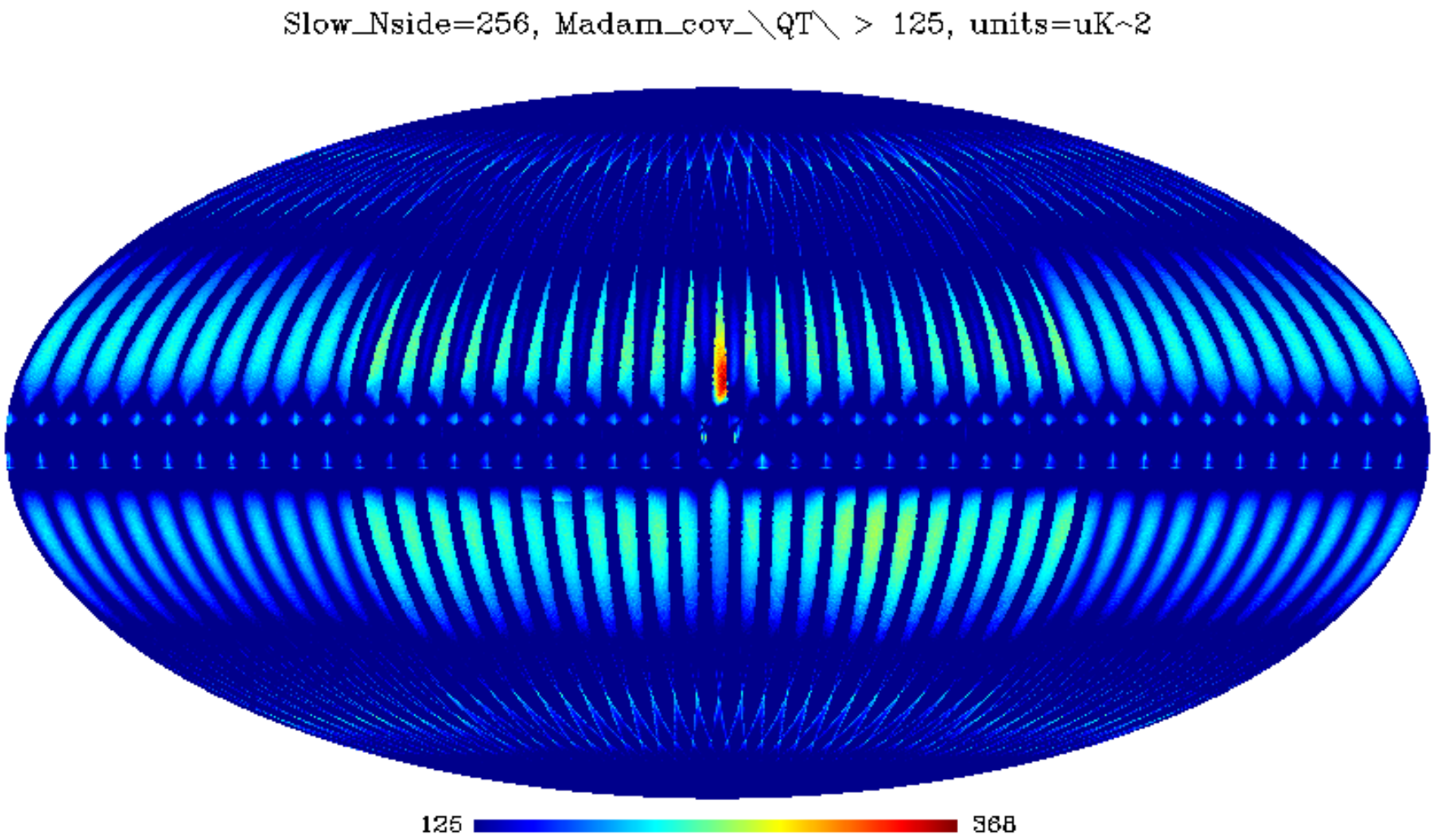
QT – LiteCOrE Slow



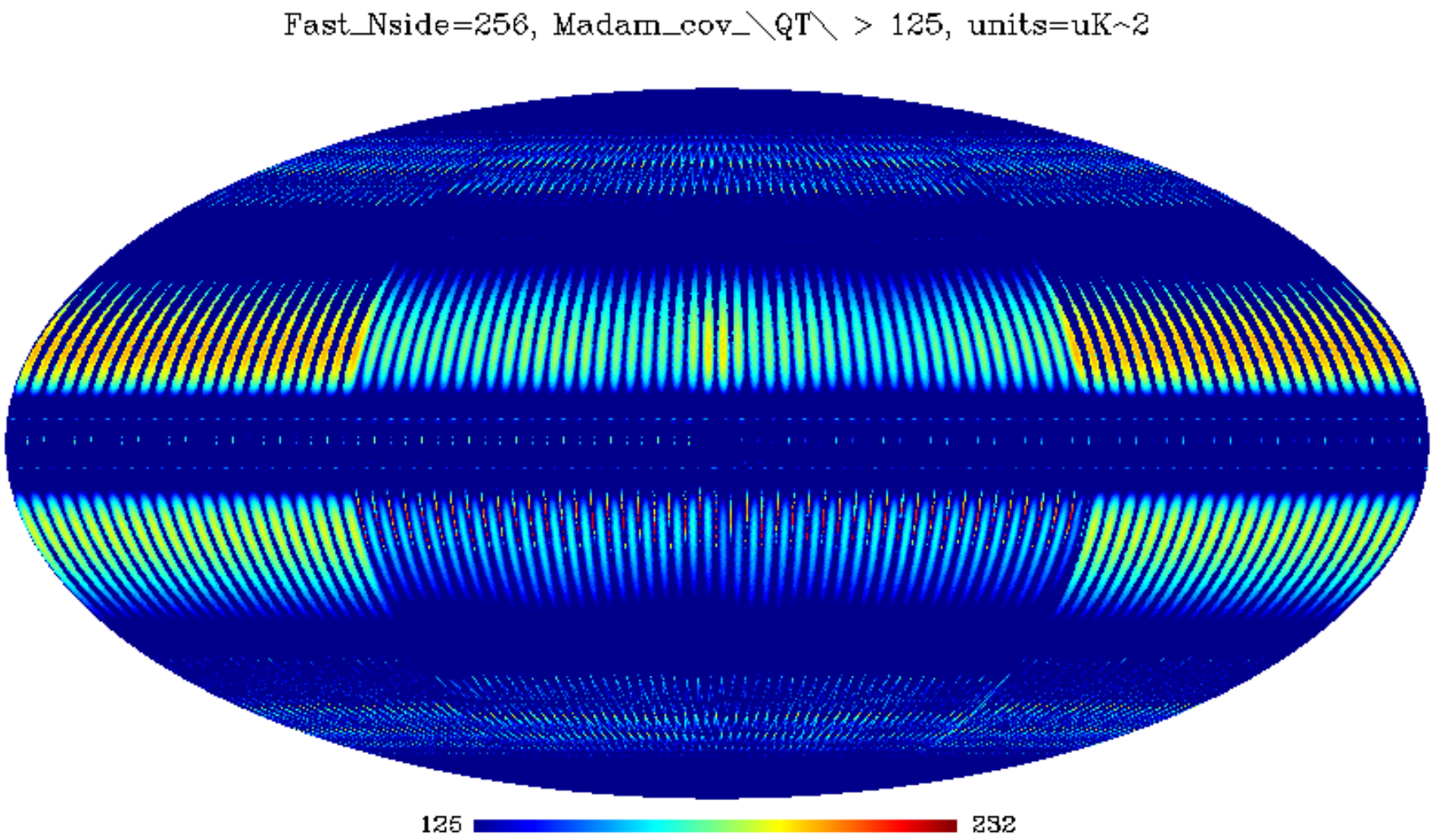
QT – LiteCOrE Fast



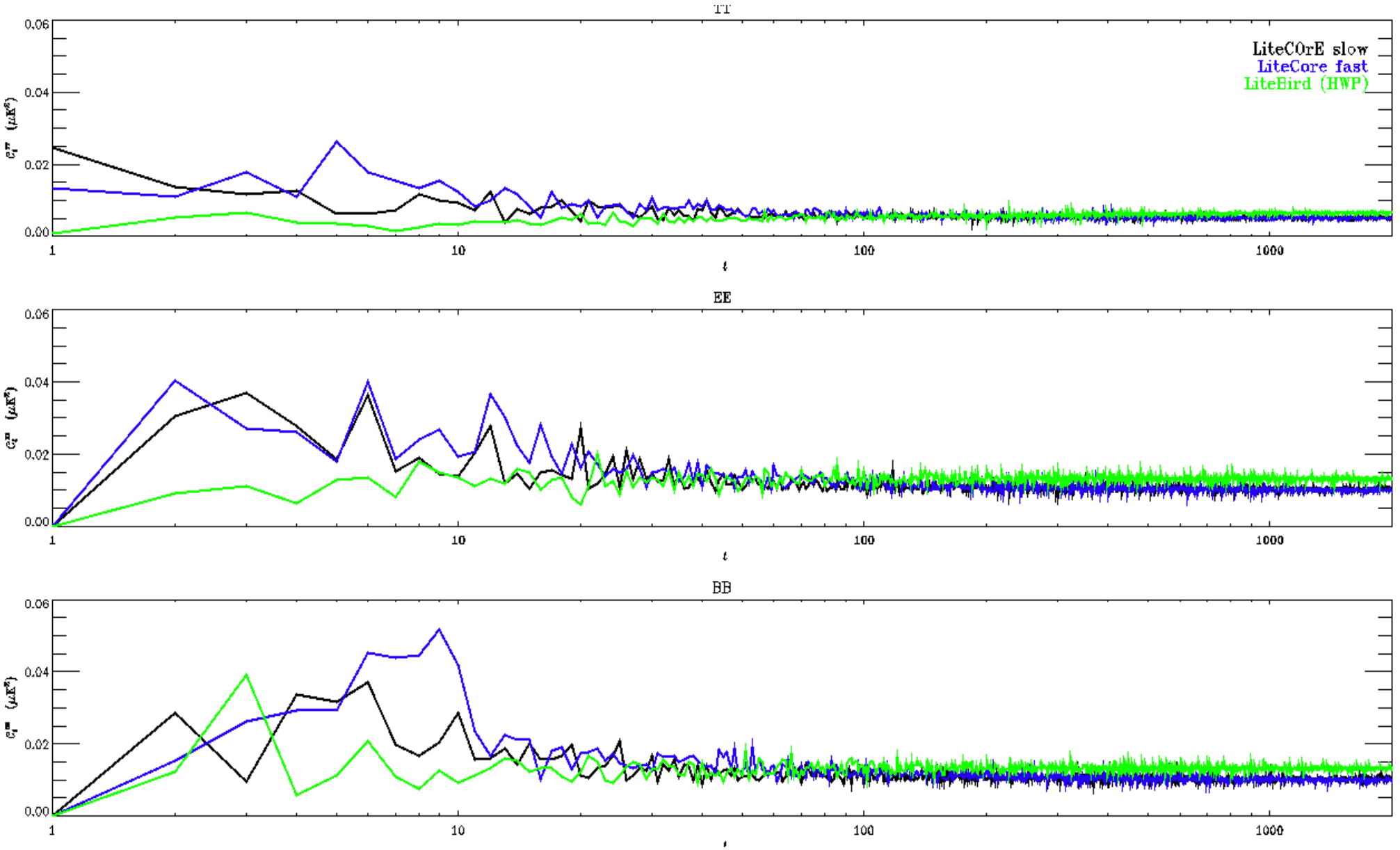
QT – LiteCOrE Slow



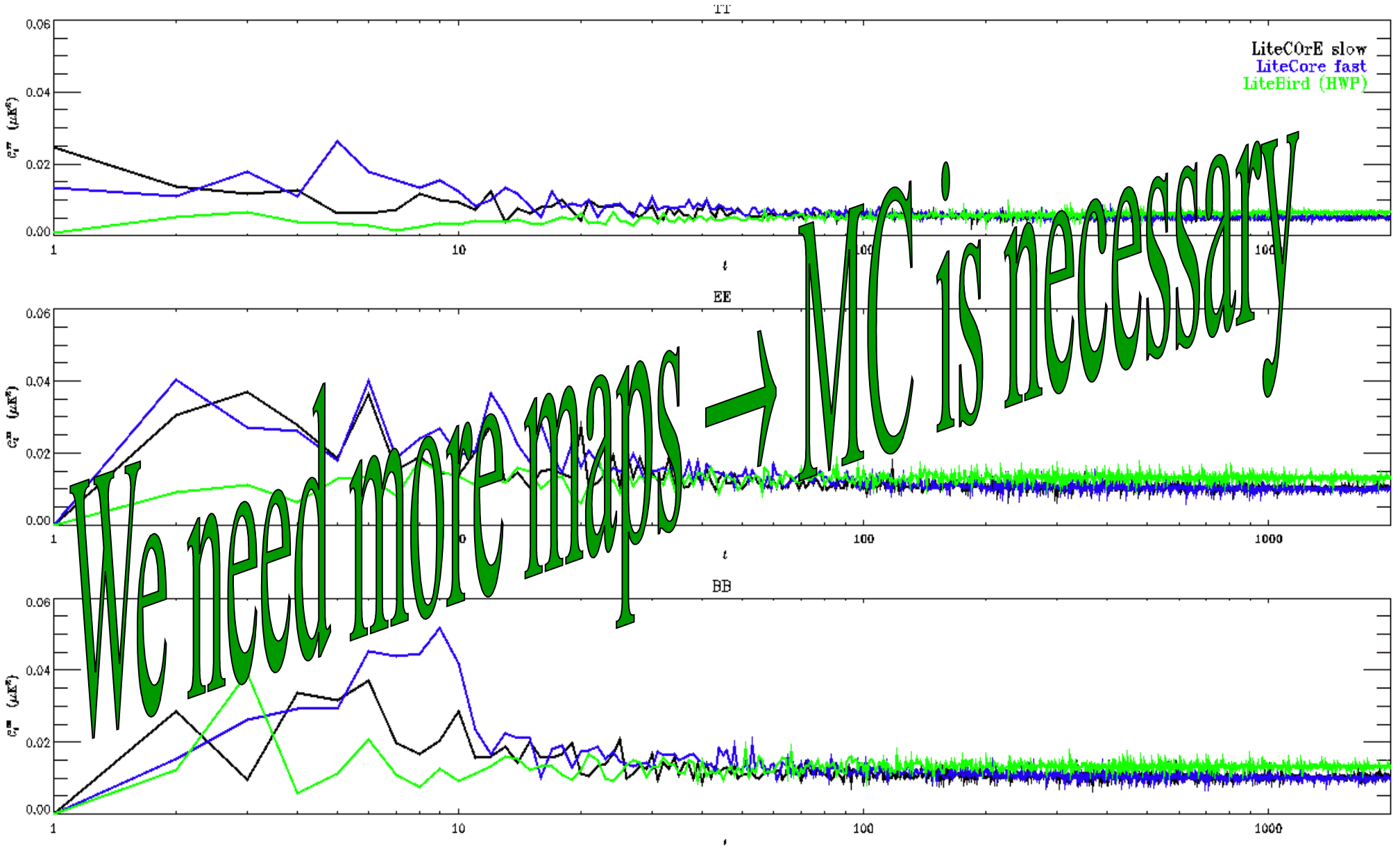
QT – LiteCOrE Fast



Noise map spectra



Noise map spectra



We need more maps → MC is necessary

Conclusions

- On the single detector on boresight exercise, both the pixel condition number and the distribution of the 3x3 covariances look similar for the slow and fast scans.
- They are also overall reasonable, but variance and TP covariances are asymmetric between Q and U.
- This need to be investigated in terms of impact on map quality and noise property.
- Will be done with dedicated noise Monte Carlo (being setup).
- We also want to repeat the exercise for pixels in different positions in the focal plane.