Mapping polarization with CorE: preliminary results

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**Fast Scan**

- Precession period = 4 days
- Spin rate = 1rpm
- Angular rate = \(2\pi \sin(45\pi/180)/(1\times60) = 7.40480\times10^{-2}\) 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 = \(2\pi \sin(45\pi/180)/(0.5\times60) = 3.70240\times10^{-2}\) rad/s
- Beam size = 1.6842427e-3 rad
- Beam crossing time = 4.549057e-2s
- 4 hits per beam: samplerate = 87.93 Hz

**LiteCOreE**

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

[Graph showing map condition number with different conditions and occurrences marked as LiteCorE slow, LiteCore fast, and LiteBird (HWP).]
Map condition number

- Optimal condition $r$ is $\frac{1}{2}$ 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 $\mu K^2$ and Nside=1024 for all plots
Covariance map - QQ

- LiteCore-Slow QQ
- LiteCore-Fast QQ
- LiteBird QQ

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QT

Covariance map - QT

- LiteCore-Slow QT
- LiteCore-Fast QT
- LiteBird QT
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

2) Strange behaviour of QQ and QT

We downgrade the maps to Nside=256
Covariance map - TT, Nside=256

- Green: LiteBird TT
- Blue: LiteCore-Slow TT
- Red: LiteCore-Fast TT

Number of pixels vs. covariance occurrence.
Covariance map - QQ, Nside=256

- LiteBird - QQ
- LiteCore-Slow QQ
- LiteCore-Fast QQ
UQ

Covariance map - UQ, Nside=256

- LiteBird UQ
- LiteCore-Slow UQ
- LiteCore-Fast UQ
QT

Covariance map - QT, Nside=256

- Green: Lite-Bird QT
- Blue: LiteCore-Slow QT
- Red: LiteCore-Fast QT
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

\[ \text{Slow\_Nside}=256, \text{Madam\_cov\_QQ}>800, \text{units}=\text{uK} \]
QQ – LiteCOre Fast

Fast_Nside=256, Madam_coy_QQ > 800, units=uK
QT – LiteCOre Slow

Slow_Nside=256, Madam_cov\QT\ > 50, units=uK
QT – LiteCOReE Fast

\[ \text{Fast}_\text{Nside}=256, \text{Madam}\_\text{cov}\_\backslash\text{QT}\_ > 50, \text{units}=\text{uK} \]
QT – LiteCOrE Slow

$\text{Slow\_Nside=256, Madam\_cov\_QT\ >\ 125, units=uK^{-2}}$

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QT – LiteCOrE Fast

Fast_Nside=256, Madam_cov\QT\ > 125, units=uK^2
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.