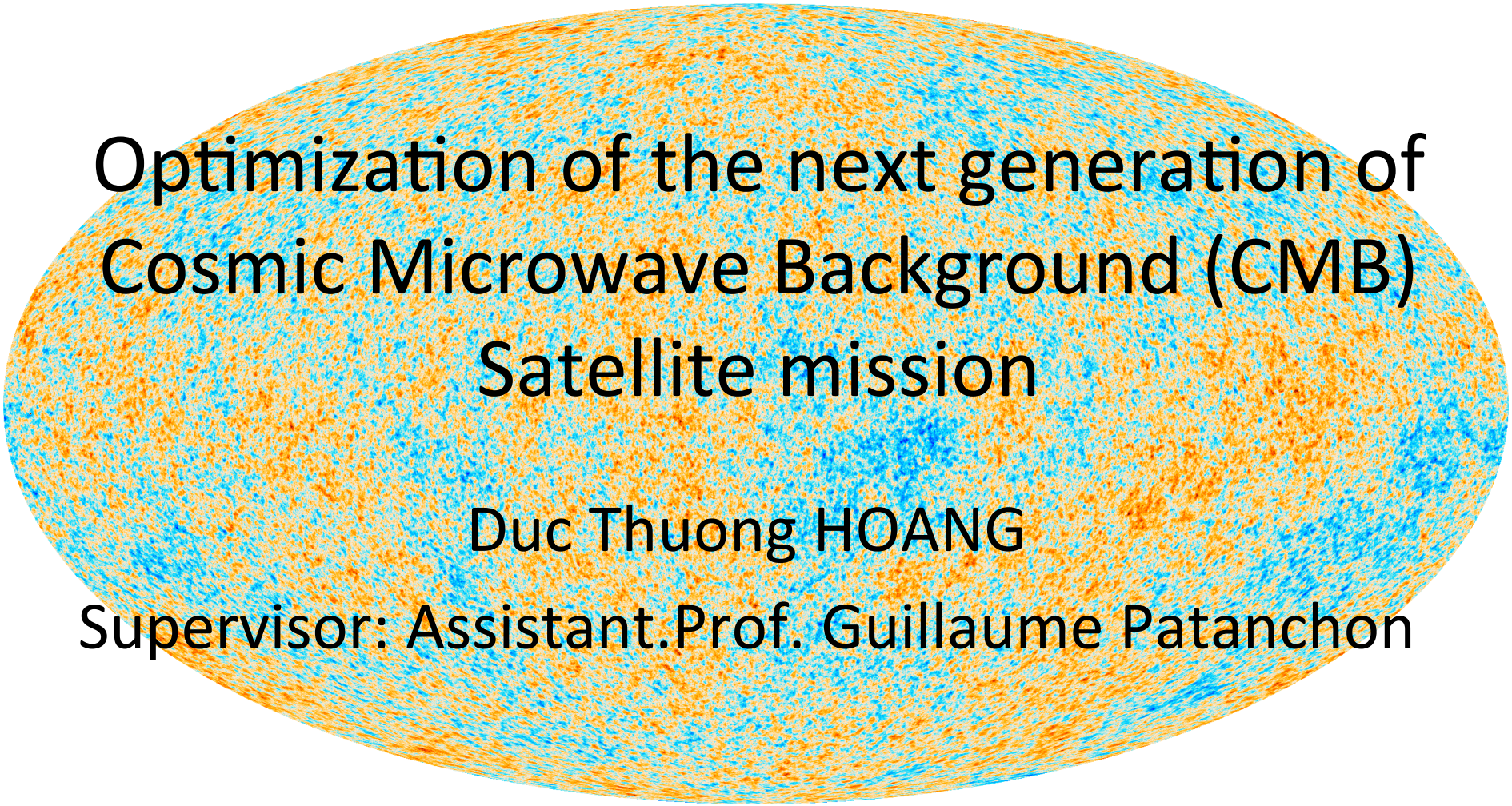
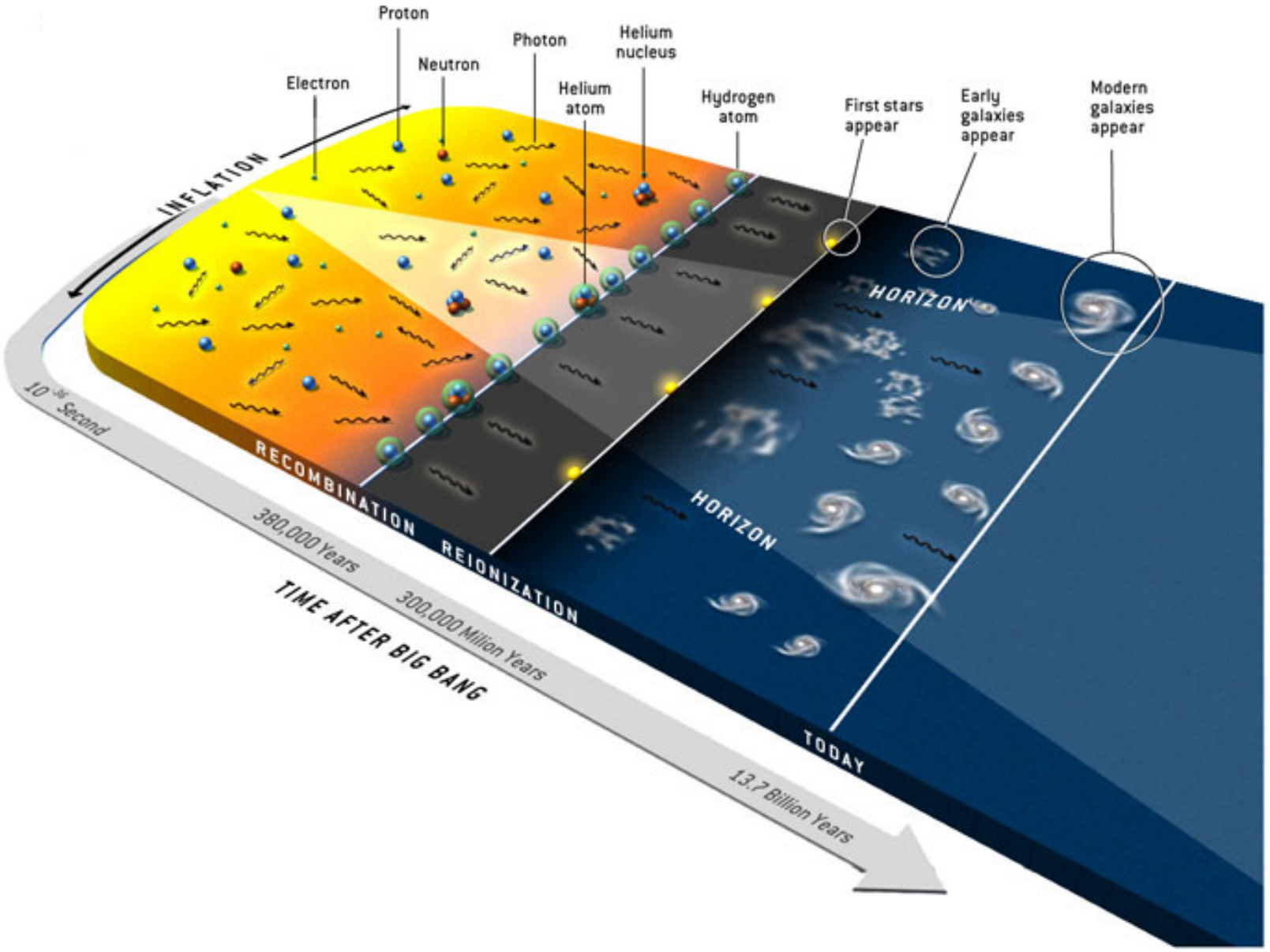


Optimization of the next generation of Cosmic Microwave Background (CMB) Satellite mission

Duc Thuong HOANG

Supervisor: Assistant.Prof. Guillaume Patanchon

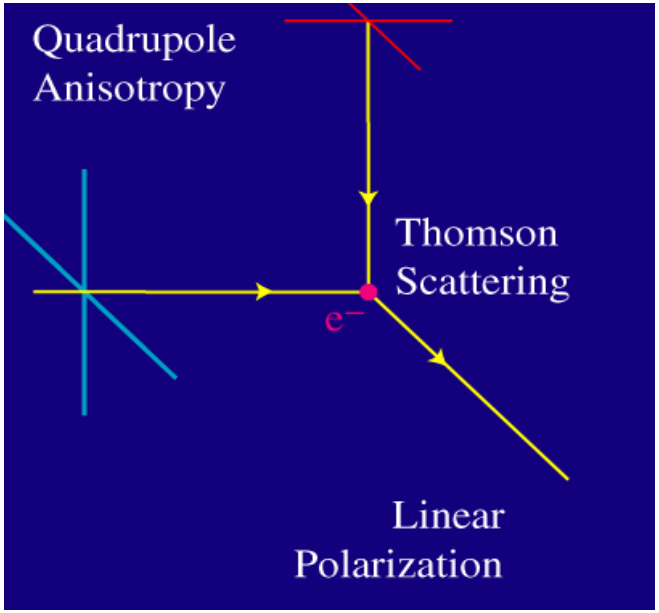
I. Introduction -> Evolution of the Universe



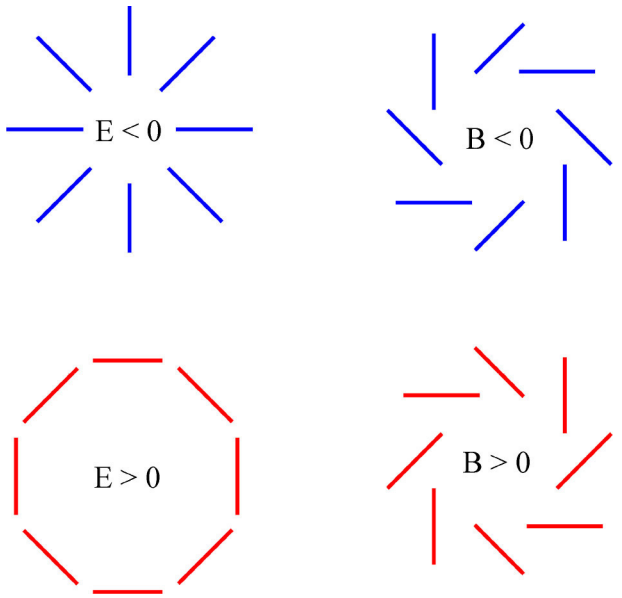
I. Introduction -> CMB polarization

The polarization can be decomposed into 2 components:

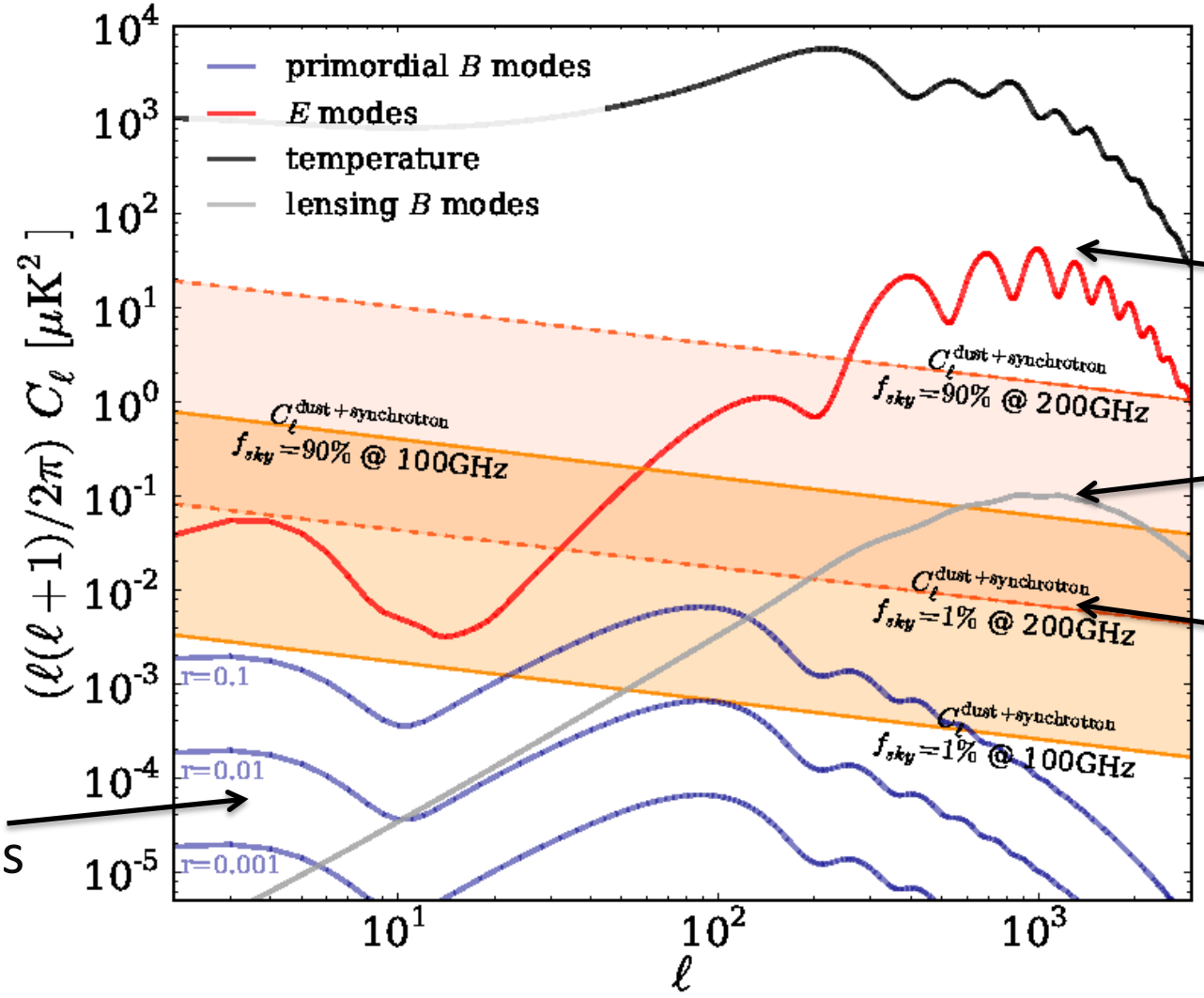
- E-mode (like an electric field) or gradient-mode
- B-mode (like magnetic field) or curl-mode



(Waynehu)



E and B angular power spectrum



E-modes

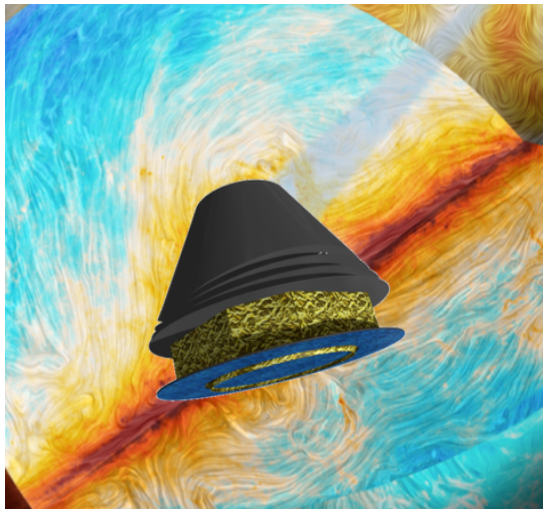
Lensing on B-modes

Foreground polarization

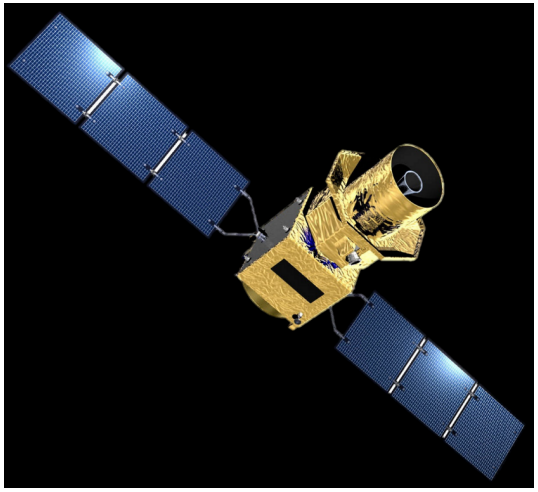
B-modes

II. Future CMB satellites

For example: CORE

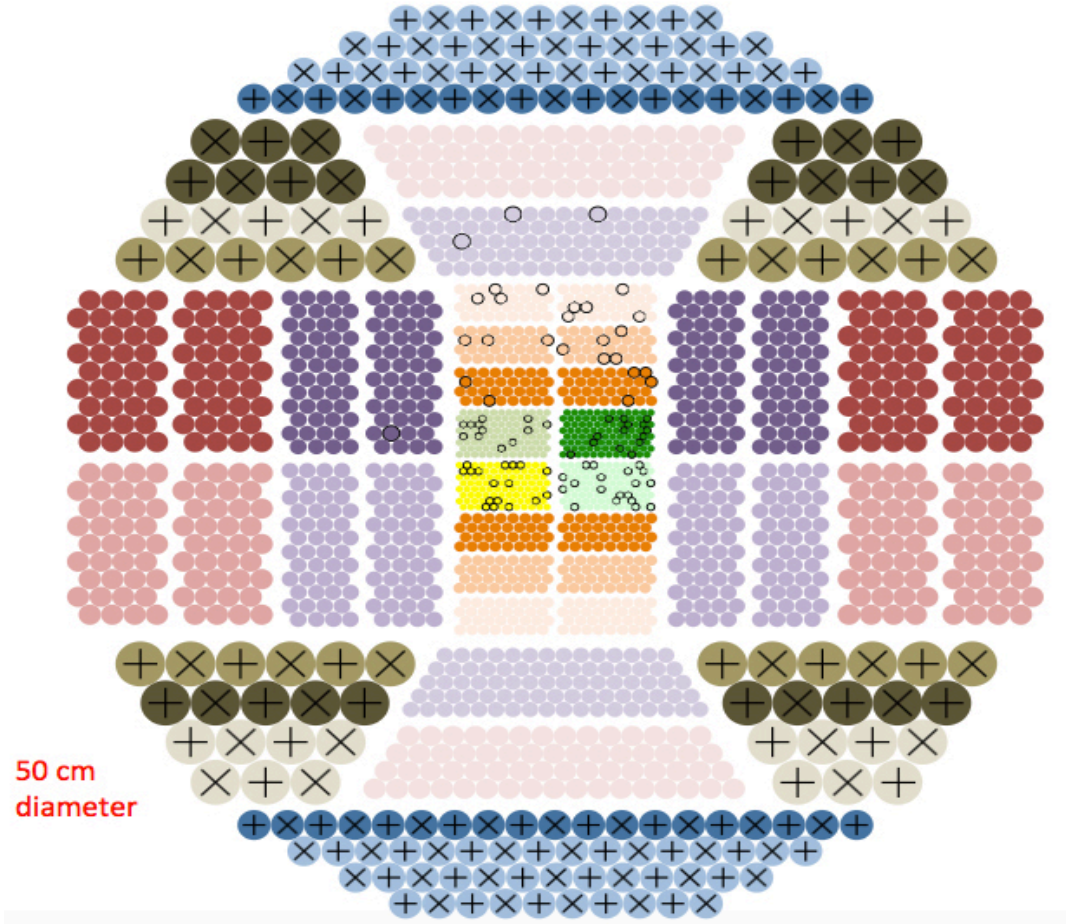


The Cosmic Origin Explore



LiteBird (JAXA)

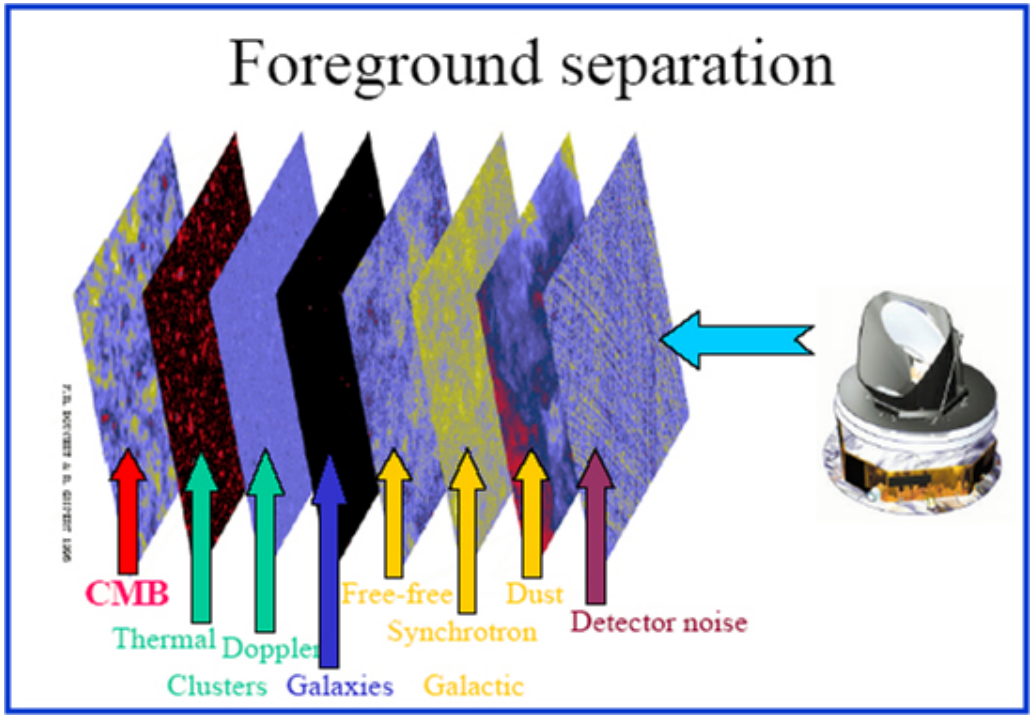
GHz	N_{det} (M5)
60	24×2
70	24×2
80	24×2
90	39×2
100	39×2
115	38×2
130	124
145	144
160	144
175	160
195	192
220	192
255	128
295	128
340	128
390	96
450	96
520	96
600	96
TOTAL	2100



(CORE proposed to ESA M5)

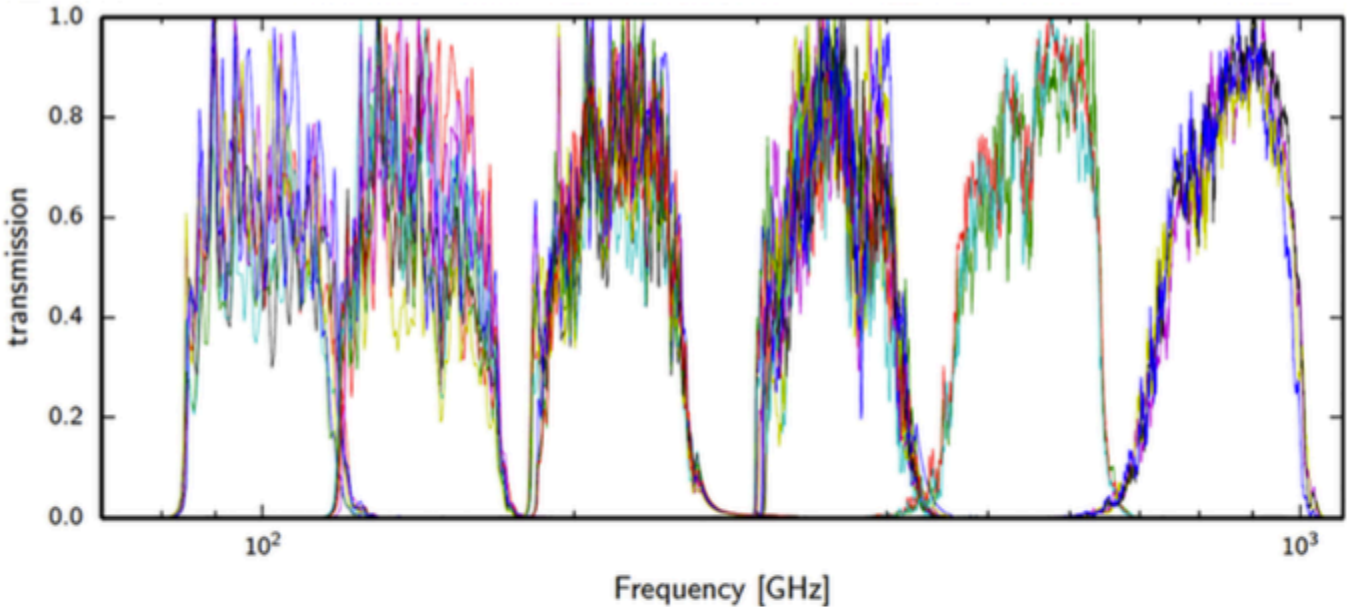
II. Potential systematic effects

- Beam mismatch
- Cosmic rays
- 1 / f noise
- *Band-pass mismatch*
- Thermal fluctuations
- …

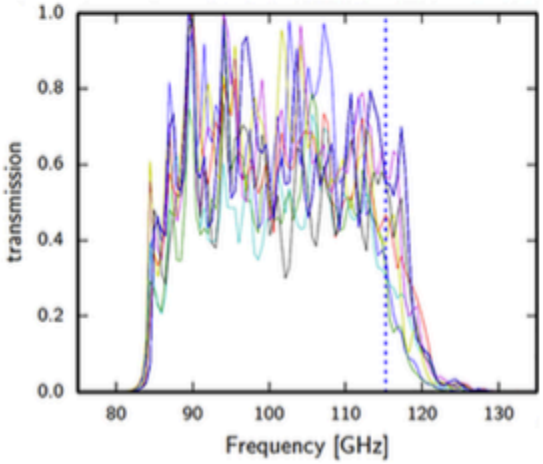


The Galactic components contaminate the measurement of CMB polarization

II. Band-bass mismatch



(Planck filter shapes)



=> different relative calibration between CMB and other components with different spectra.

III. Band-bass mismatch effect

- Detectors measure signal on the sky:

$$S_a(t) = \Delta T_{\mathrm{CMB},p} + Q_p \cos 2\psi(t) + U_p \sin 2\psi(t) + \Delta T_{\mathrm{Gal},a,p}$$

$$S_b(t) = \Delta T_{\mathrm{CMB},p} - Q_p \cos 2\psi(t) - U_p \sin 2\psi(t) + \Delta T_{\mathrm{Gal},b,p},$$

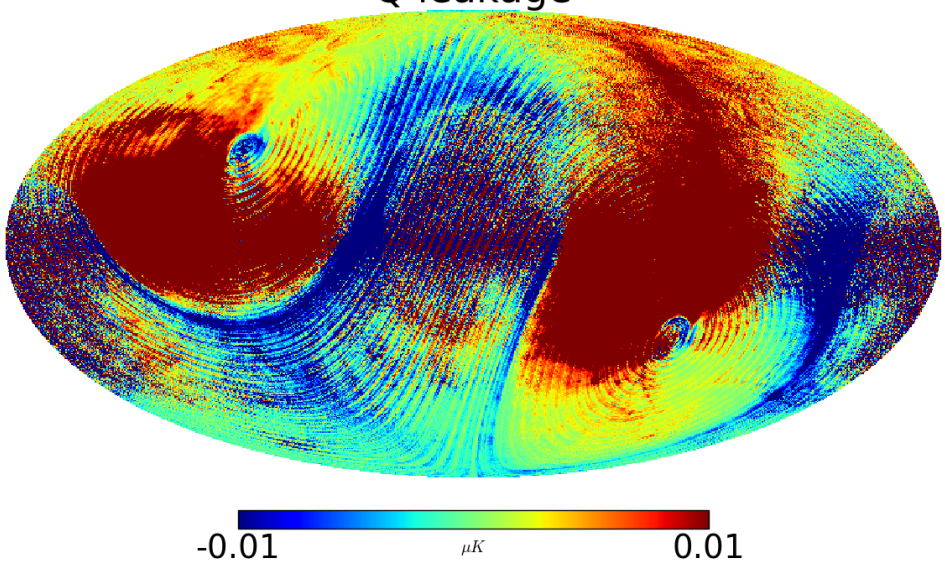
$$\Delta S = \frac{S_a(t) - S_b(t)}{2} = Q_p \cos 2\psi(t) + U_p \sin 2\psi(t) + \delta T_{\mathrm{Gal},p},$$

I: Intensity and Q, U are Stoke's parameters of the CMB polaziration

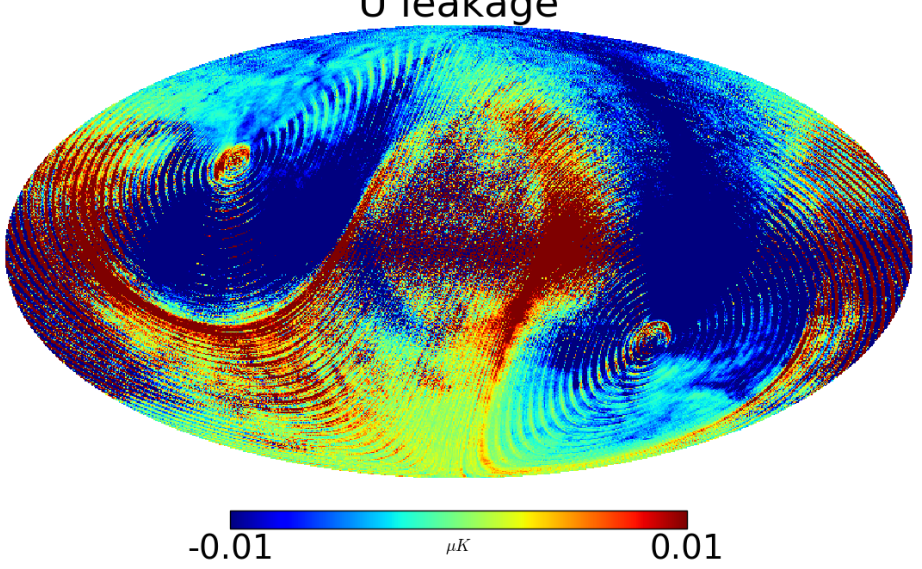
ψ Detectors angle

III. Band-bass mismatch effect (74 detectors)

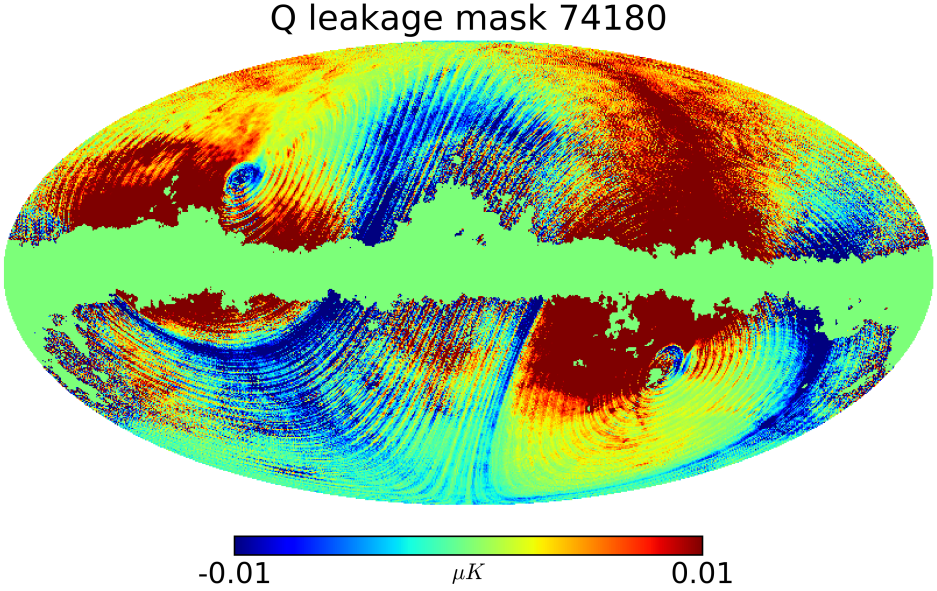
Q leakage



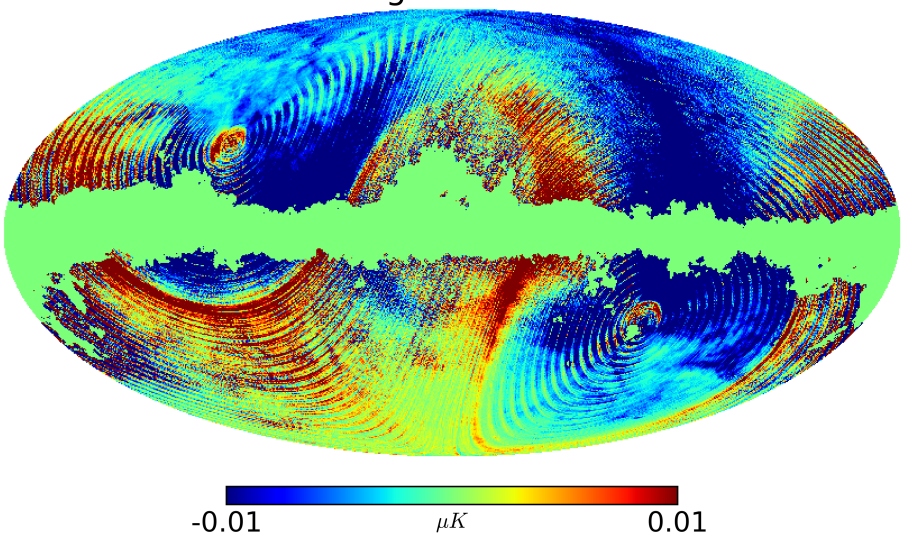
U leakage



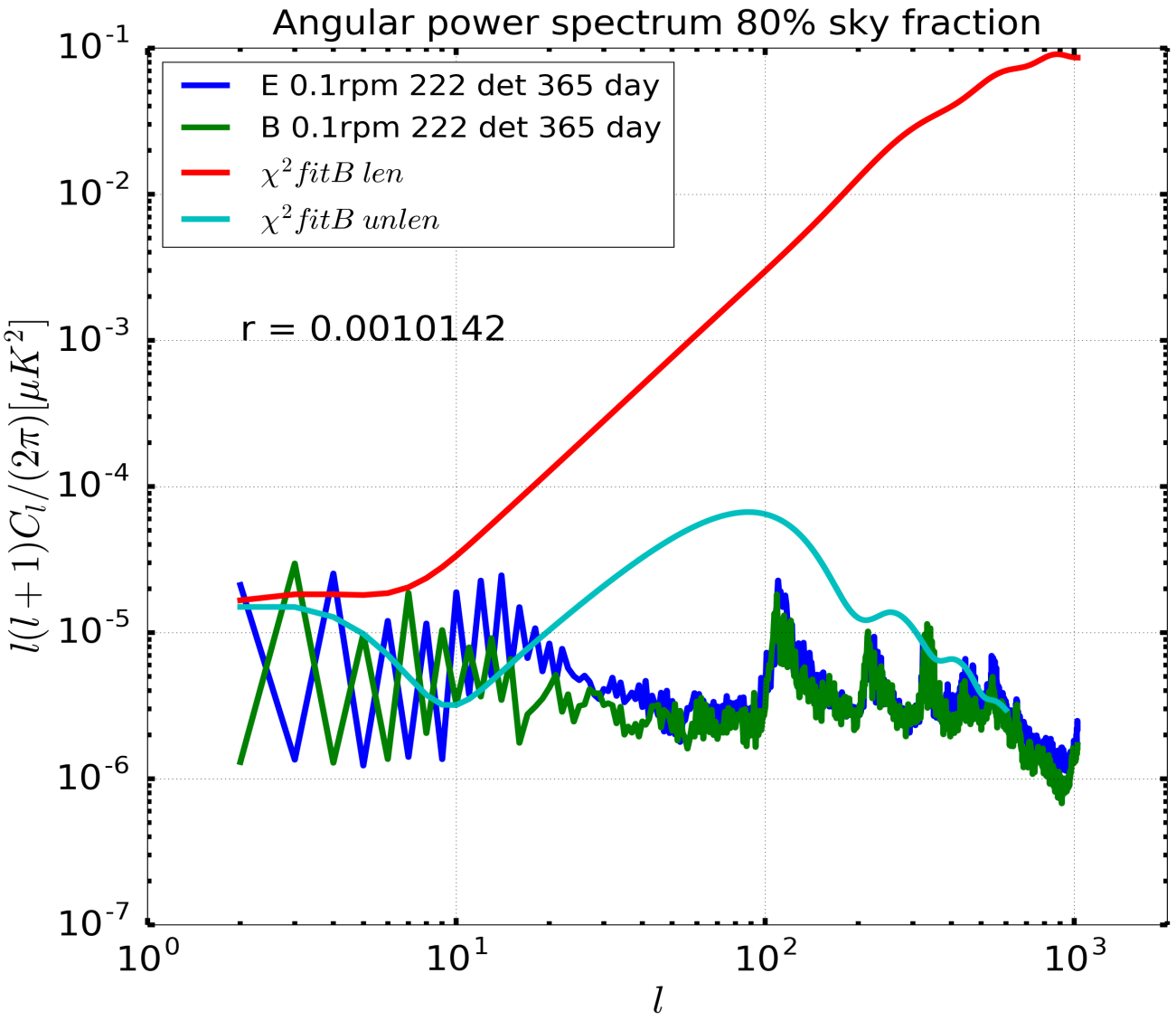
Q leakage mask 74180



U leakage mask 74180

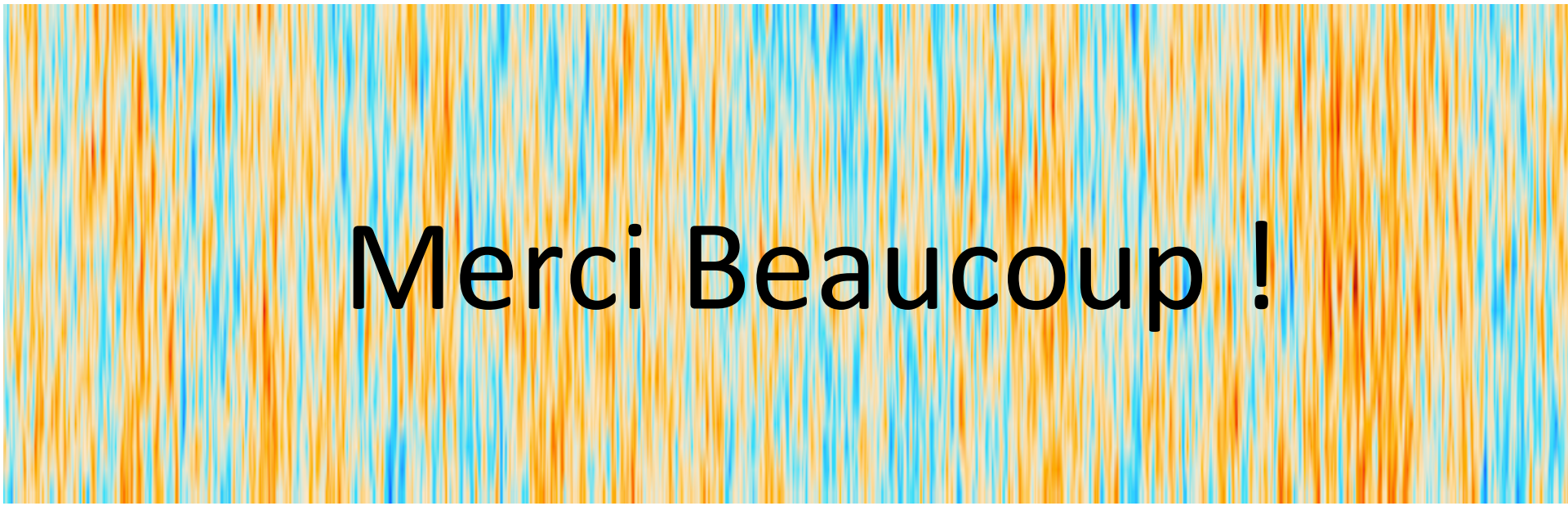


III. Band-bass mismatch effect



IV. Conclusions and future work

- Band-pass mismatch is non-negligible effect due to leakage from intensity to polarization.
- Band-pass mismatch depend on scanning strategy of the satellite.
- I am working on correction methods.
- In the near future, I will work with another systematic effect as particle interaction with detector arrays.


Merci Beaucoup !