Galactic Science

CMB S4- Spring meeting
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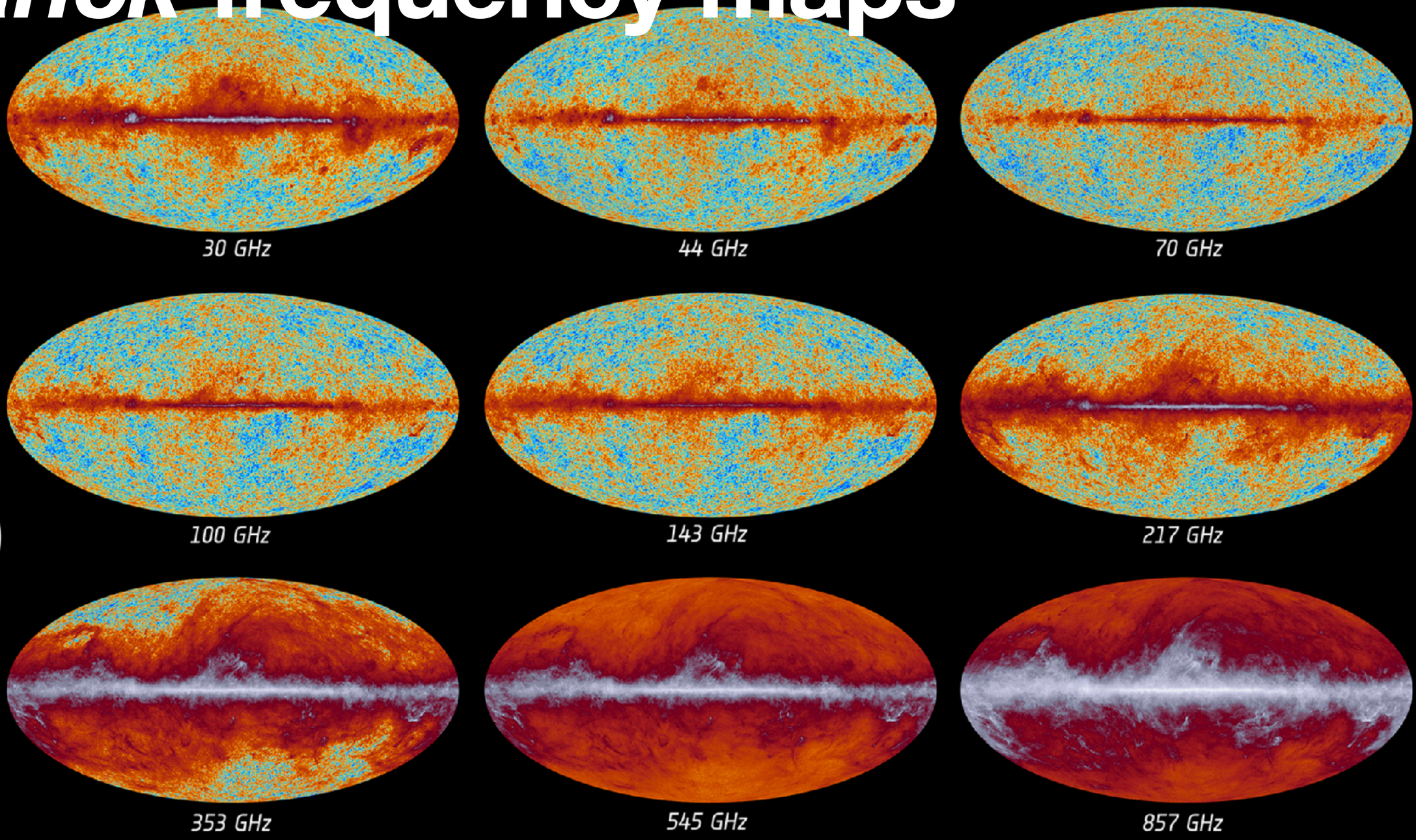
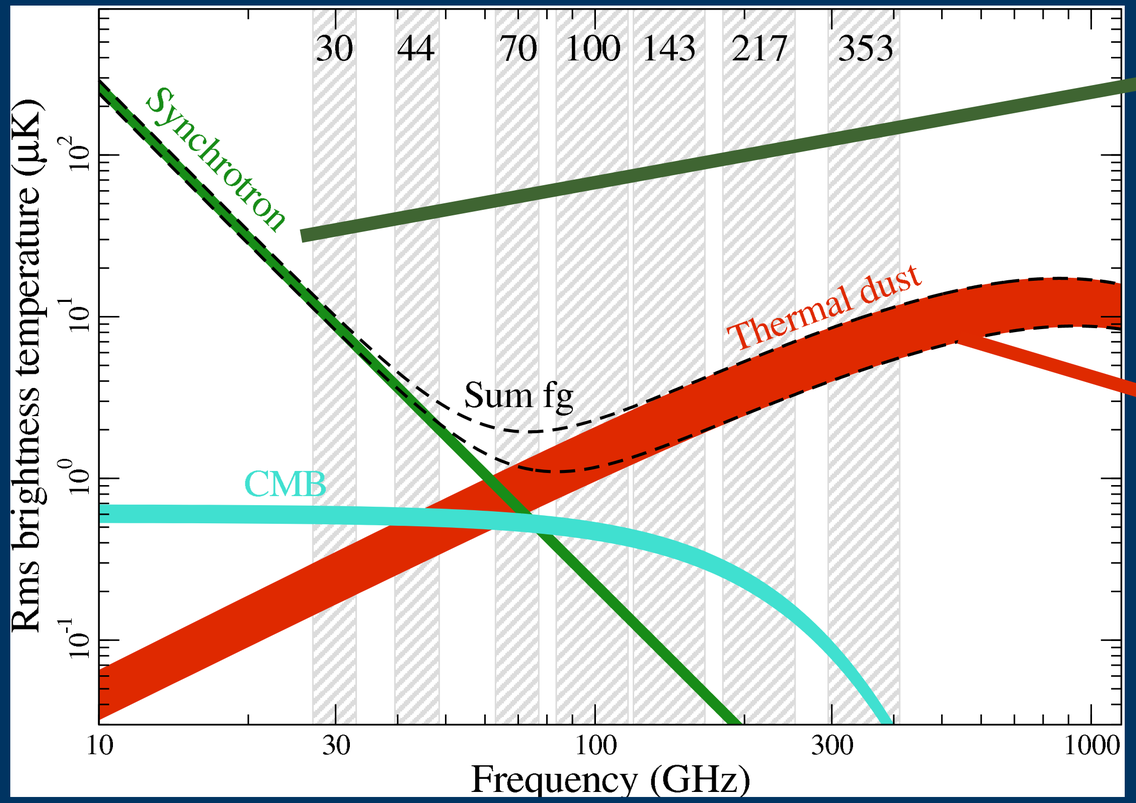
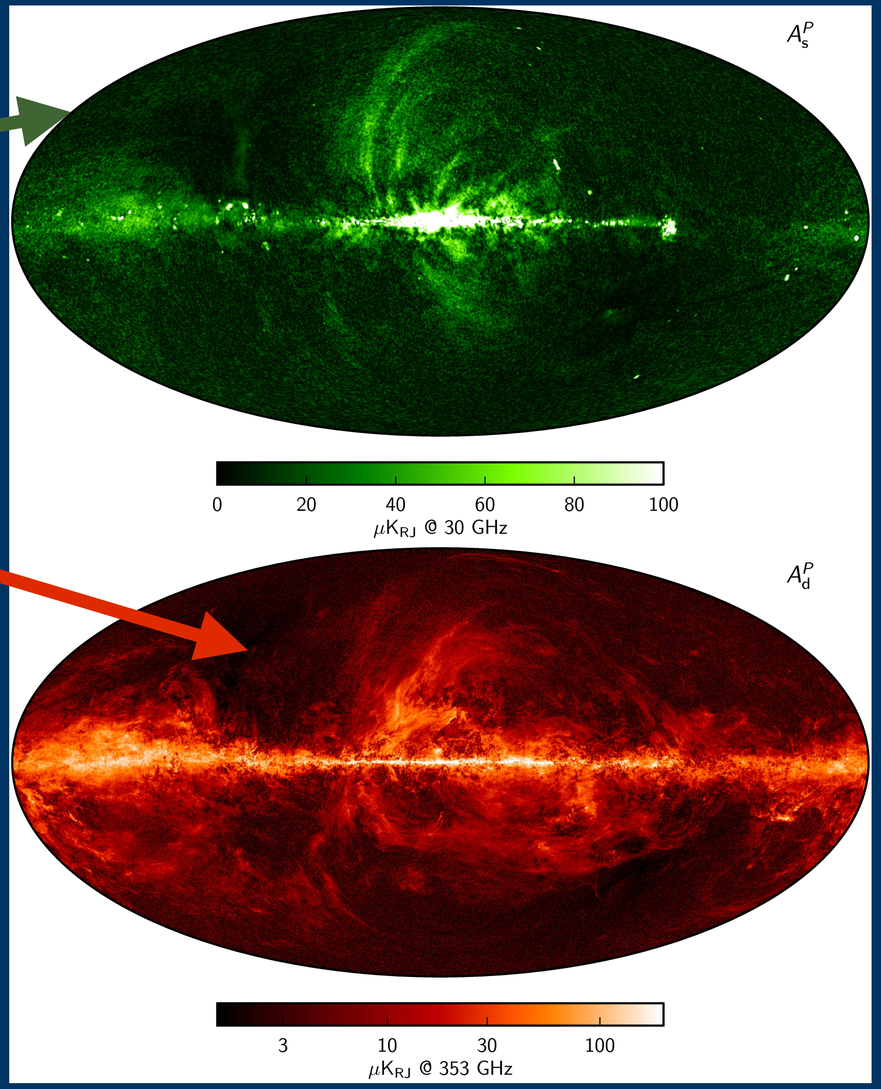
Planck frequency maps



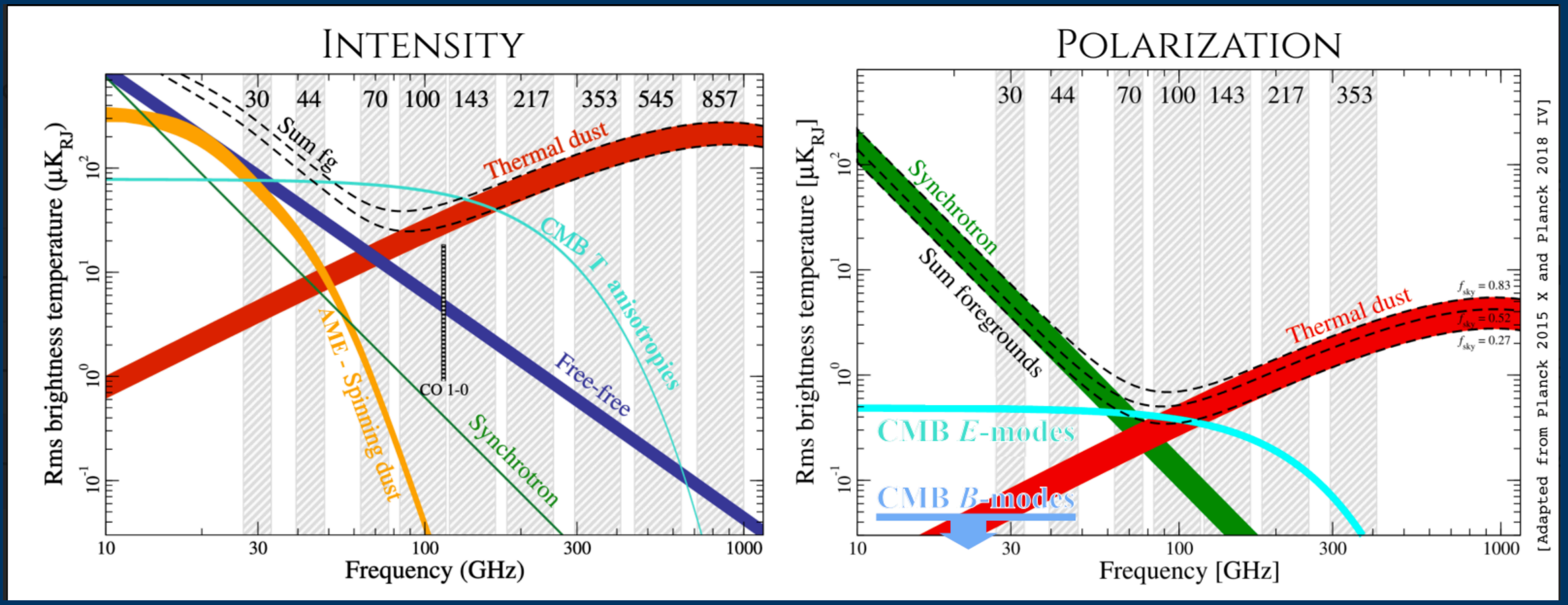
1. Galactic Foregrounds



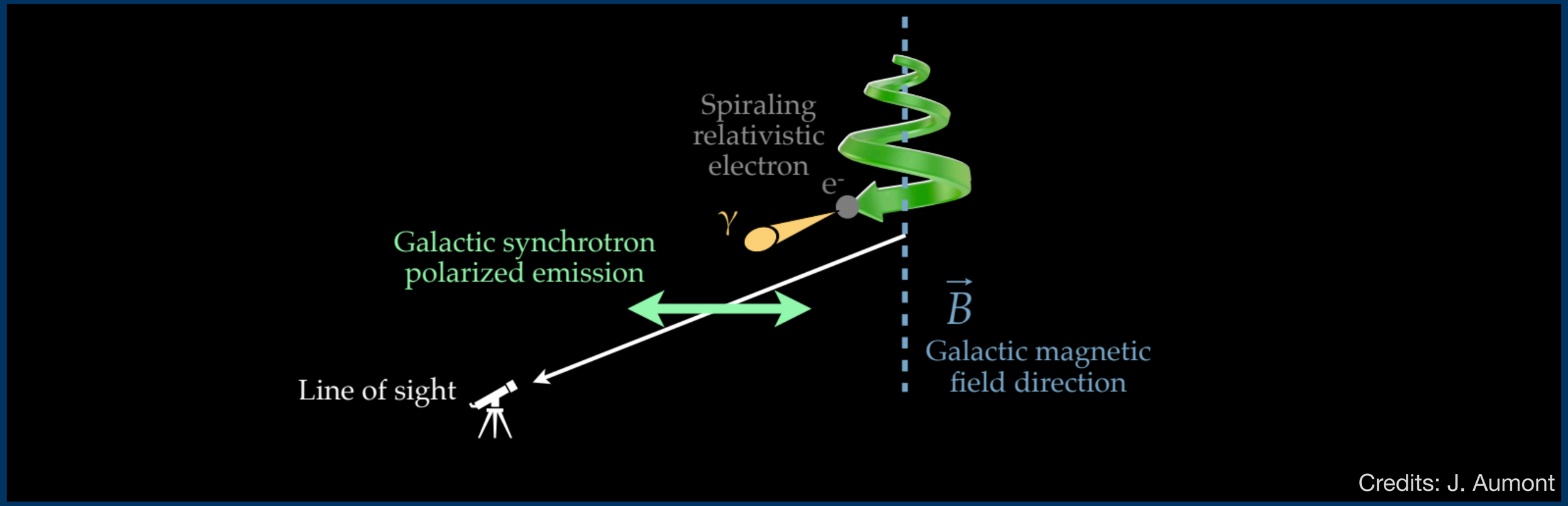
Planck Collaboration 2016



1. Galactic Foregrounds

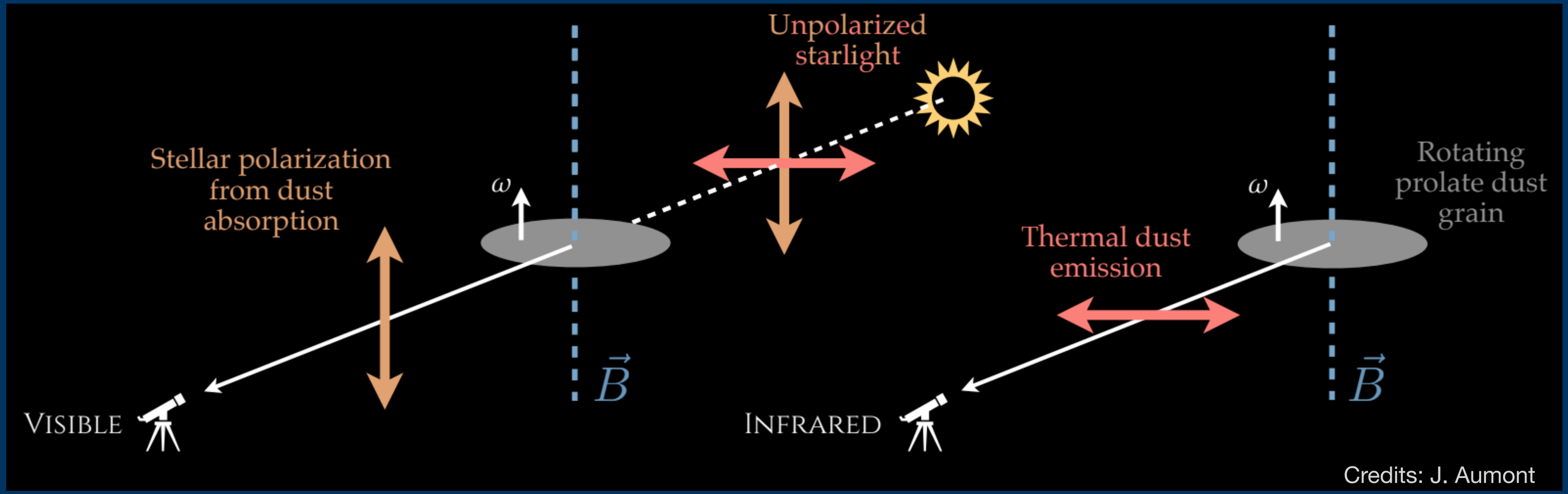


Synchrotron



Credits: J. Aumont

Thermal Dust



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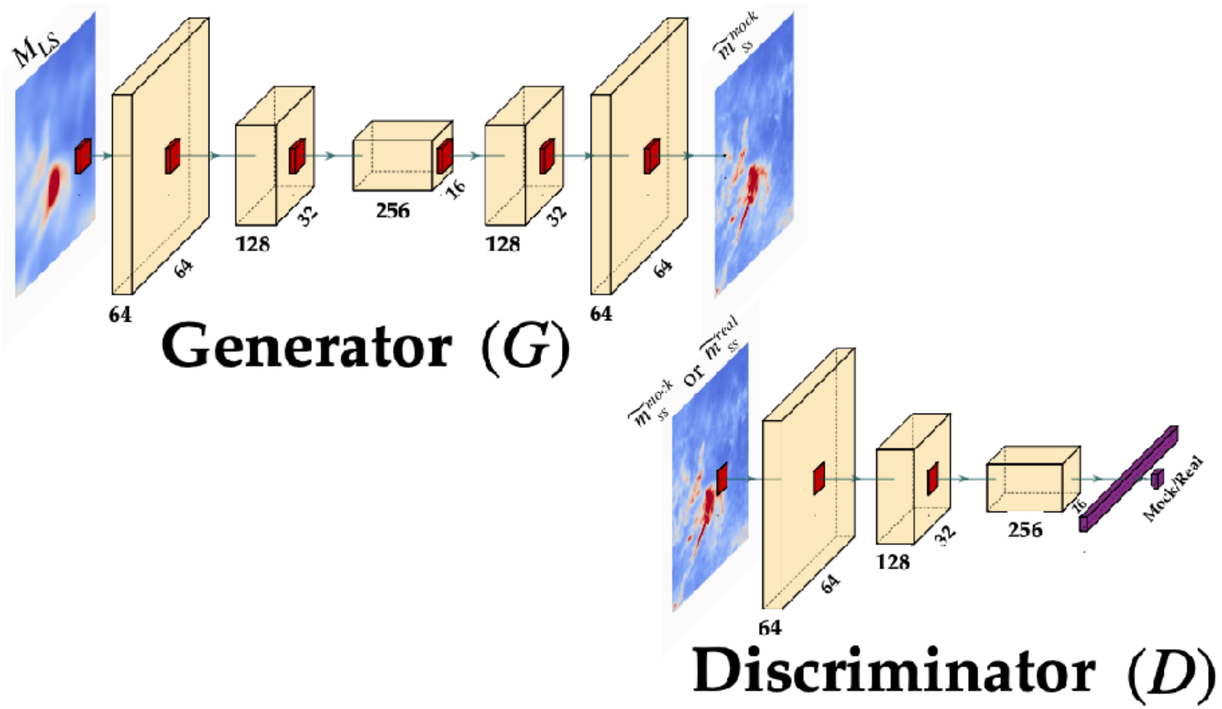
Galactic Foreground modelling

Aim to extract as much info as possible to access the emission at small scales strongly contaminated by noise

- De-noise techniques
- Clustering techniques to identify regions of high level of homogeneity (GP,+ 2022, Carones, GP, + 2023)
- Use neural networks to *learn statistical properties* of dust emission in high SNR regions (Krachmalnicoff&GP 2021, GP&Bai 2020)

Generation of small angular scales

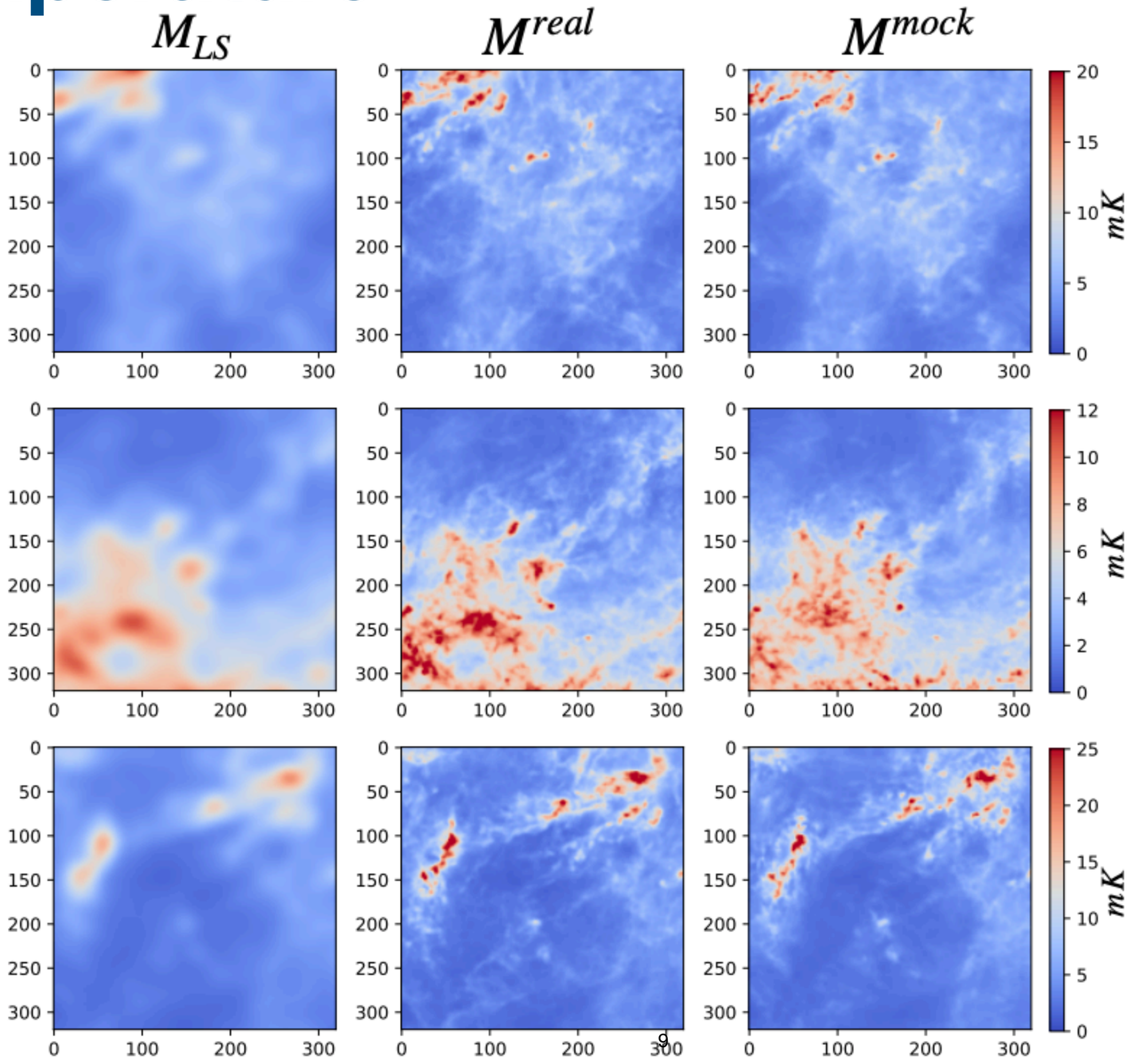
Krachmalnicoff&GP 2021



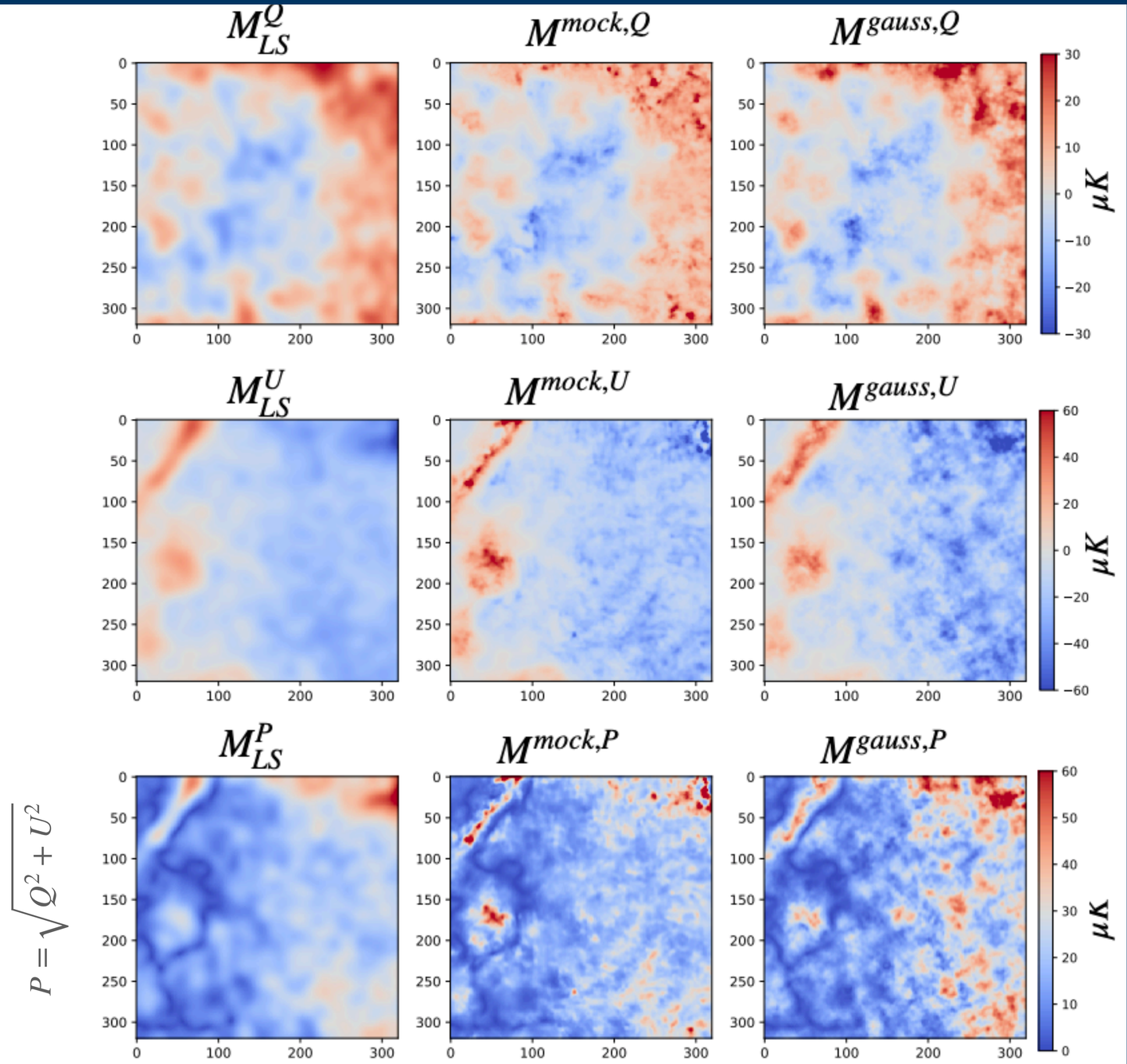
Training details DCGAN (Radford et al. 2016):

- Inputs: 320x320 images (20x20 deg2) dust maps at 80’ arcmin reso,
  Outputs: dust maps at 12’
- Training from 350 images with mini-batches of 16 images
- stochastic Gradient Descent (*Adam optimizer, LR=0.0002)* for 3000 epochs

Dust temperature

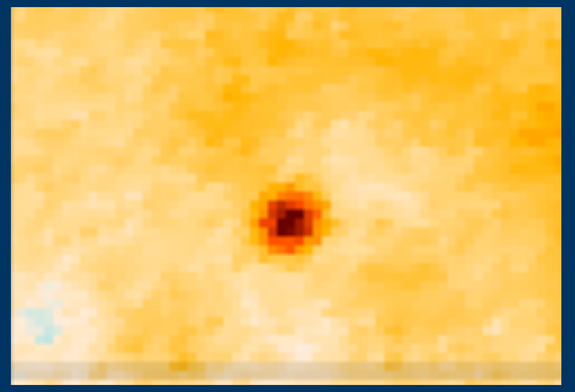


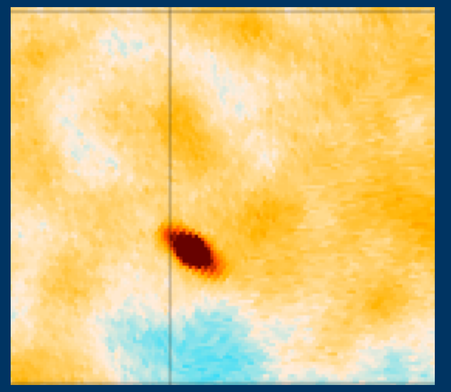
Training set
Inputs: T Dust @ 80’
Outputs: T Dust @ 12’

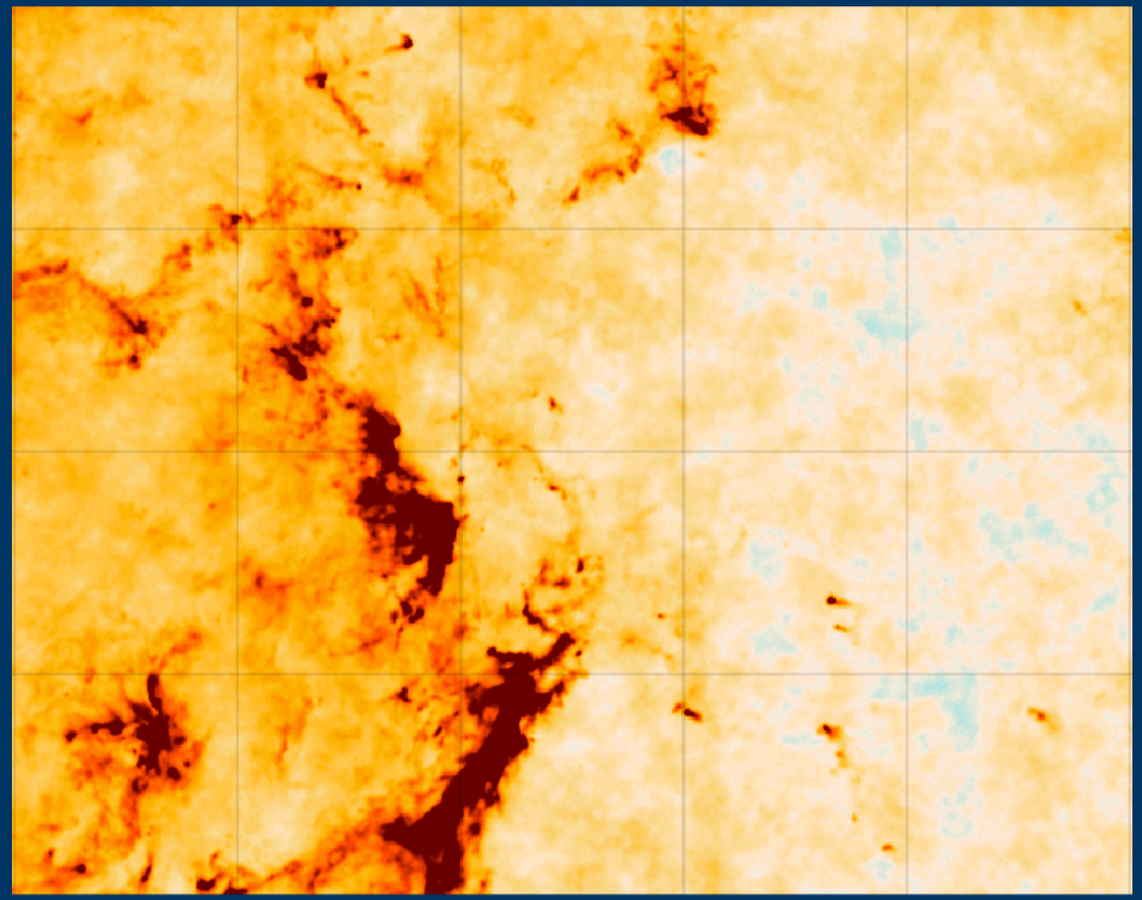


Krachmalnicoff&GP 2021

Dusty emission







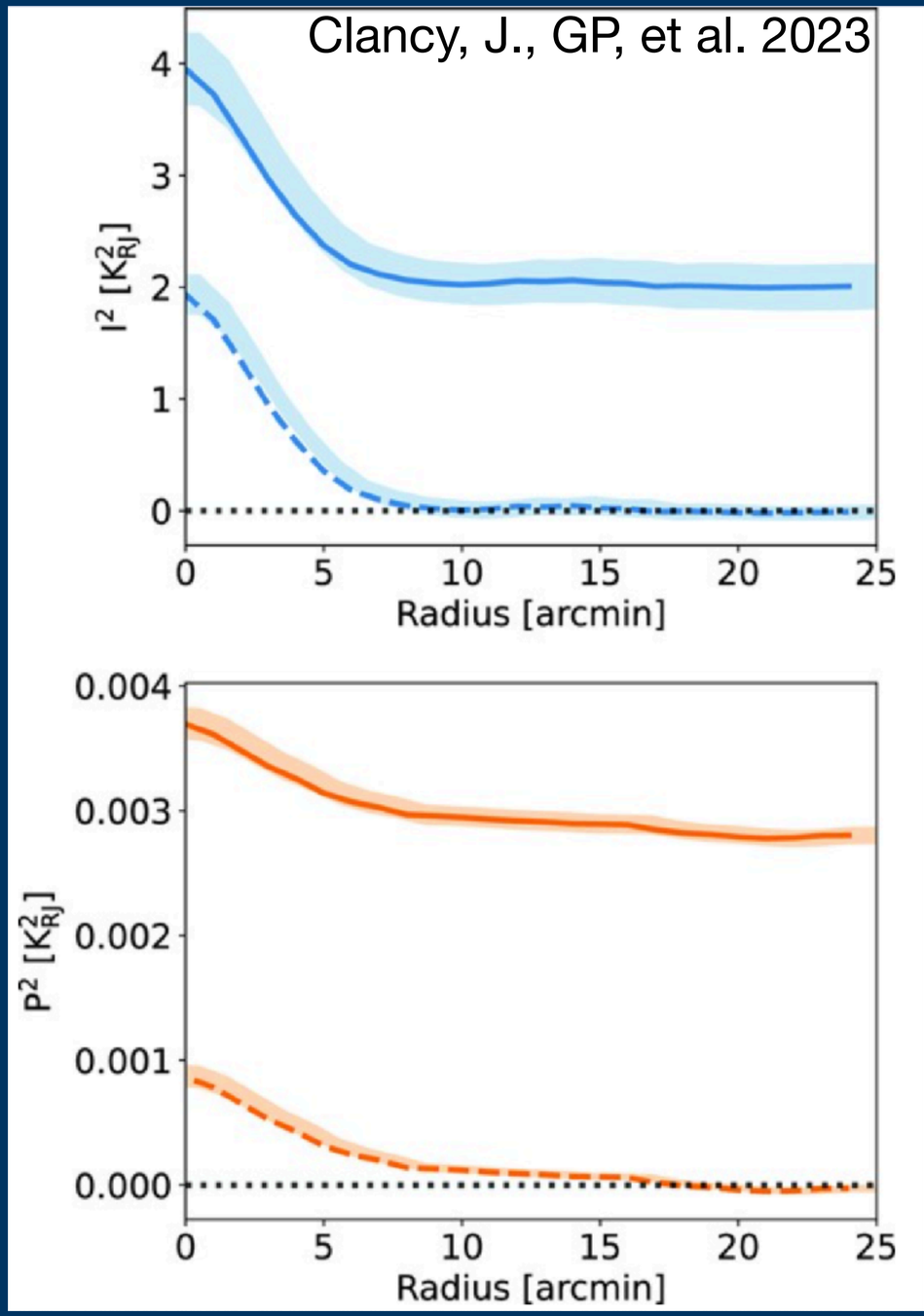
At $\nu > 200\,\mathrm{GHz}$, mainly from :

- Cold Galactic Clumps are ~1.8% polarized

Cold Galactic Clumps

Using the *Planck* Galactic Cold Clumps Catalog, PGCC

- stack 0.5x0.5 deg2 Polarization maps at the source location
- Remove bias due to background
- Assess the level of average fractional polarization
- Alina+ 2019 found that most of these objects live in Galactic filaments -> Galactic magnetic field with dust polarized emission



Galactic Magnetic field inference

Assessing Galactic Field Misalignment Cukierman (2022),

-> EB dust power spectra

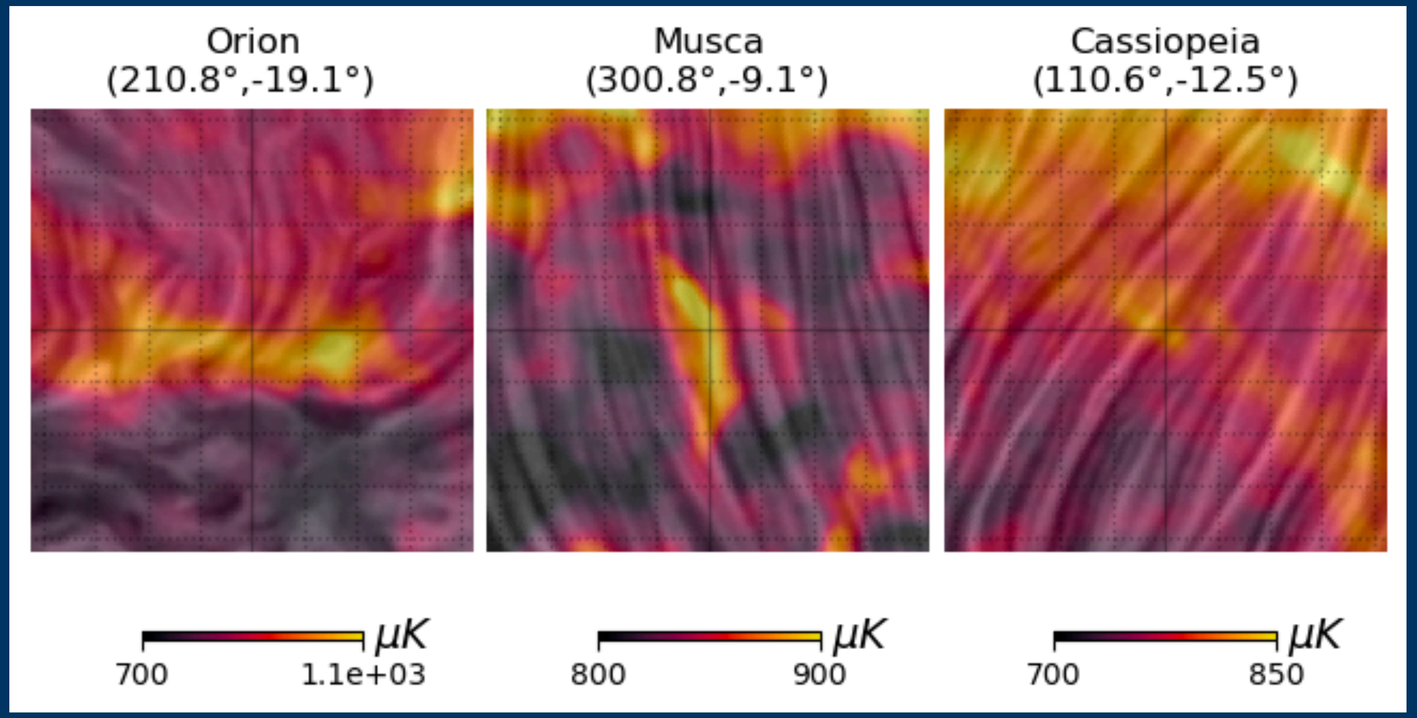


Figure 4.

Summary

- Still a lot of exciting science to do with CMB! AME polarization and exo-Oorts Clouds (Nibauer 2021)
- **Need** to characterize and model the Galactic foregrounds to efficiently remove it for inflationary B-mode searches
- Current effort is on forecasting the non-gaussian small scales of Dust emission, that can contaminate small scales CMB polarizatio maps !
- Models already released and publicly available in the pysm3 package https://github.com/galsci/pysm