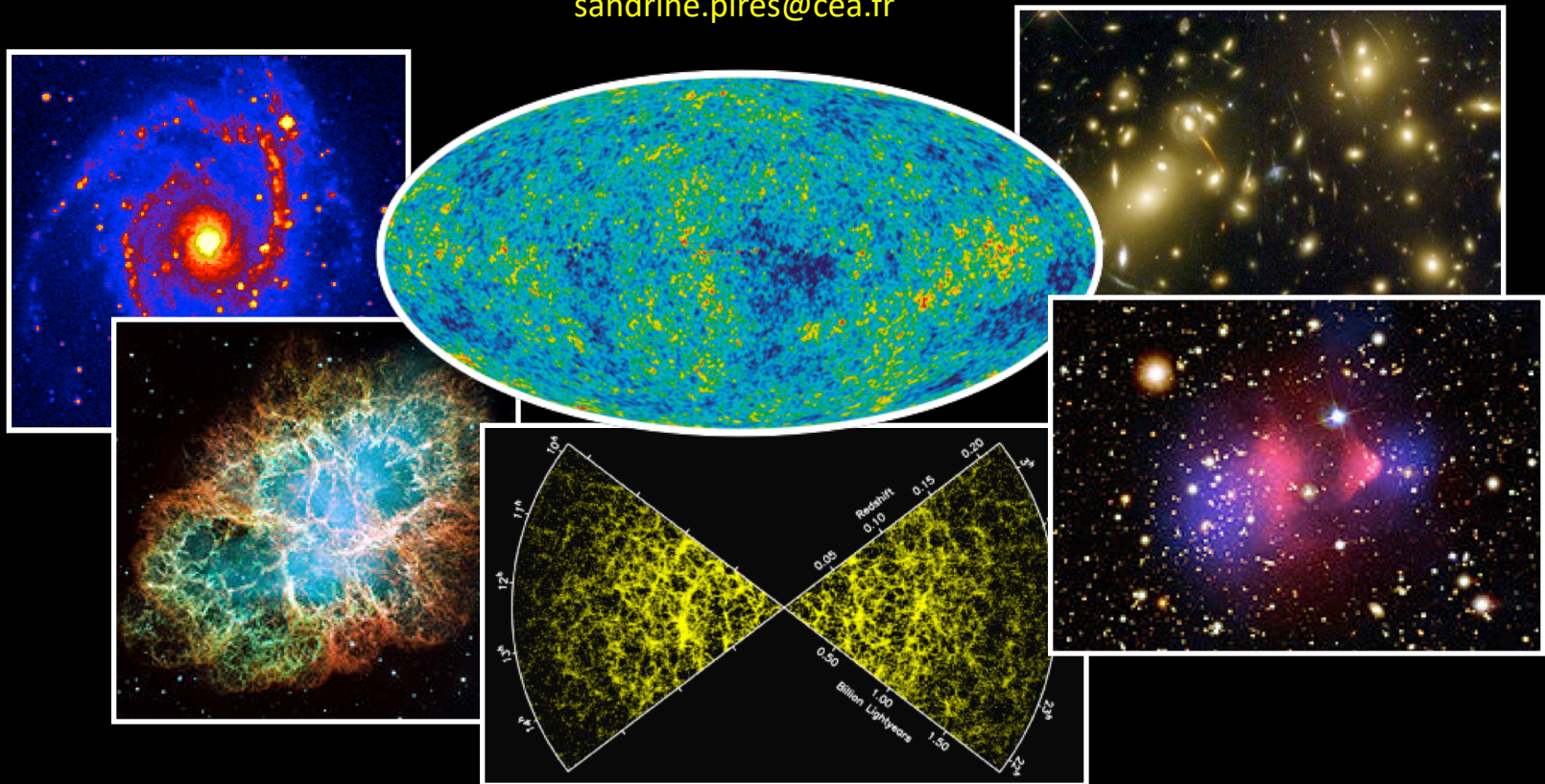# Inpainting and Morphological Component Analysis
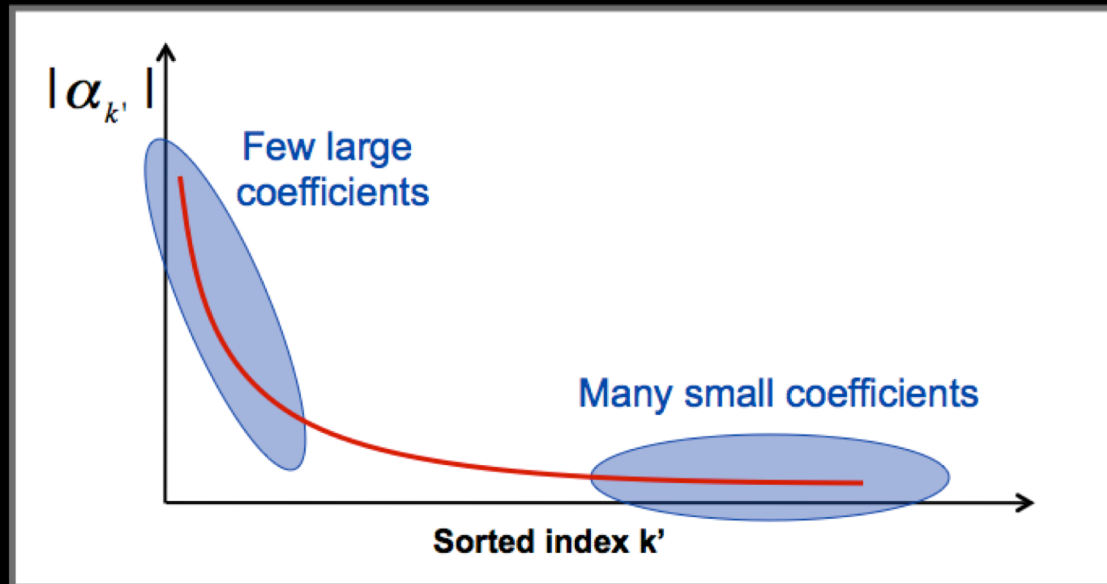
Sandrine Pires
sandrine.pires@cea.fr

Methods based on sparsity

Considering a transform : $\alpha = \Phi^T X$
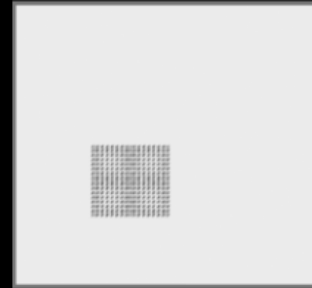
A signal X is sparse in a basis Φ
if most of the coefficients α are equal to zero or close to zero
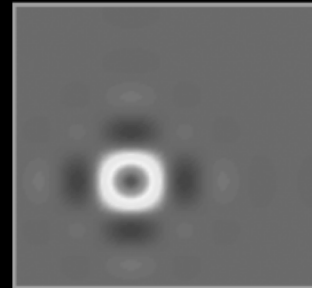
Signal and image representations

✓ Local DCT :

    ✓ Stationary textures
    ✓ Locally oscillatory

✓ Wavelet Transform

    ✓ Piecewise smooth
    ✓ Isotropic structures

✓ Curvelet Transform

    ✓ Piecewise smooth
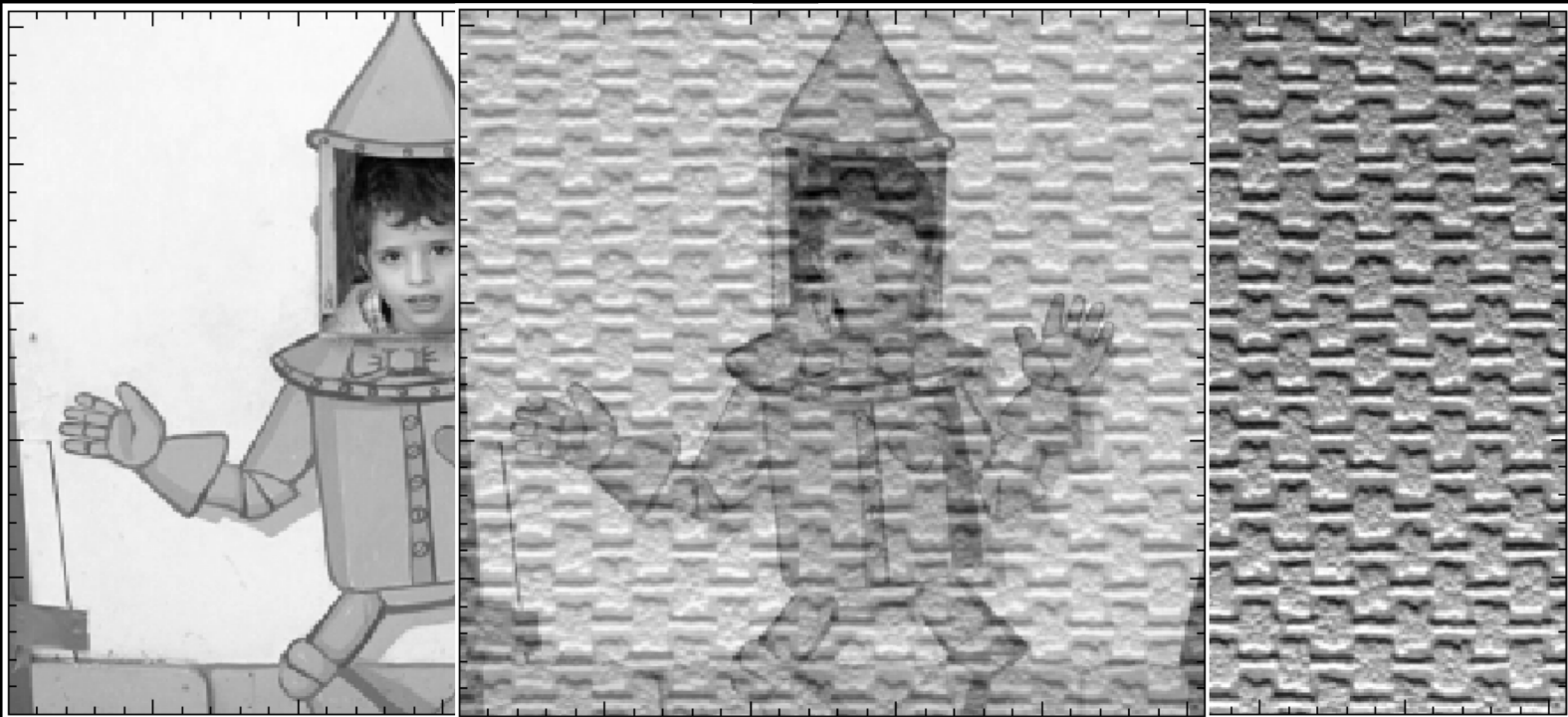   ✓ Edge structures

Morphological Component Analysis

(Starck et al, 2004)

$$Y = X_1 + X_2$$

$$\alpha_i = \phi_i^T X_i$$
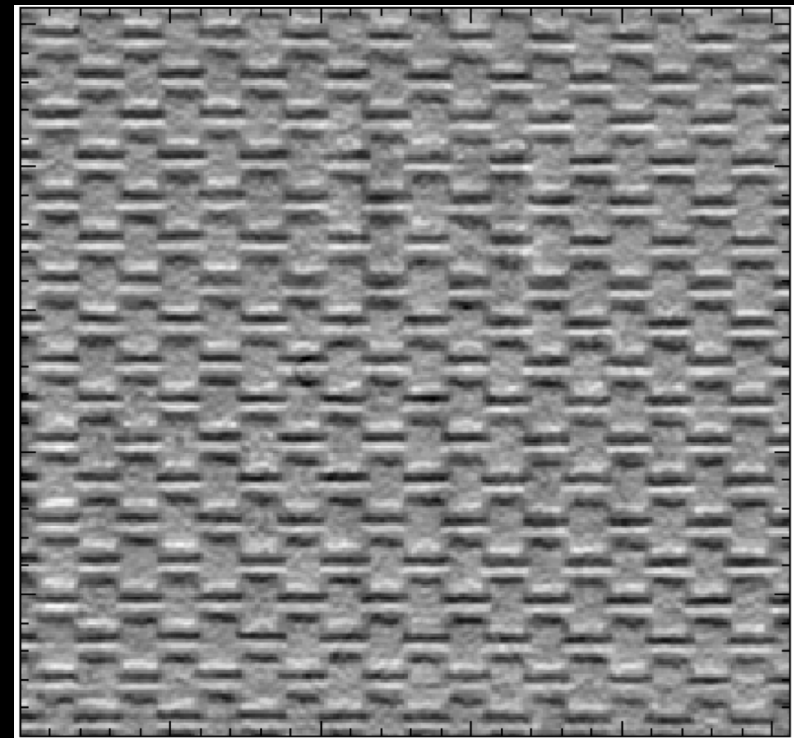
Morphological Component Analysis

$$\min_{\alpha_i} \sum_i ||\alpha_i||_1 \text{ s.t. } Y = \sum_i \Phi_i \alpha_i$$
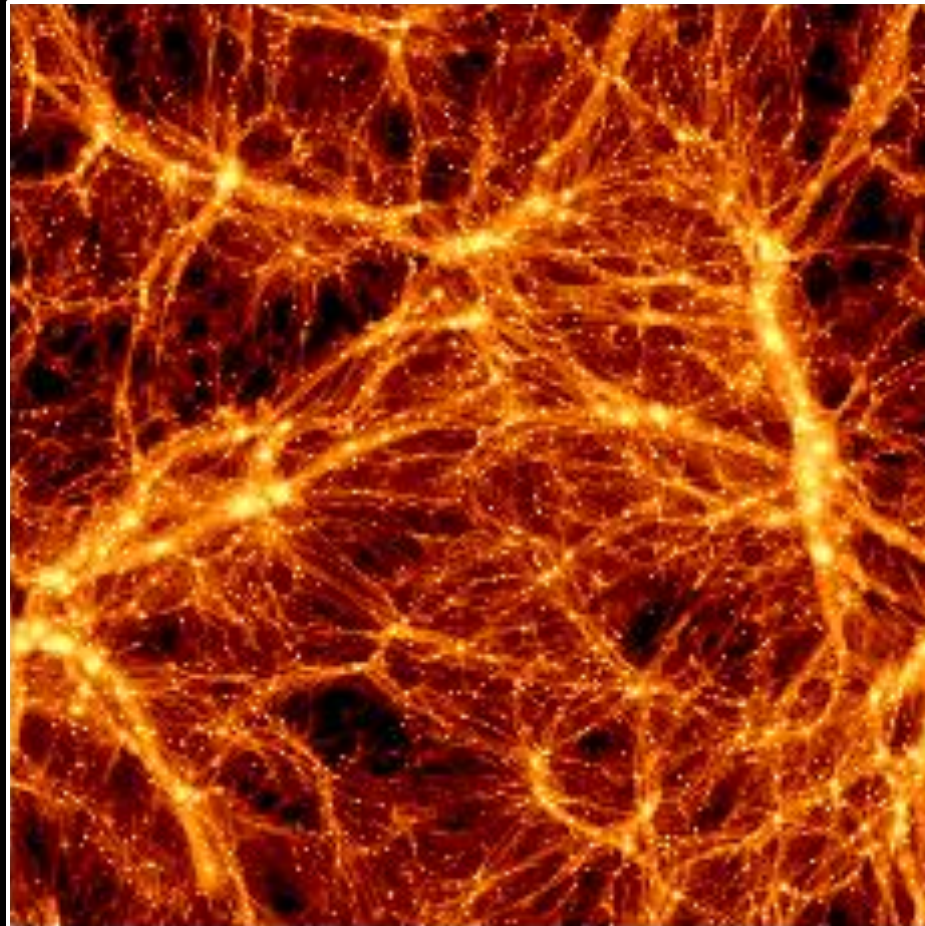
Ridgelet component

DCT component

Contour image
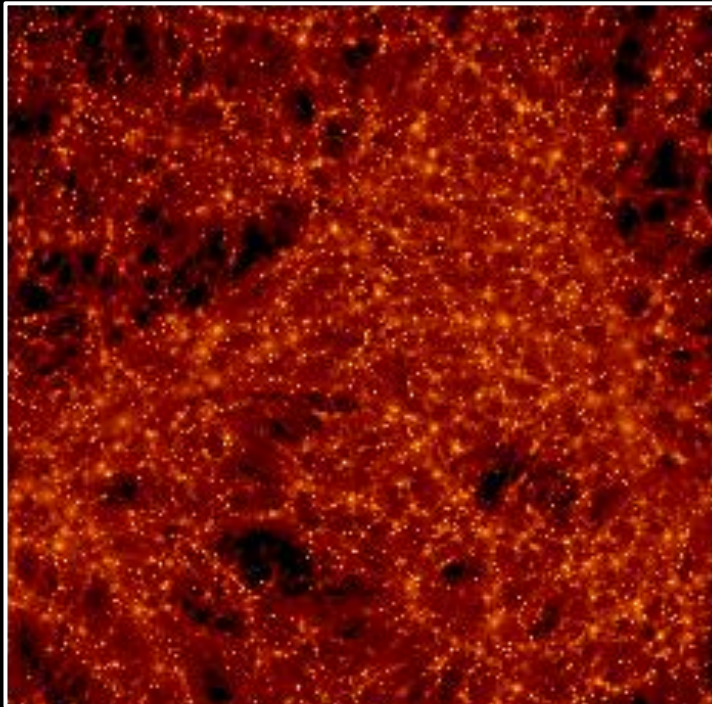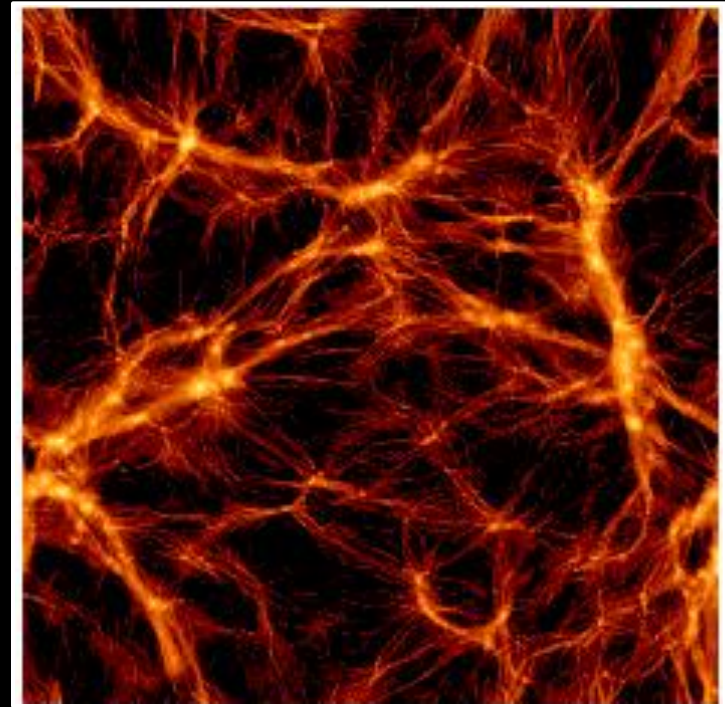
Texture

Morphological Component Analysis

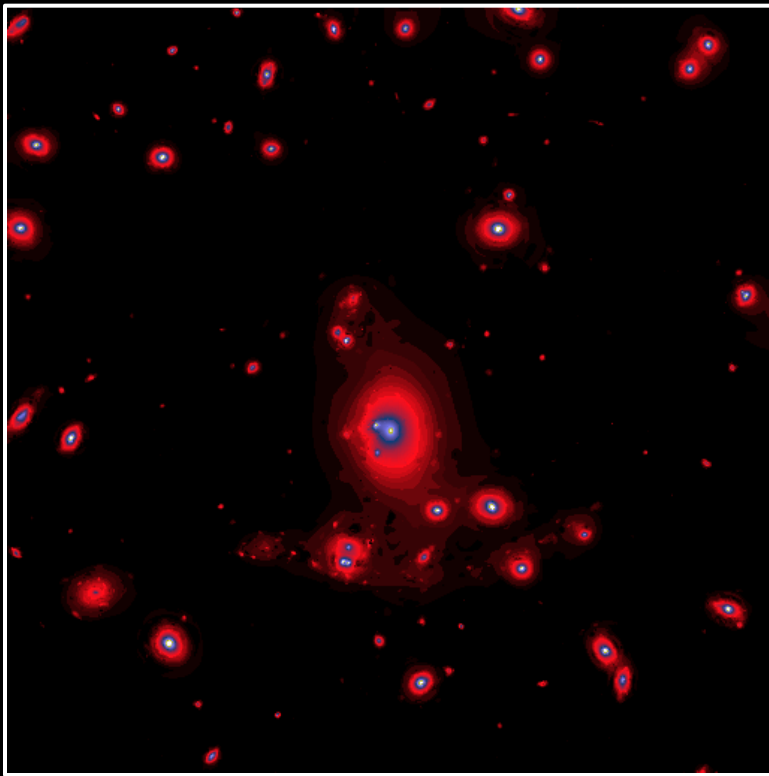# Morphological Component Analysis

Wavelet component

Curvelet component

Compact sources

Filaments

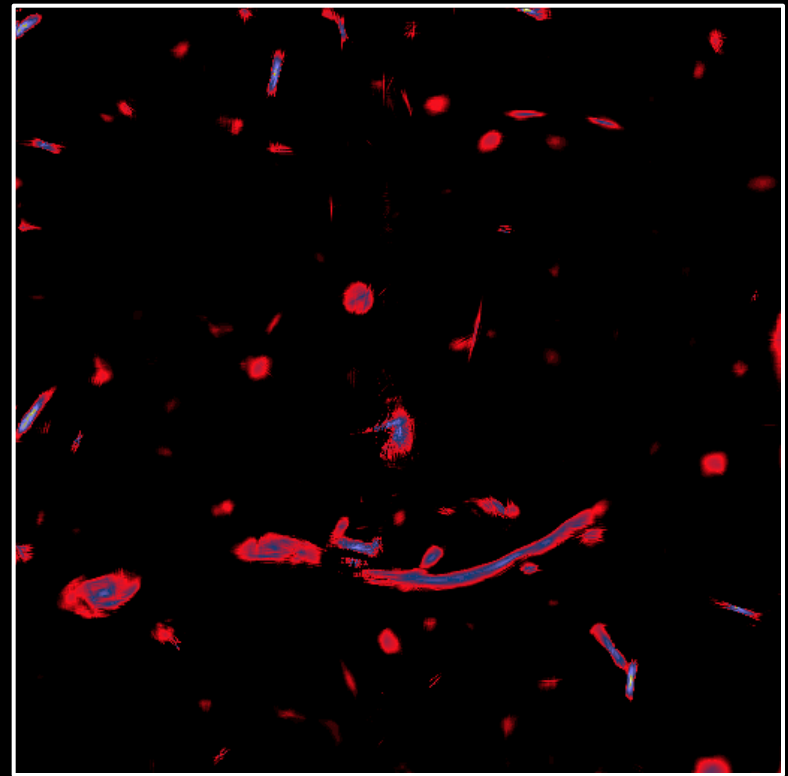# Morphological Component Analysis
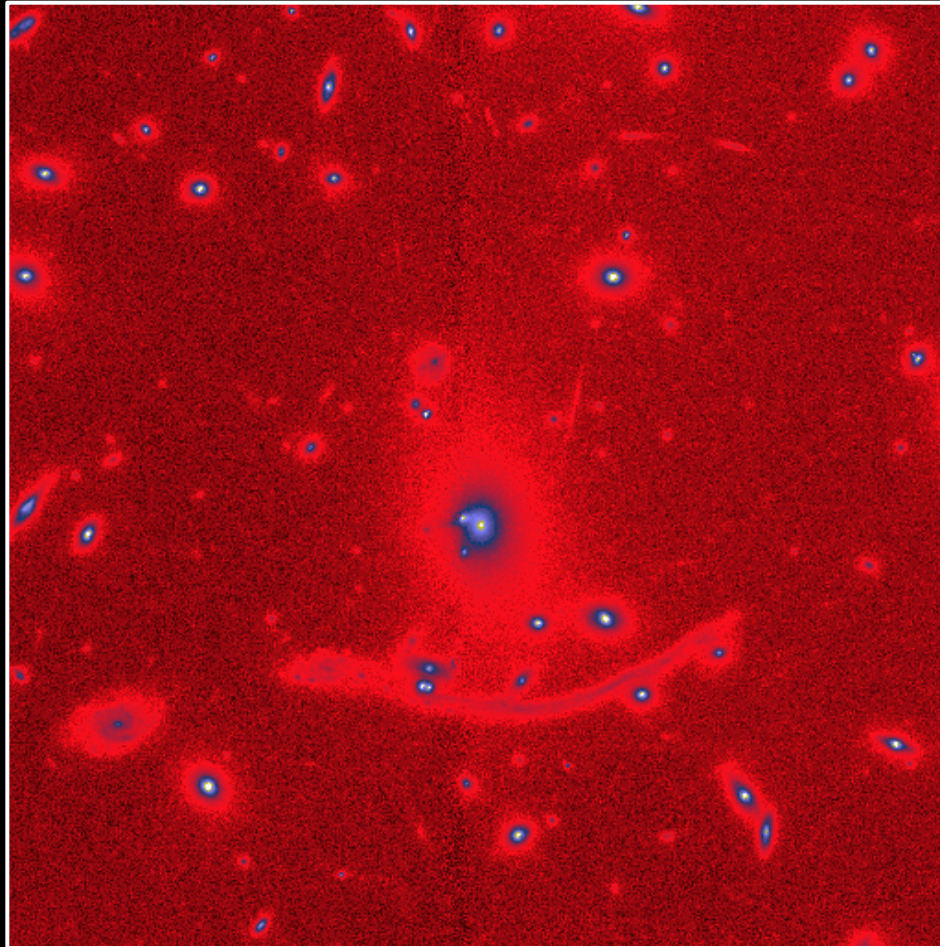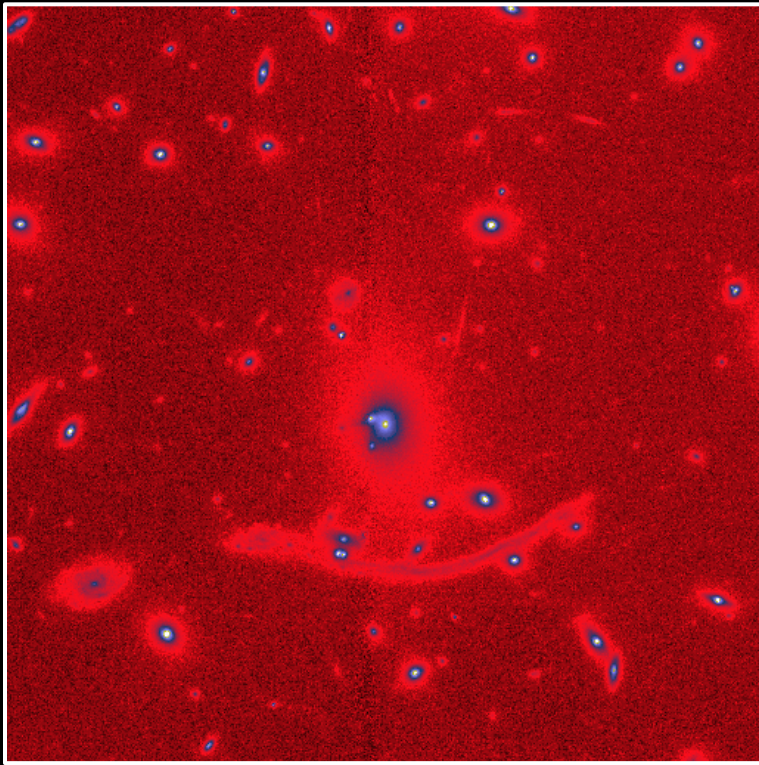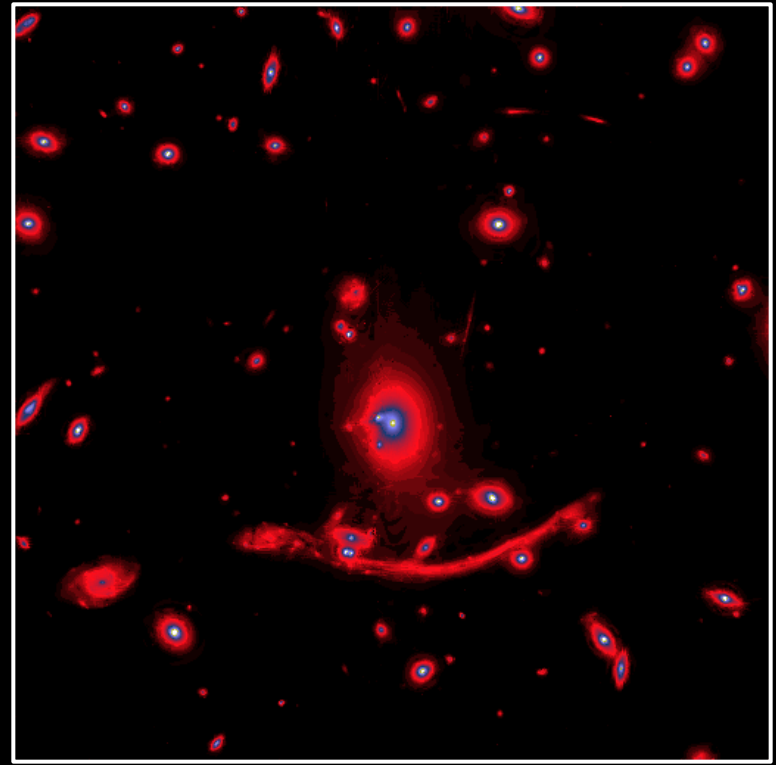
Morphological Component Analysis

Wavelet component

Ridgelet + Curvelet
component

Morphological Component Analysis

Original image

Reconstructed image

# MCA TUTORIAL

Missing data

(Elad et al, 2005)

✓ Causes of missing data:
  - ✓ Occurrence of defective or dead pixels
  - ✓ Partial sky coverage due to problems in the scan strategy
  - ✓ Saturated pixels
  - ✓ Absorption or masking of the signal by a foreground

✓ Problems caused by missing data:
  - ✓ Bias and decrease on statistical power
  - ✓ Distortions in the frequency domain due to abrupt truncation
  - ✓ Other edge effects in multi-scale transforms

✓ How to deal with missing data?
  - ✓ Correction of the measure by the proportion of missing data
  - ✓ Other corrections specific to a given measure (i.e. MASTER for power spectrum estimation)
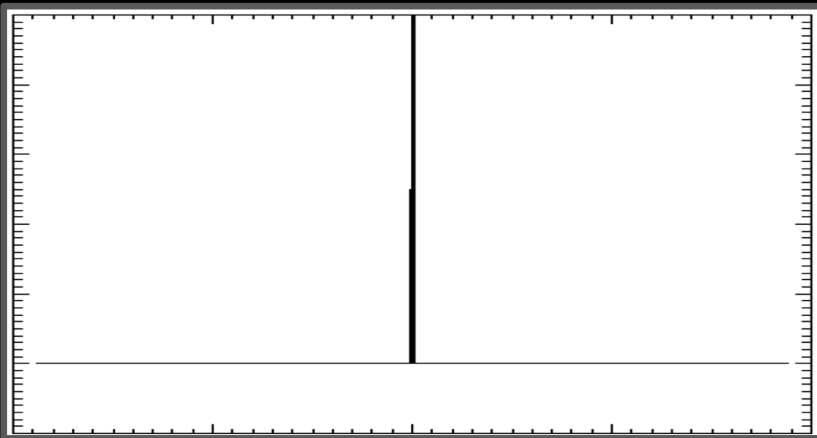 - ✓ Inpainting methods

Inpainting based on sparsity

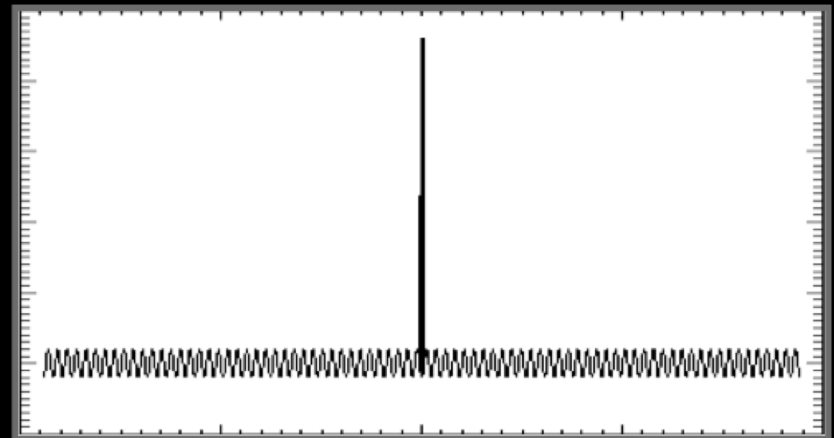$$\min_{\alpha} ||\alpha||_1 \text{ s.t. } Y = M\Phi\alpha$$
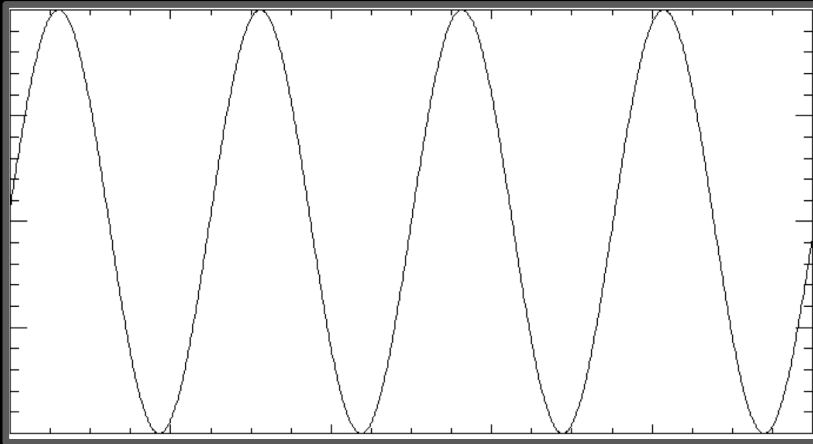
Sine curve
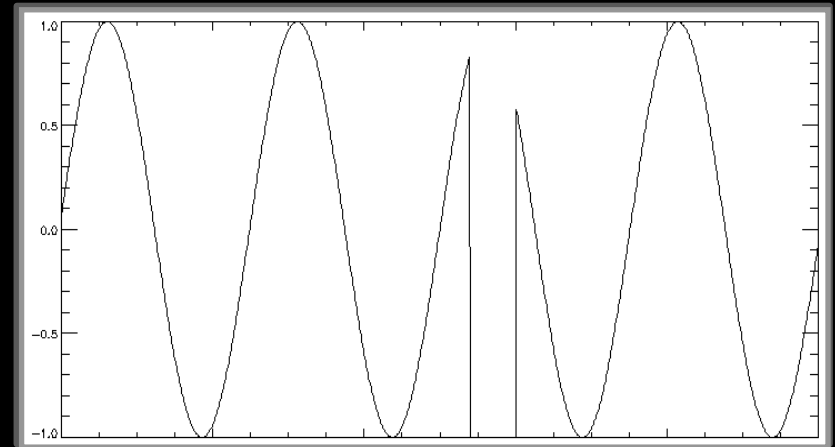
Truncated sine curve
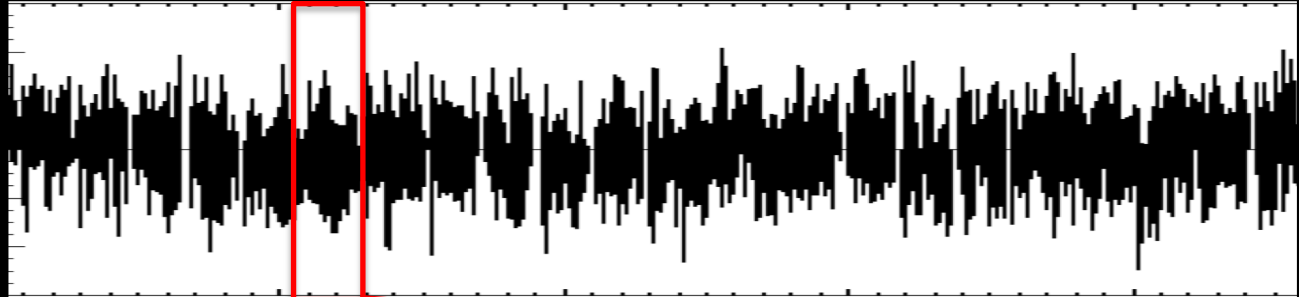
Fourier transform of the sine curve

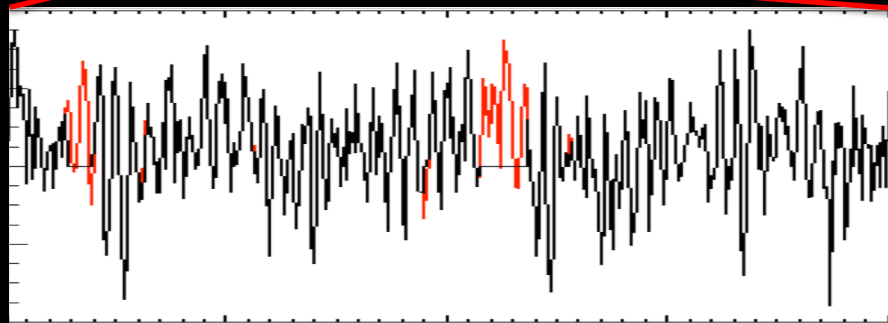*Fourier transform of the truncated sine curve*
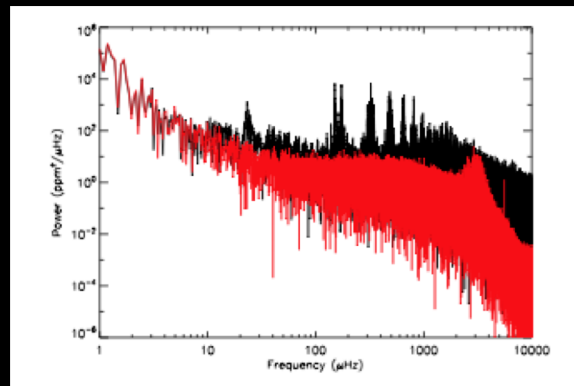
Inpainting on asterosismic data
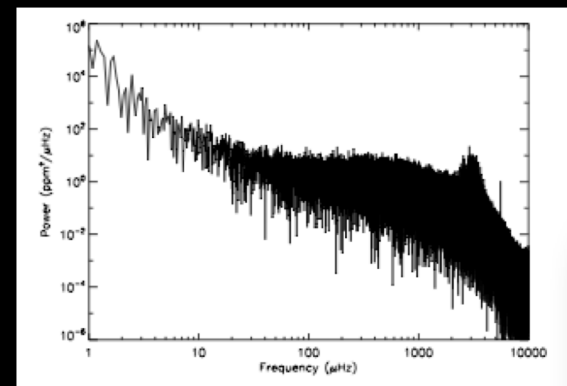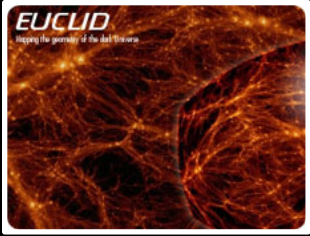

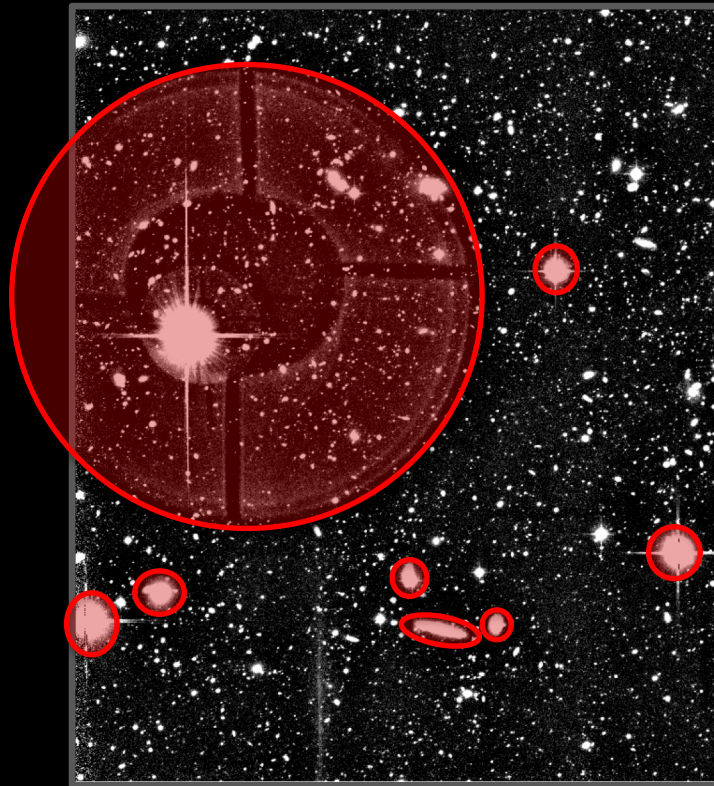*Light curve (time series)*

Zoom on the Light curve

Power spectrum
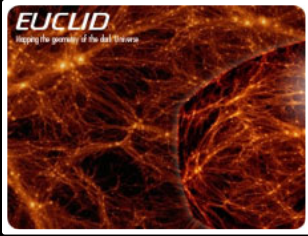
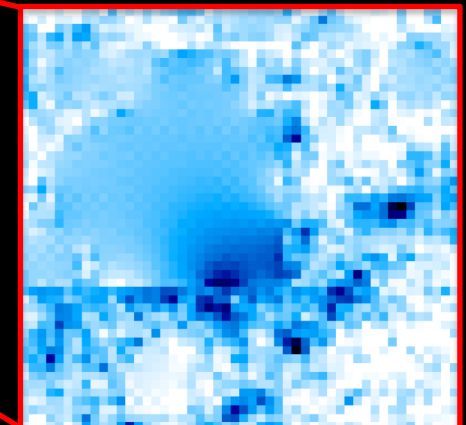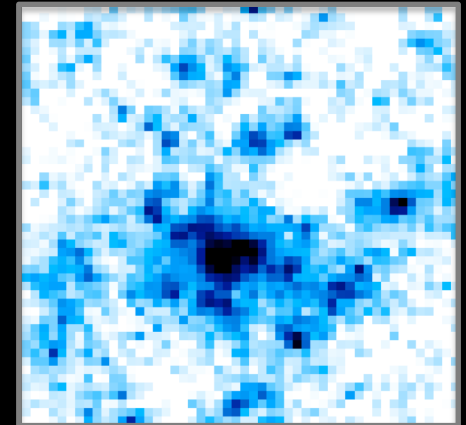*Original (red) and masked (black) data*

Inpainted data (black)

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Missing data
In Weak Lensing

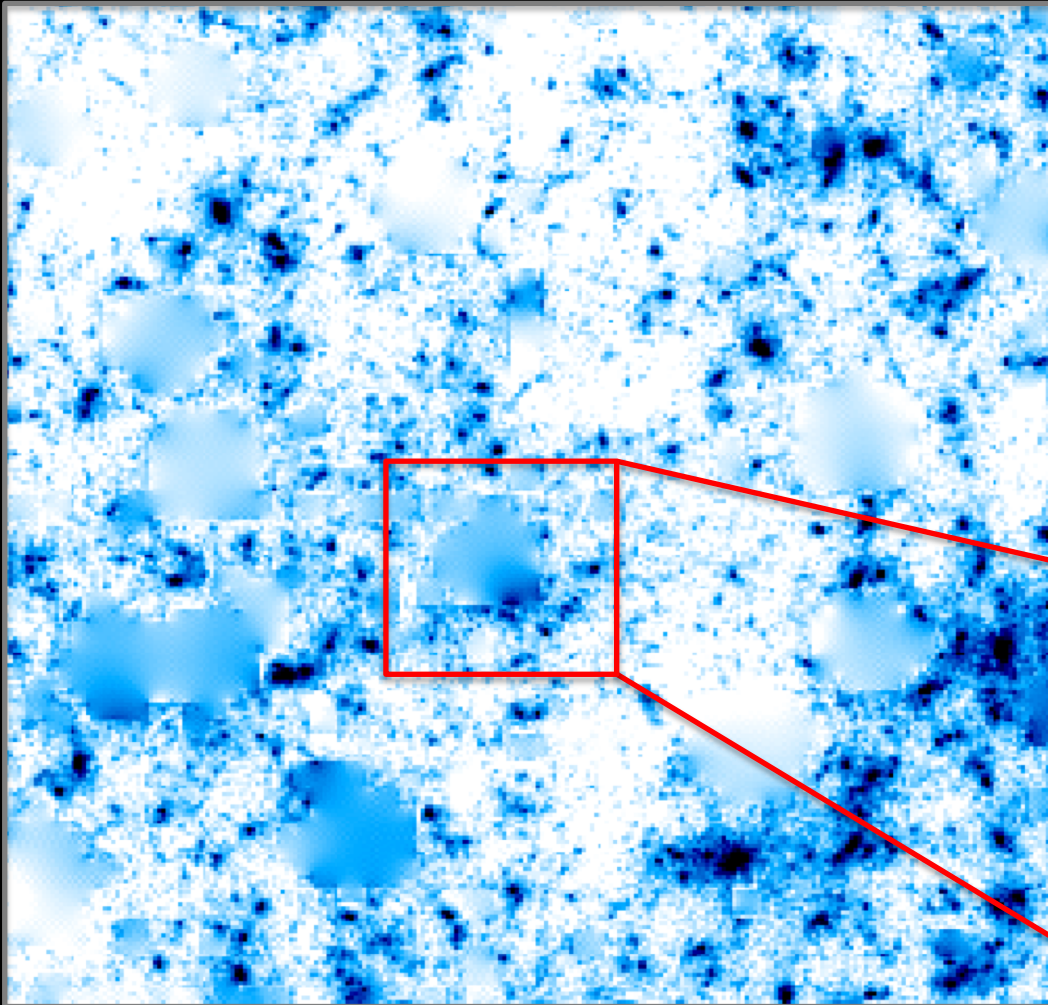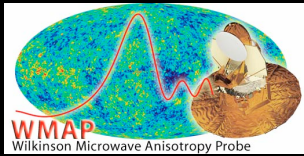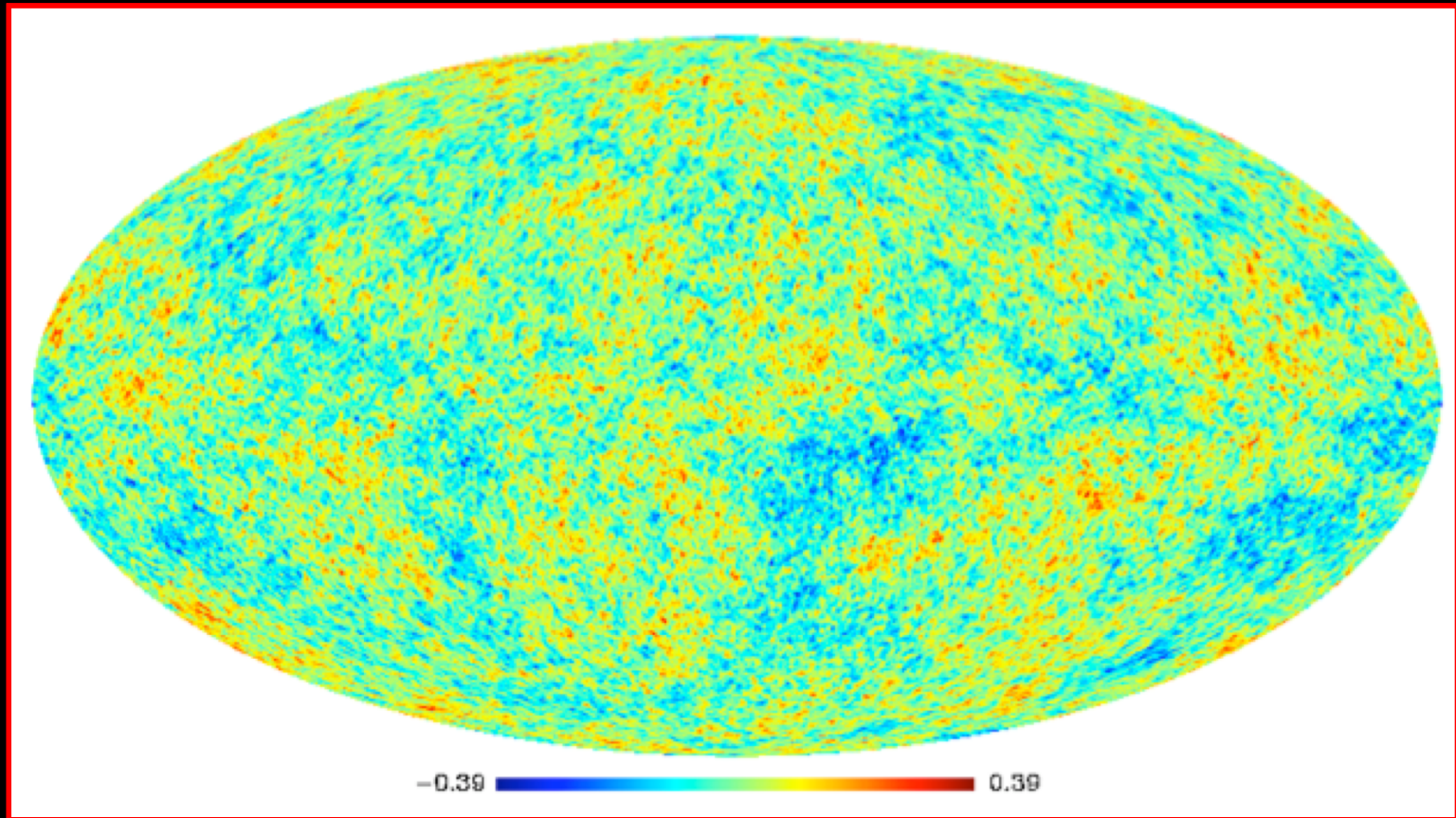# Missing data
In Weak Lensing data

Inpainting
in Cosmic Microwave Background data

INPAINTING TUTORIAL