

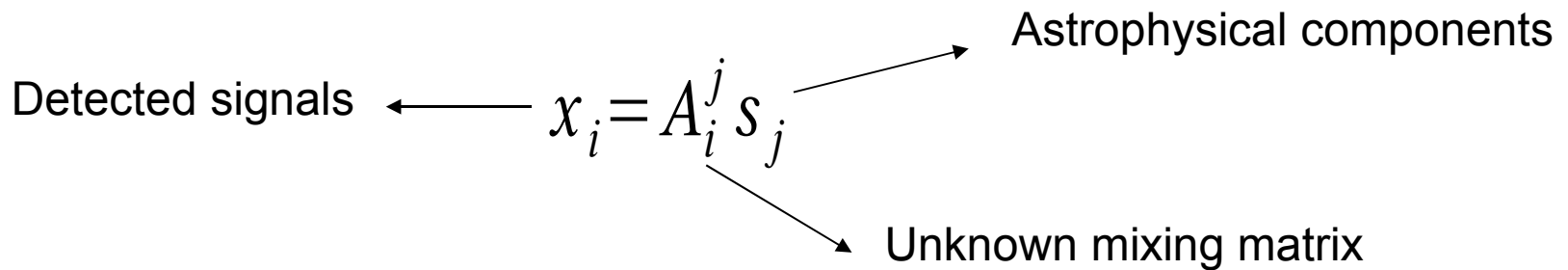
Component Separation on BPol with FastICA

Preliminary Tests

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FastICA

- It is an application of the **Independent Component Analysis** (ICA) principle.
- Maximizing the non-gaussianity of mixtures of the detected signals at different frequencies, it tries to separate different independent components, under a very few assumptions.



Recovered component (**blindly**)

$$y = w^i x_i = w^i A_i^j s_j = k^j s_j$$

This vector has to maximize the non-gaussianity of y

FastICA - Achievements

Simulations:

- ✓ **Planck total intensity** simulated data, good reconstruction of the CMB power spectrum. (Maino et al. 2002).
- ✓ **Planck polarization** simulated data, E modes have been recovered on all relevant scales (Baccigalupi et al. 2004).
- ✓ **Next generation** CMB experiments, recovering of B modes on limited sky patches (Stivoli et al. 2006).

Real data:

- ✓ **COsmic Background Explorer**, reconstruction of the amplitude and spectral index of cosmological perturbations (Maino et al. 2003).
- ✓ **BEAST** experiment, extraction of the correct temperature spectrum (Donzelli et al. 2005).
- ✓ **WMAP 3yr**, recovering of the correct power spectrum in total intensity (Maino et al. 2006).

FastICA goes parallel

- To evaluate errors on the reconstruction and stability of its quality, a statistically significant number of simulation is needed.
- Moreover, to deal with the huge data amount of the next future experiments (very high resolution and large number of frequency channels), we found mandatory to share the ICA computation on many processors.

For these reasons, a parallel version of the code, called **PICA**, has been implemented

BPol Specifics

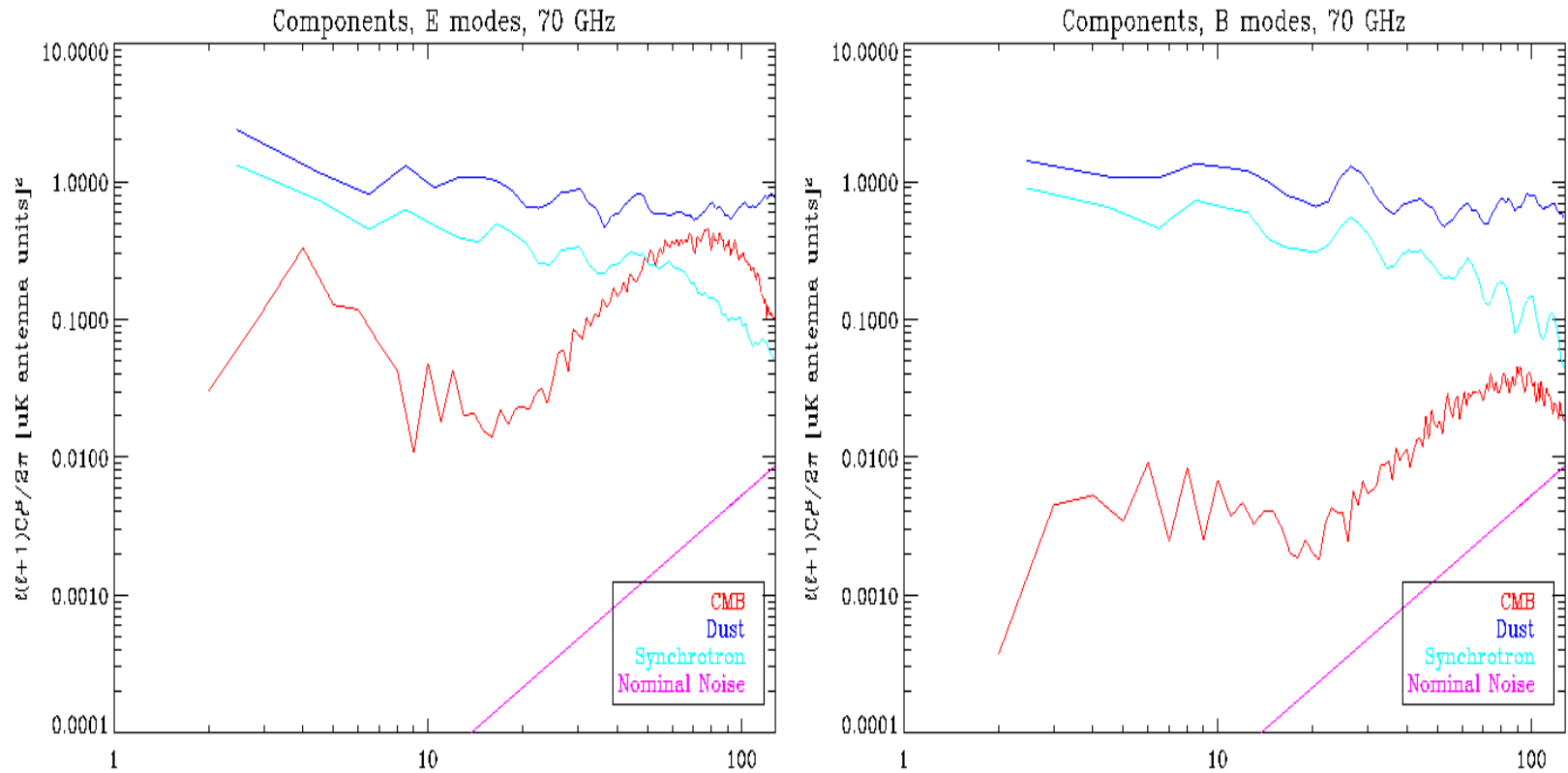
Agreed:

• Freq (Ghz):	70	100	143	217	353
• FWHM (amin):	30	20	15	10	10
• Noise rms (uk, 1 amin pixel):	3	3	3	3	10

Proposed:

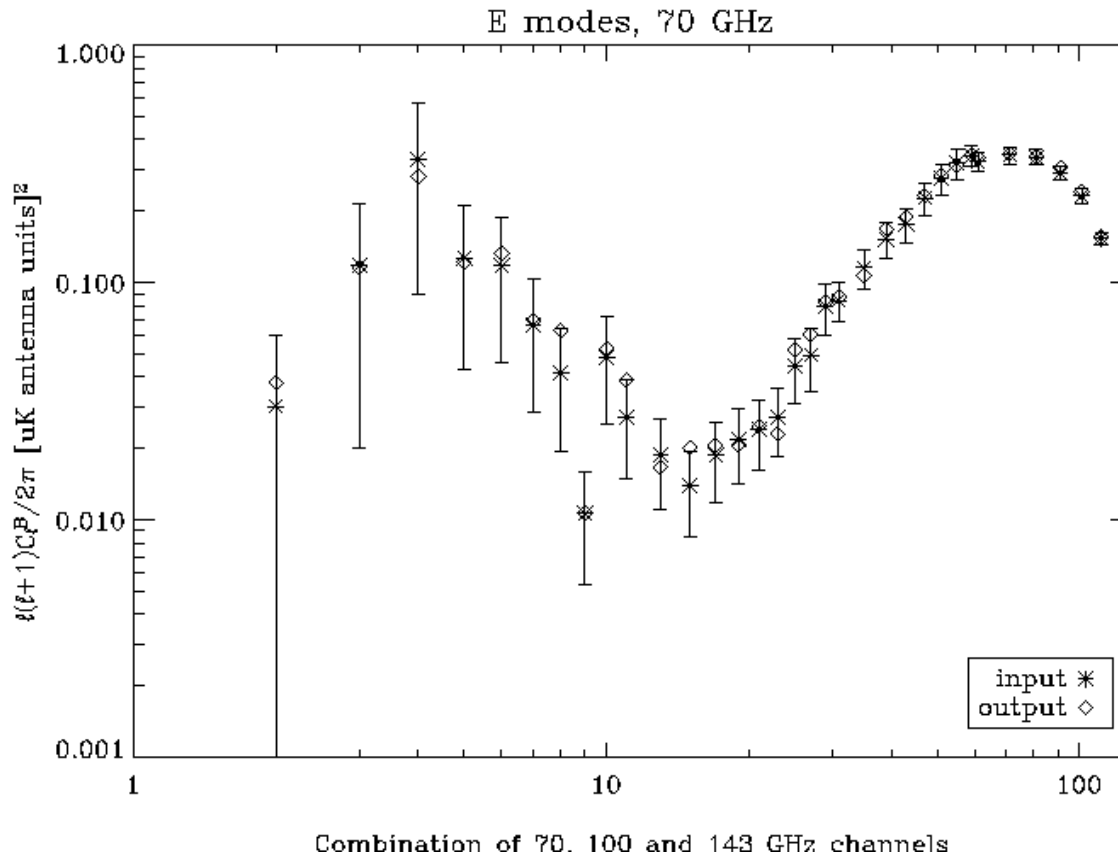
• Freq (Ghz):	30	44	or	40	55
• FWHM (amin):	120	120		120	120
• Noise rms (uk, 1 amin pixel):	20	20		20	20

Simulated Bpol Sky



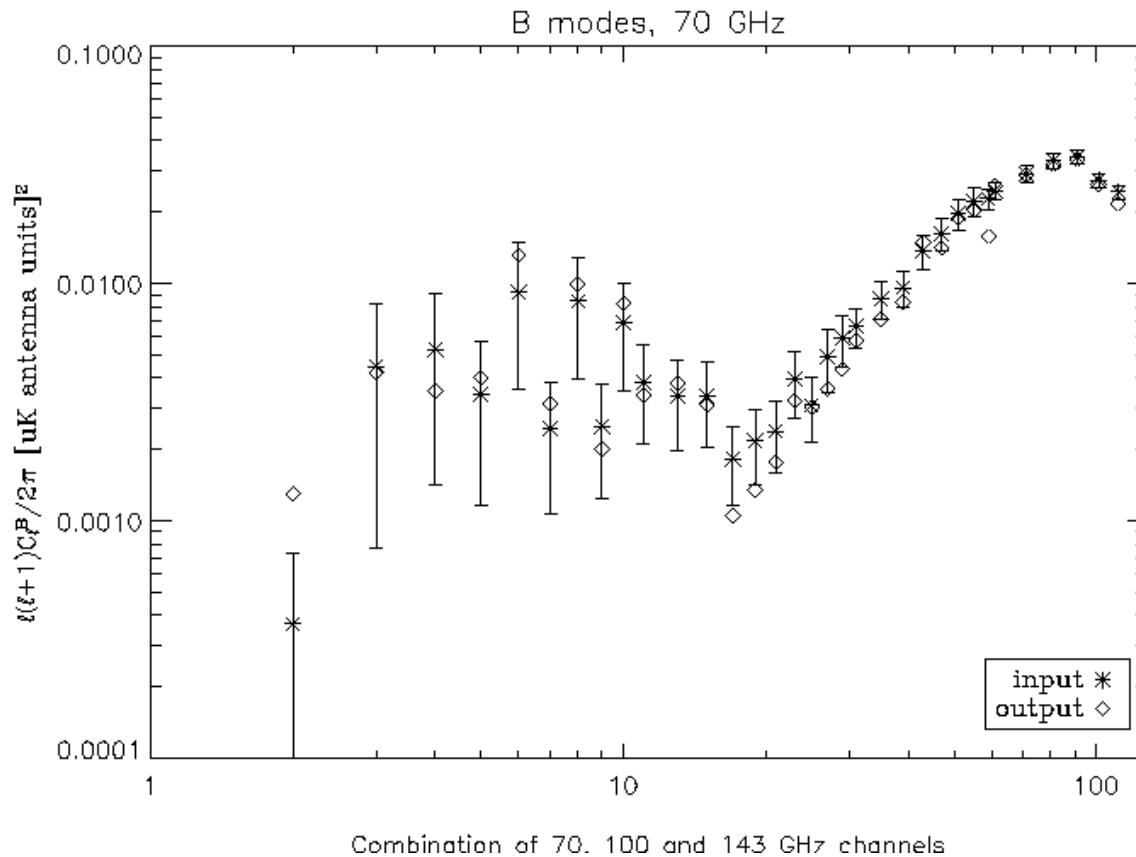
A strong assumption: all-sky constant spectral index

Recovered E modes



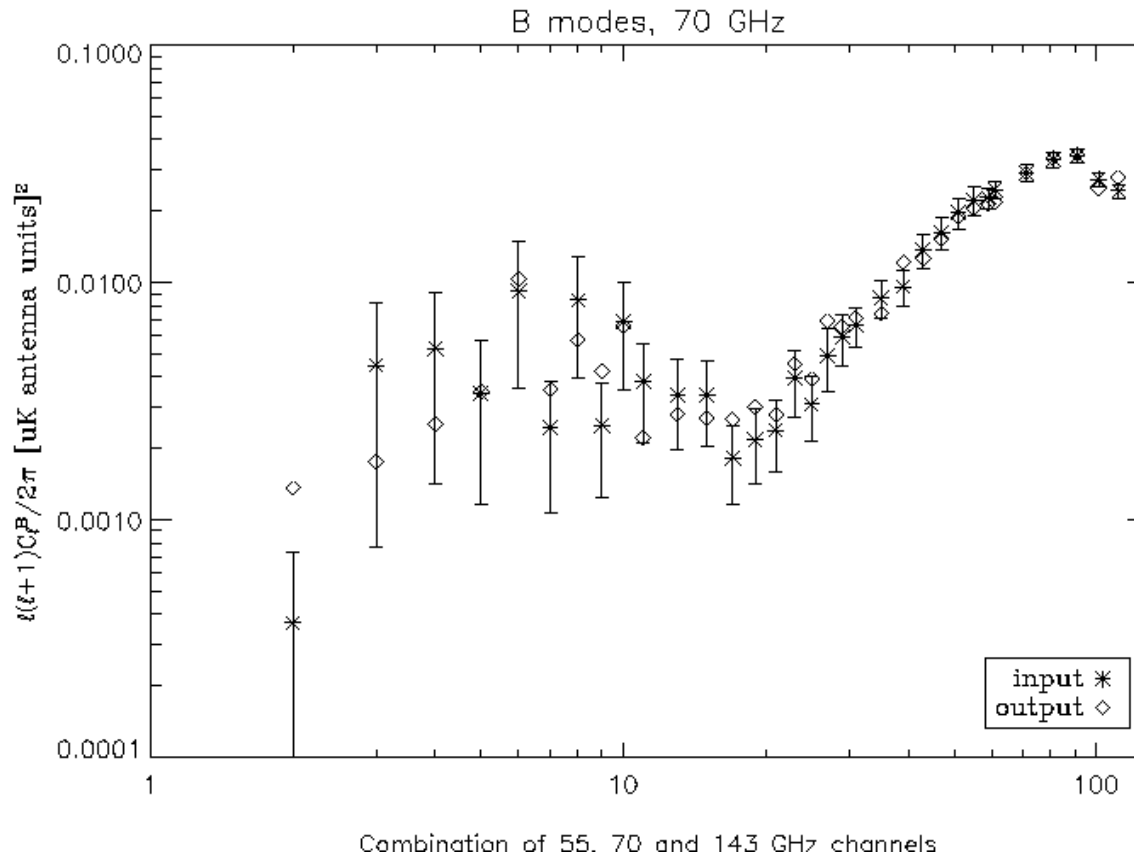
- Channel combination: 70 – 100 – 143 GHz
- 10 deg. galactic cut
- 2 deg. FWHM

Recovered B modes



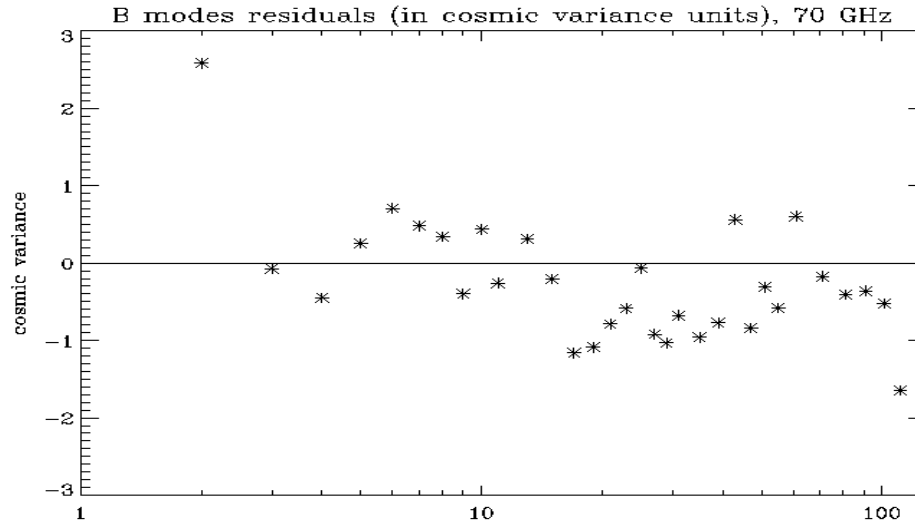
- Channel combination: 70 – 100 – 143 GHz
- 10 deg. galactic cut
- 2 deg. FWHM
- T/S=0.001

Recovered B modes, using a low frequency channel



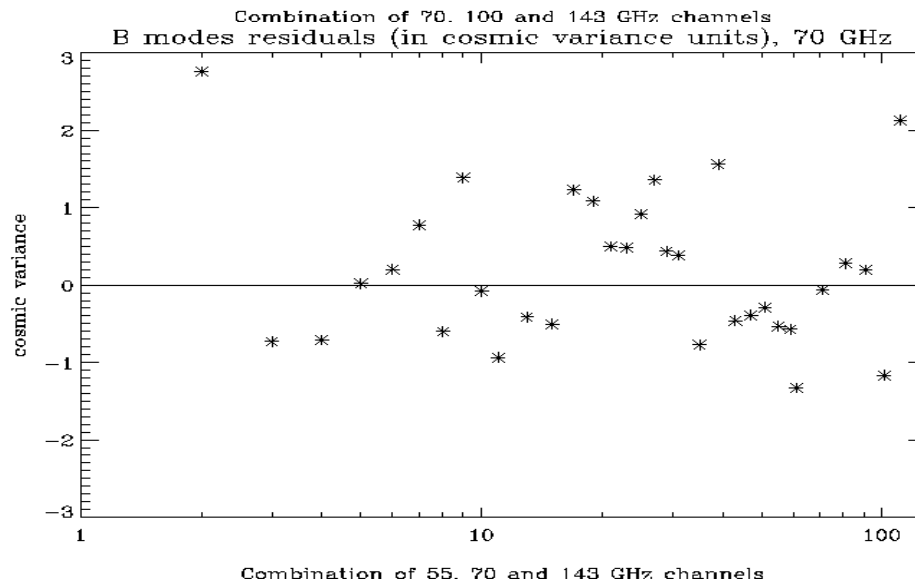
- Channel combination: **55** - 70 - 143 GHz
- 10 deg. galactic cut
- 2 deg. FWHM
- T/S=0.001
- We had to lower the noise rms at 55 GHz

B-Modes Residuals



B-modes residuals in cosmic variance units

- Upper panel (70-100-143): smaller, but maybe biased residuals



- Lower panel (55-70-143): larger, less biased (?) residuals

Comments and Prospects

- In this **naive simulation**, FastICA was able to recover the B signal buried in the foregrounds (n.b.: constant spectral index used)
- Present knowledge on these foregrounds is very poor, and this uncertainty is then 'propagated' in our results as well
- We still have to estimate the error on the separation
- Systematics (?)