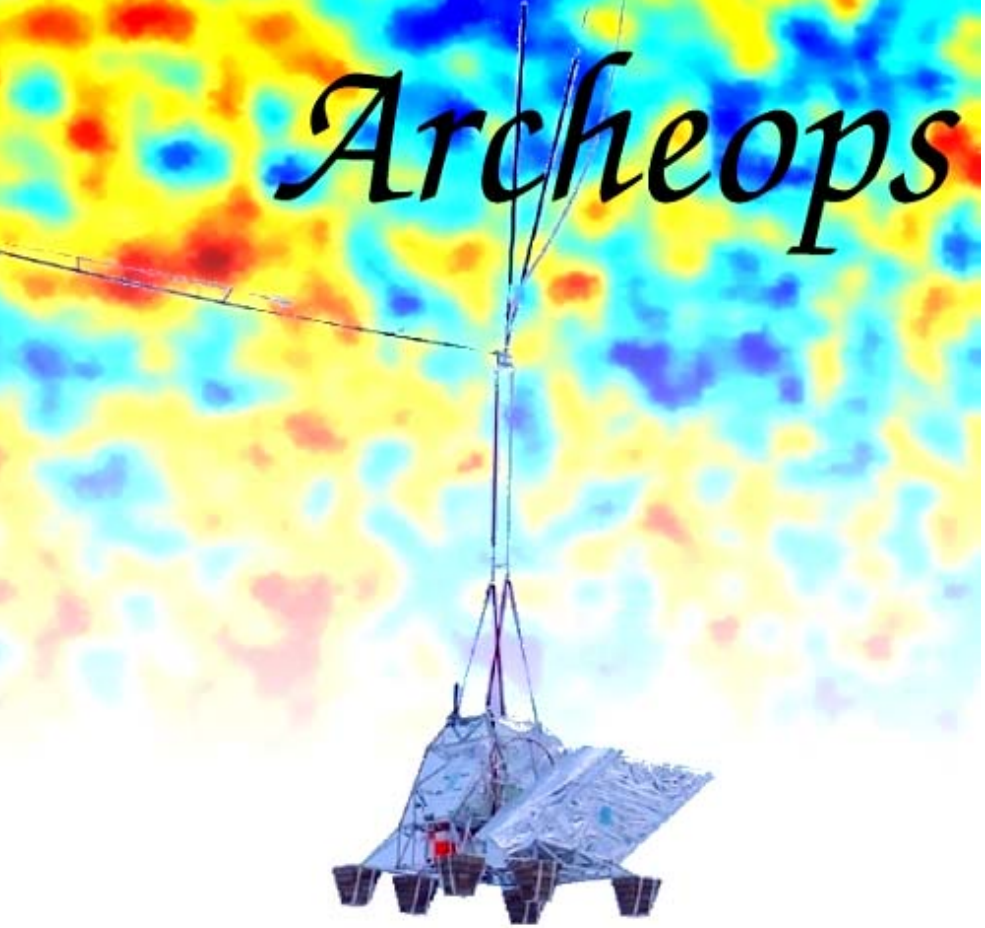
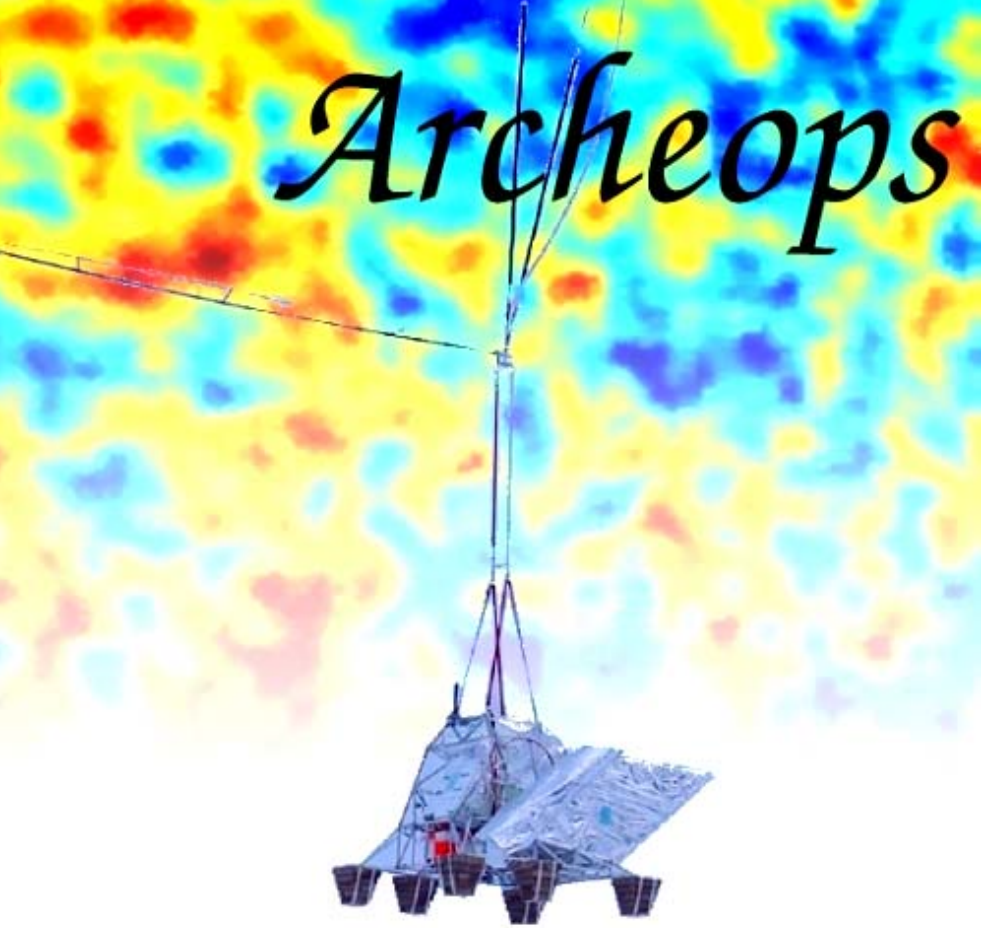


CMB power spectrum

$$\lambda = 10 - 700$$

- data analysis
- temperature power spectrum
- comparison to WMAP



PI: Alain **Benoit** (Grenoble)

FRANCE

LPSC, CRTBT, LAOG (Grenoble)

IAS, LAL, (Orsay), SPP-Saclay, IAP, CDF (Paris)

CESR, LATT (Toulouse)

ITALY

Univ. La Sapienza (Roma)

IROE-CNR (Firenze)

UK

Cardiff Astrophysics Group

USA

CALTECH, JPL

University of Minnesota

RUSSIA

Landau inst. theoretical physics

And also,

CNES

Archeops key points

- Same concept as Planck HFI
  - Off-axis Gregorian telescope
  - Spider web bolometers at 100 mK

→ Testbed for Planck HFI

- Large sky coverage : 30%
  - Large circles on the sky during night-time
  - 19 hour flight during Arctic night

→ Constraints on low λ (>10)

- High angular resolution : 10-12 arcmin

→ Constraints on high λ (<700)

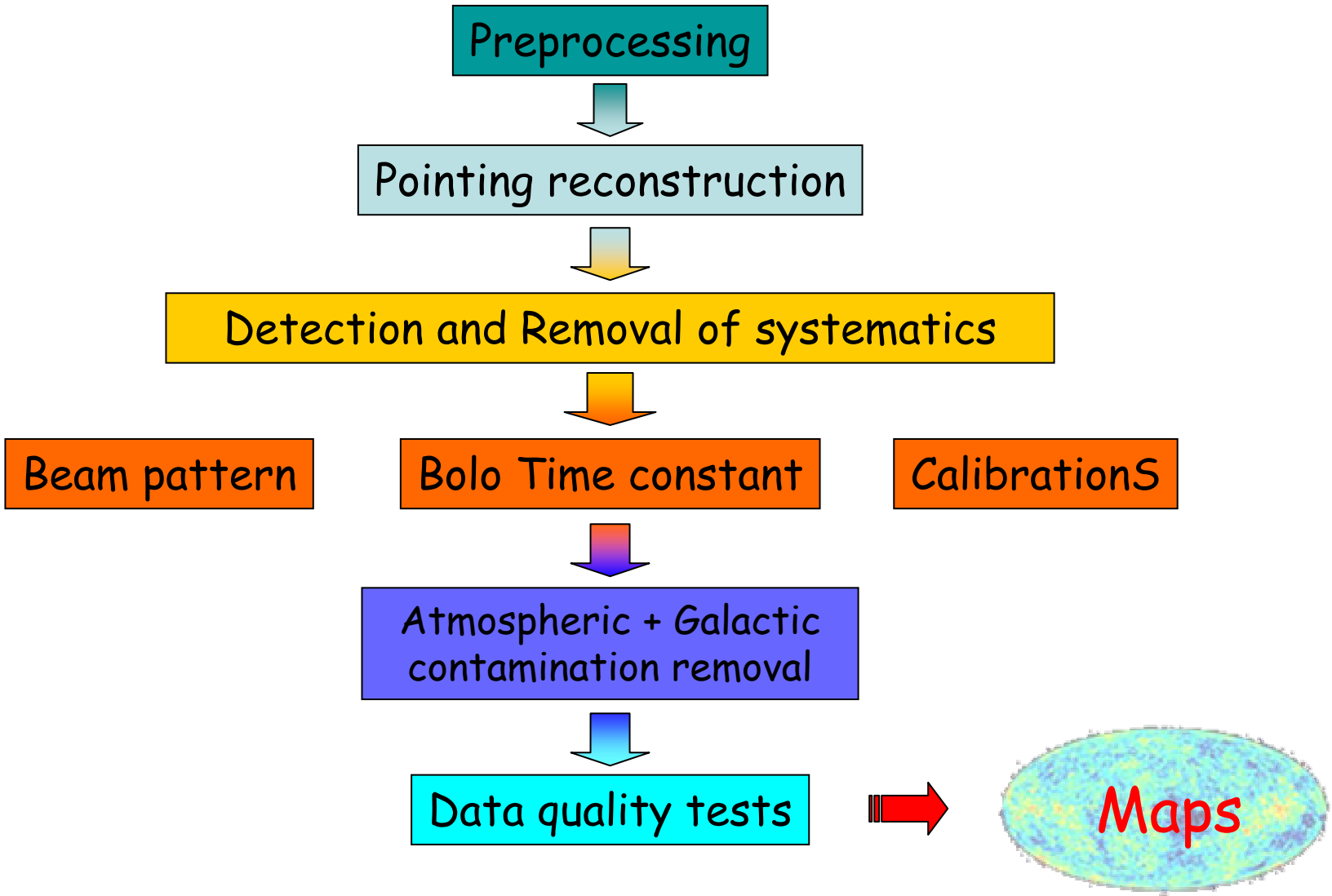
- Multiband photometer
  - 22 bolometers
  - 4 frequency bands : 143, 217, 353, 545 GHz

→ Good redundancy foreground sep.

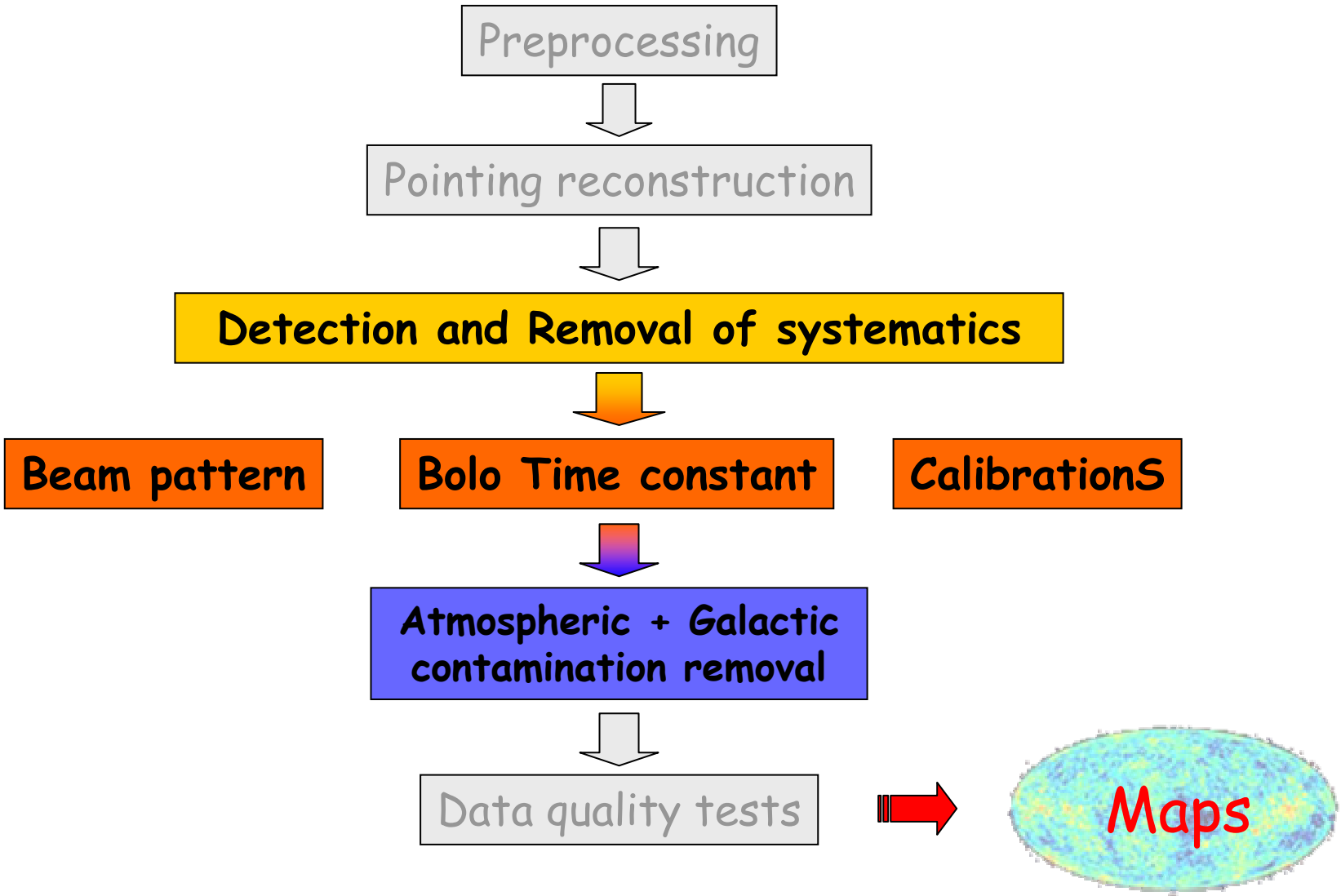
- Polarized 353 GHz Channel

→ Polarized Foregrounds

data processing



data processing improvement



bolometers

6 bolometers @ 2 frequencies

- 4 @ 143 GHz (~ 8 arcmin)
- 2 @ 217 GHz (~ 12 arcmin)

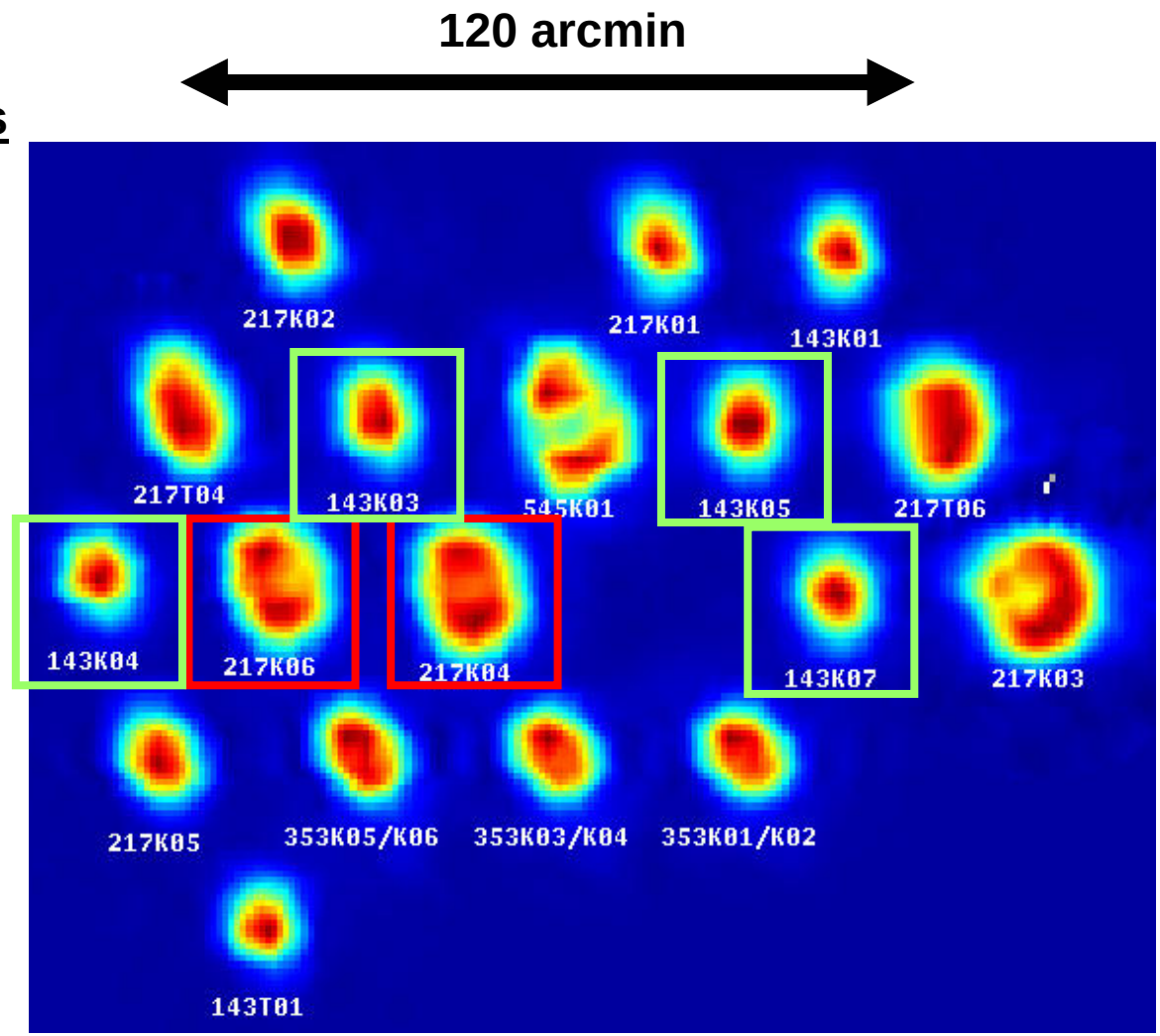
sensitivity

93 < s < 210 μKCMB.s1/2

(s_{WMAP} = 1000/1600 μKCMB.s1/2)

beam asymmetry

modelization using Asymfast



main beam : Asymfast

Tristram et al., astro-ph/0310260, accepted in PRD

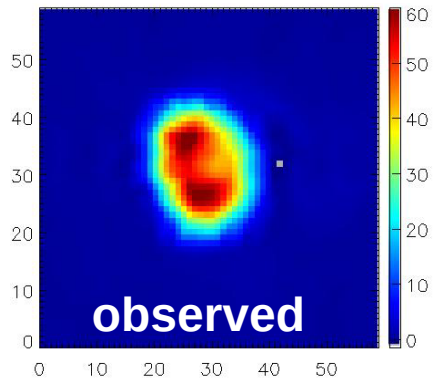
takes into account the asymmetry of the beams projected through the scanning strategy

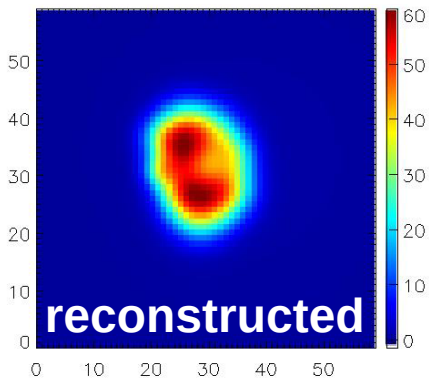
method

- decomposition of the asymmetric beam into a sum of Gaussians
- convolution in the spherical harmonic space

$$B_\lambda$$

asymmetric beam smoothing effect in multipoles

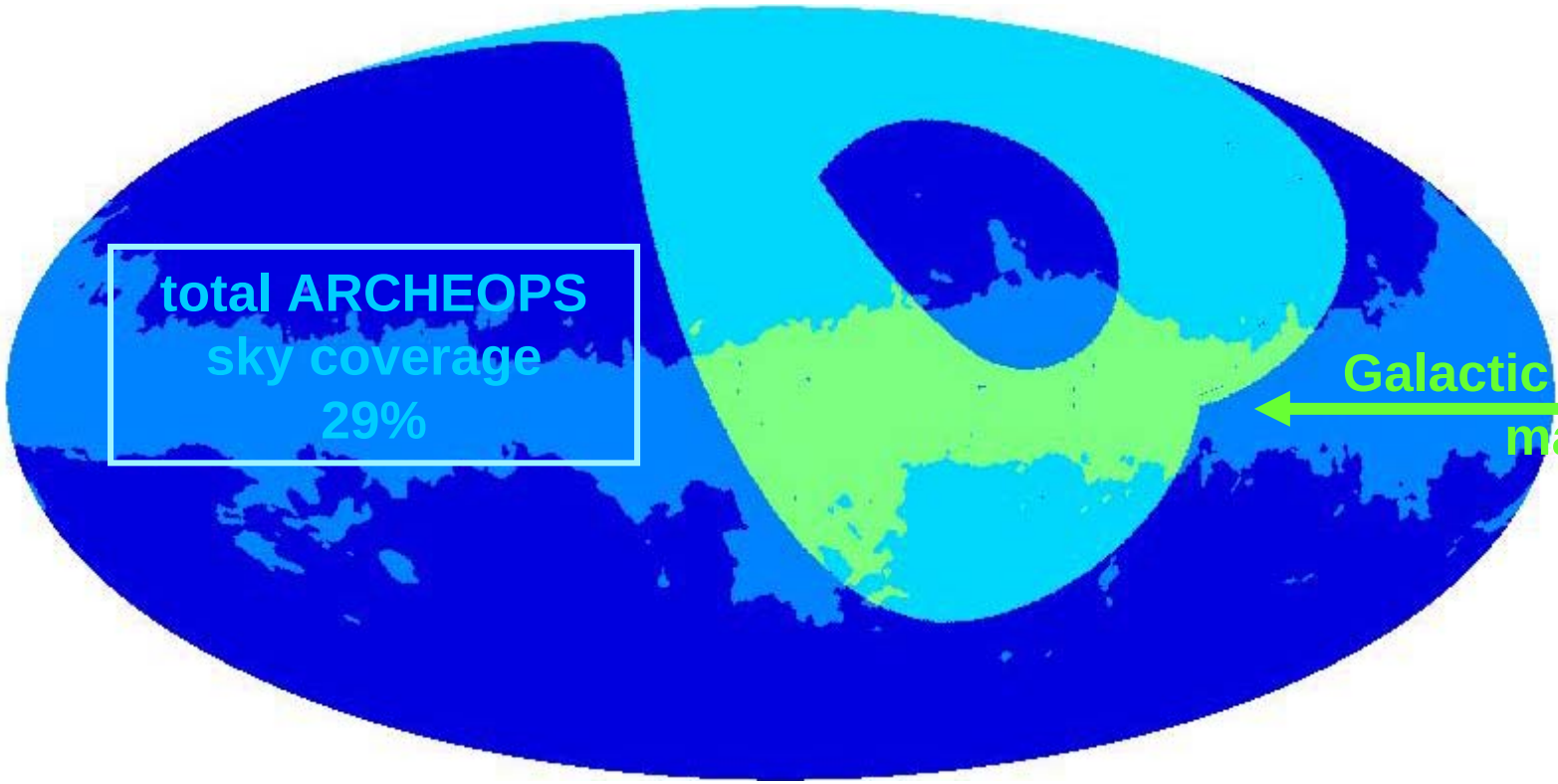




decomposition in 10 Gaussians

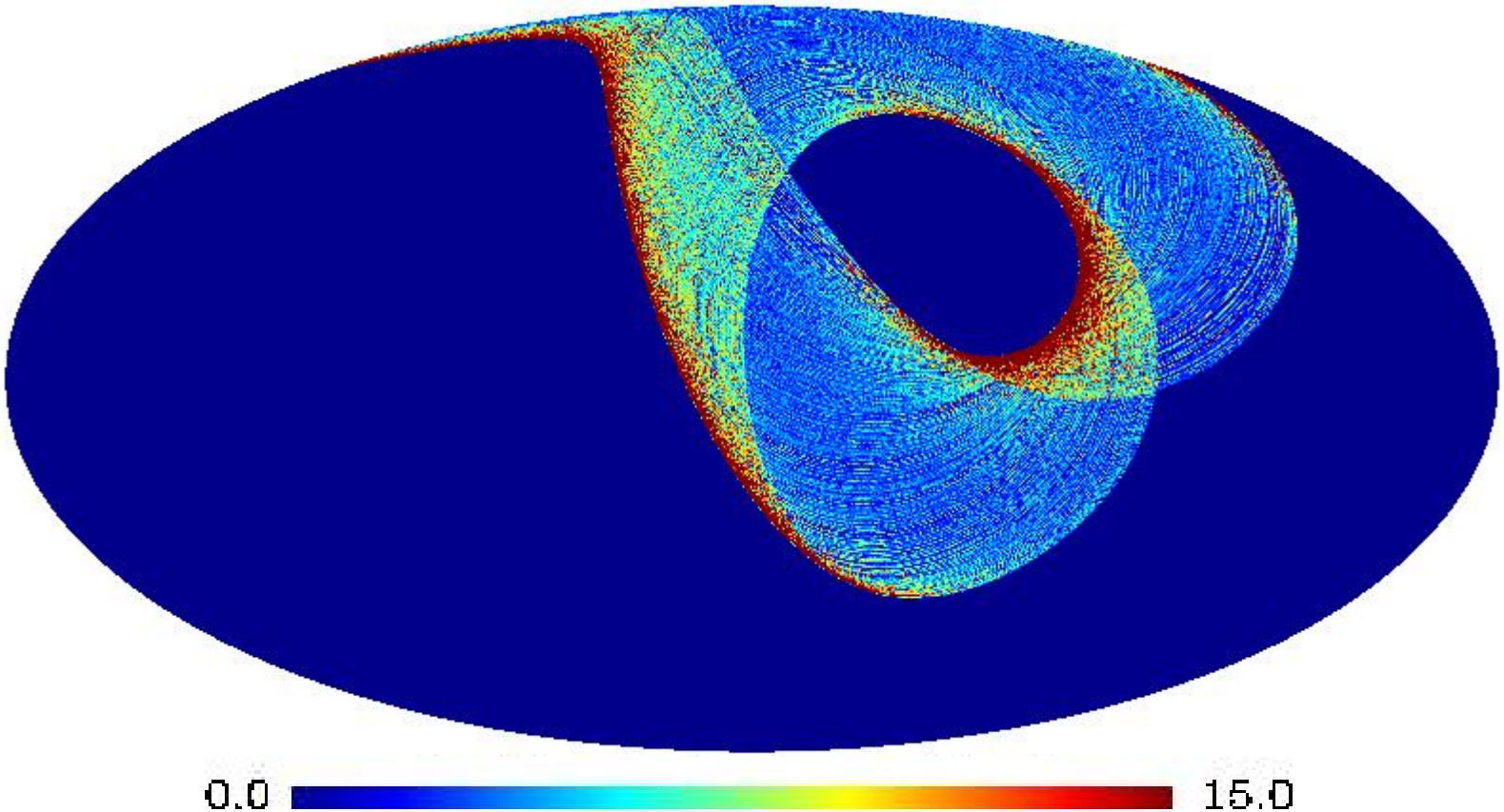
sky coverage

integration time : 11h



CMB sky coverage
19.9%

sky coverage



very inhomogeneous coverage

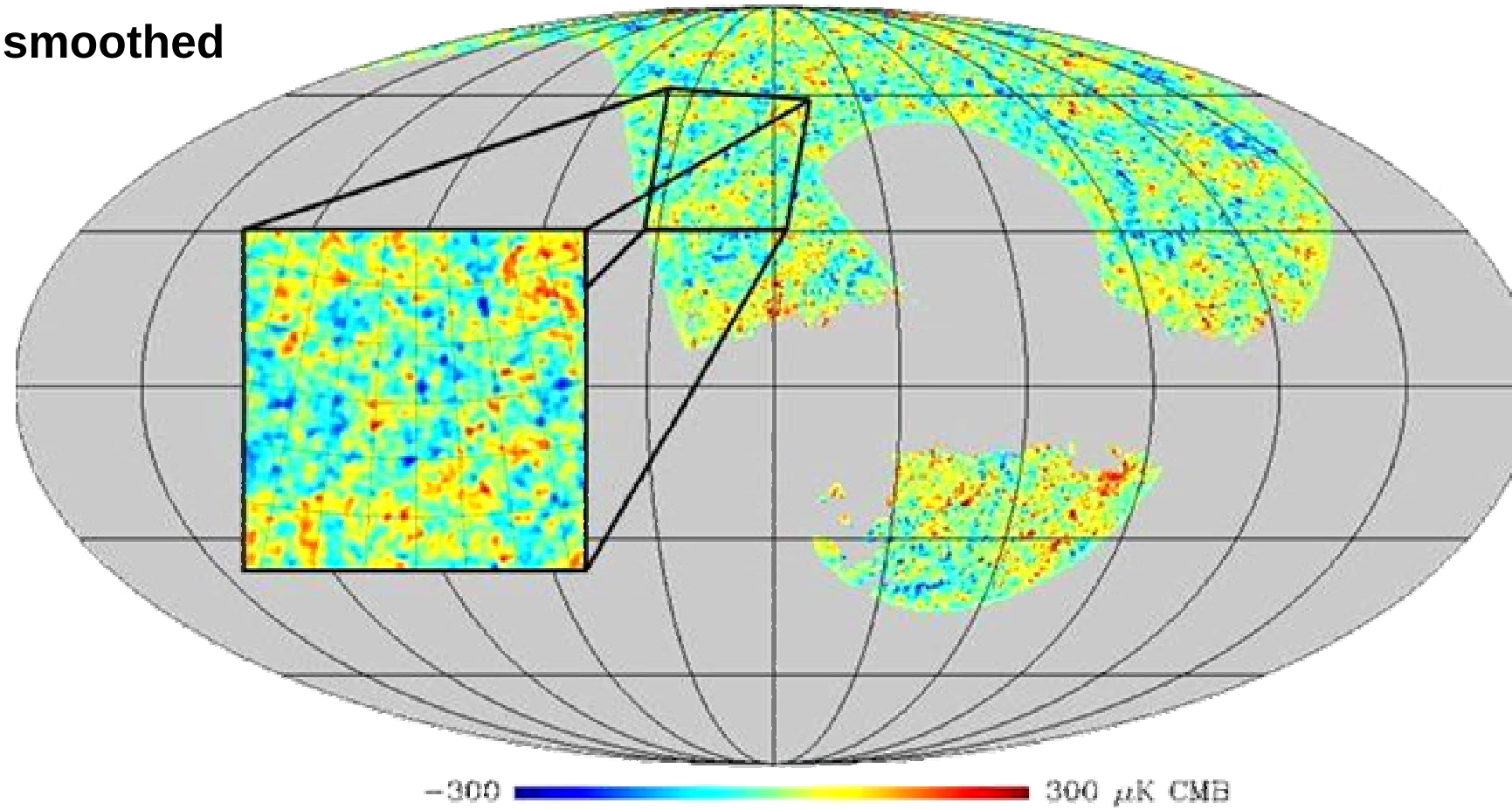
CMB map

combination of 6 bolometers optimal maps using MIRAGE

HEALPix (nside 512)

30' smoothed

Yvon & Mayet, astro-ph/0401505, accepted in A&A



Xspect,

Cl estimator using cross power spectra

Tristram et al., astro-ph/0405575

method

- compute pseudo-cross power spectra on maps
- de-biasing pseudo-cross power spectra using a MASTER-like method

Hivon et al., 2002, Astrophys. J., 567, 2

- optimal combination of cross power spectra

correcting from time-order filtering effect

uncorrelated noise between different detectors

$$\left\langle \tilde{a}^{i}_{\lambda' m} \tilde{a}^{j}_{\lambda' m} \right\rangle = \sum_{\lambda} M^{ij}_{\lambda\lambda'} F_{\lambda'} B^{i}_{\lambda'} B^{j}_{\lambda'} \left\langle a^{i}_{\lambda' m} a^{j}_{\lambda' m} \right\rangle + \left\langle n^{i}_{\lambda' m} n^{j}_{\lambda' m} \right\rangle$$

pseudo-cross power spectra from 2 detectors

correcting from pixel weighting on the sky

correcting from main beam smoothing effect

Xspect,

Cl estimator using cross power spectra

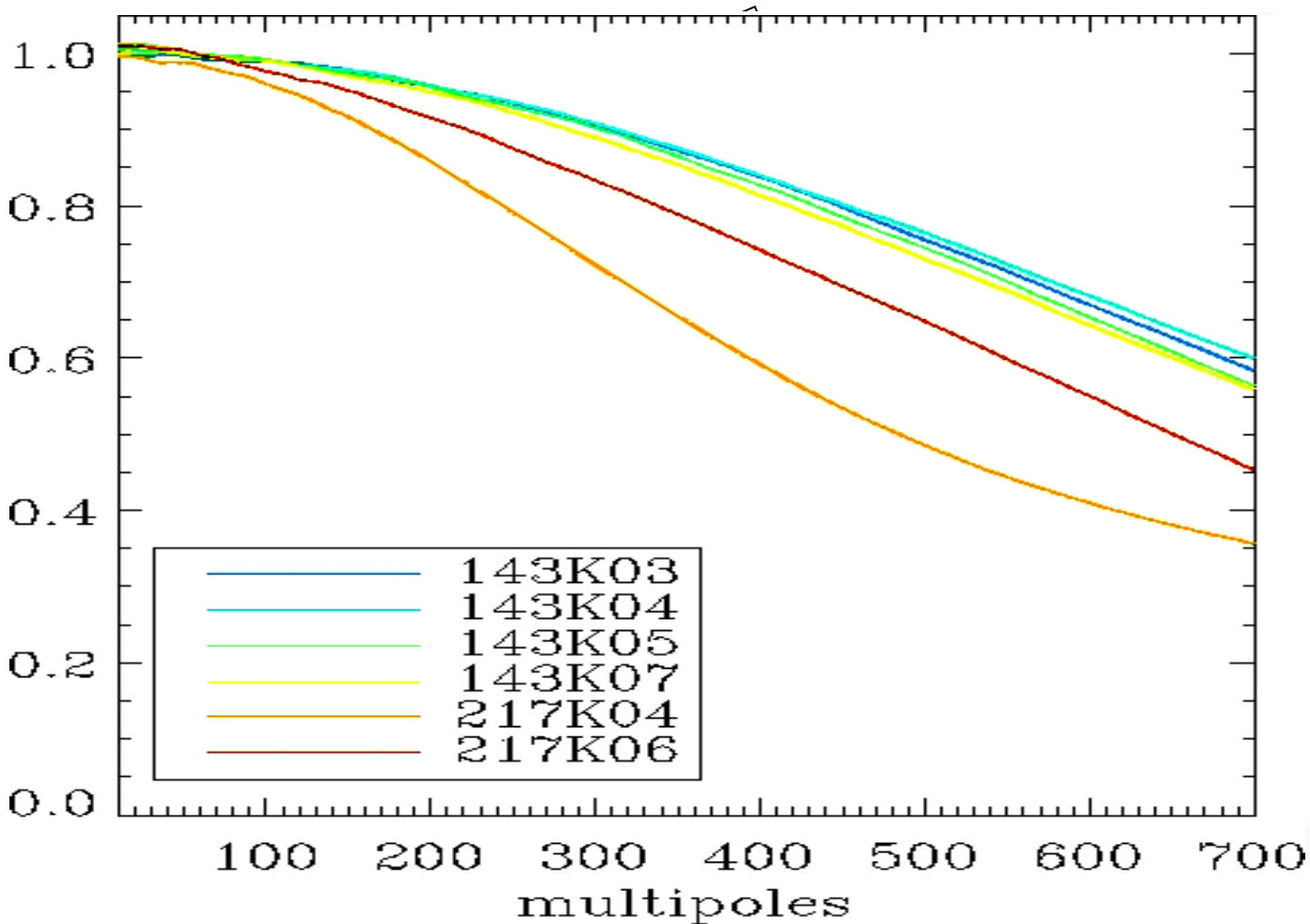
Tristram et al., astro-ph/0405575

$$\left\langle n^i_{\lambda' m} n^j_{\lambda' m} \right\rangle = 0$$

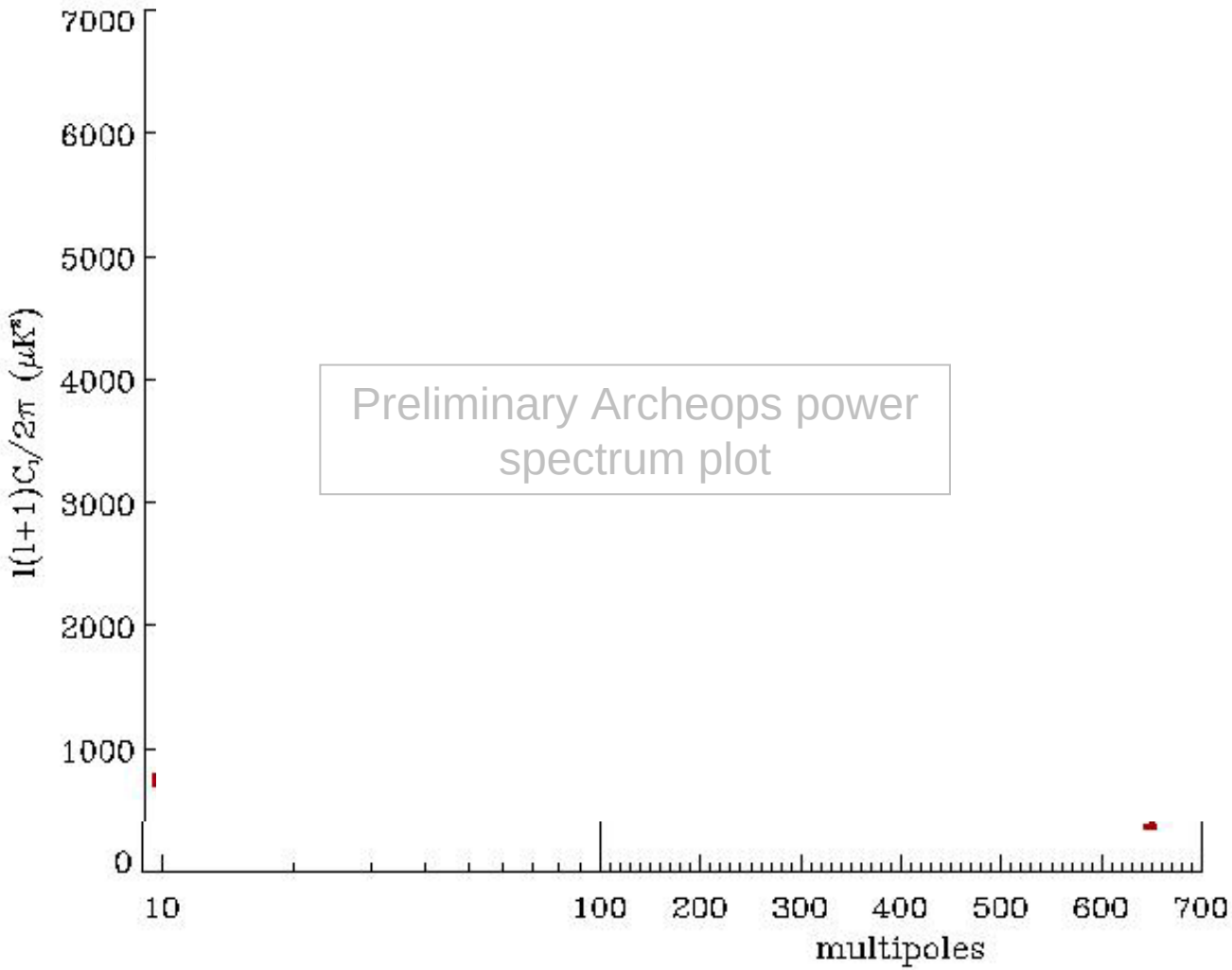
$$M^{ij}_{\lambda\lambda'}$$

$$F_{\lambda'}$$

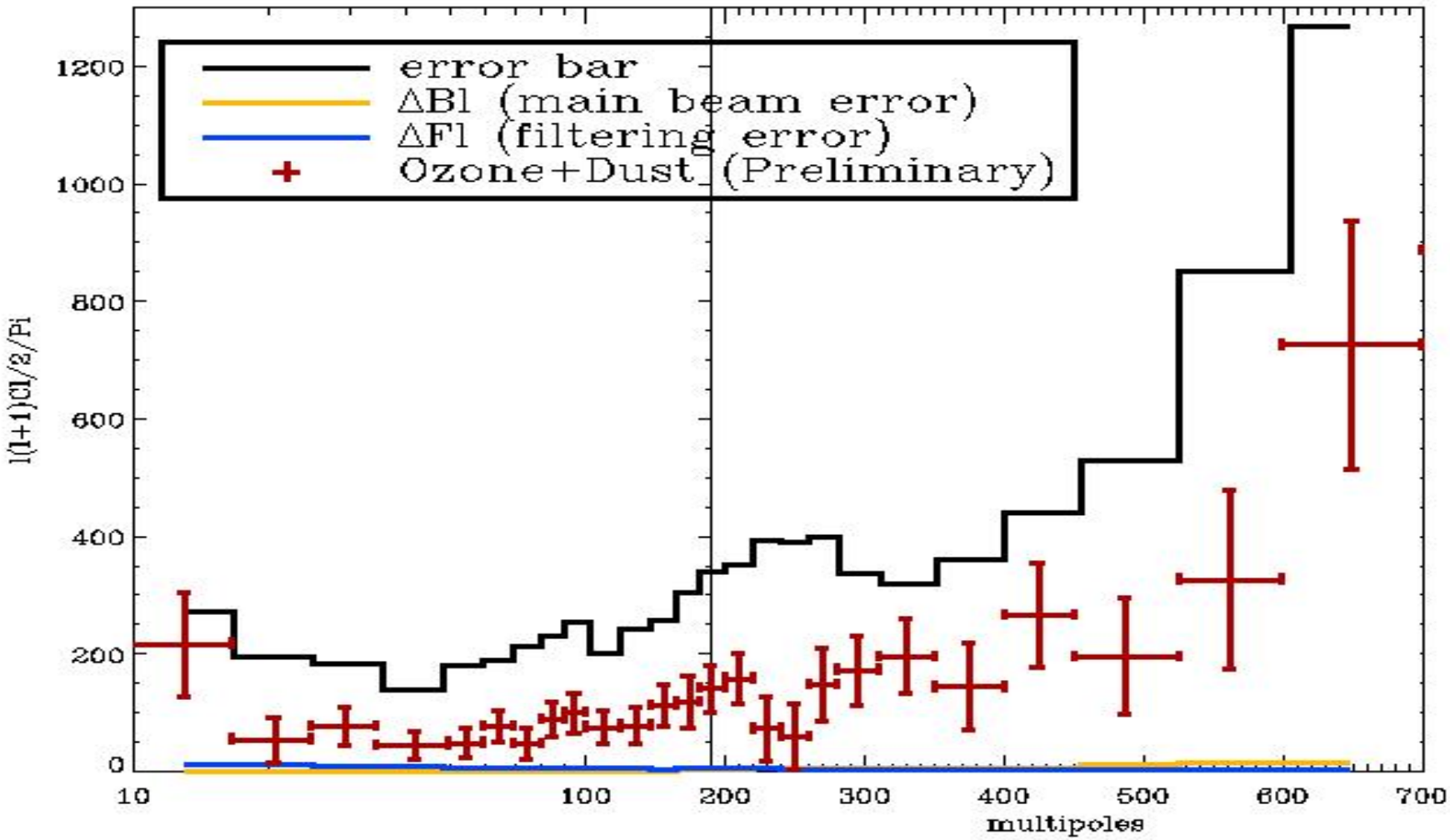
$$B^i_{\lambda'}$$



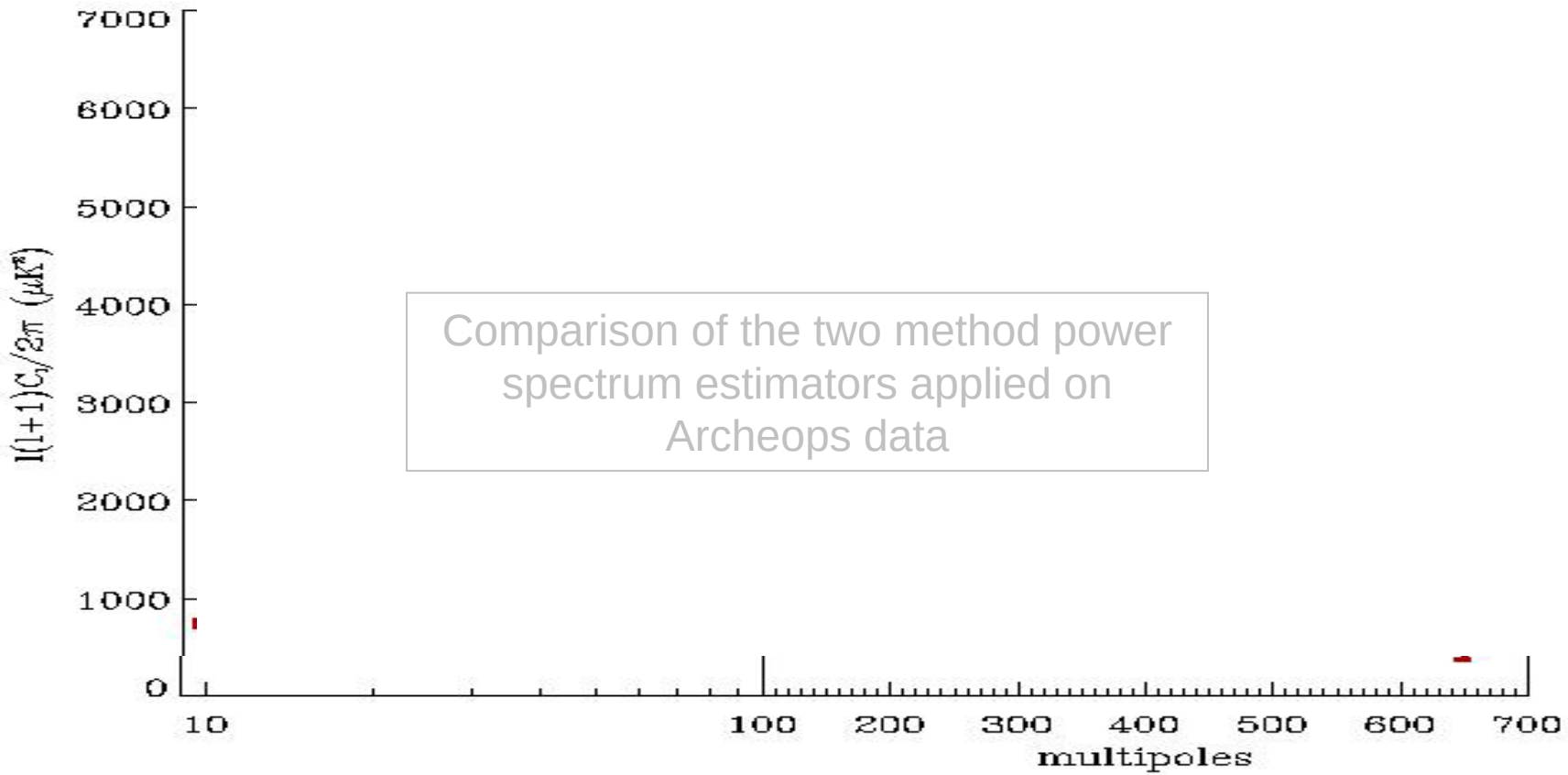
preliminary Archeops results



systematics and foregrounds contamination



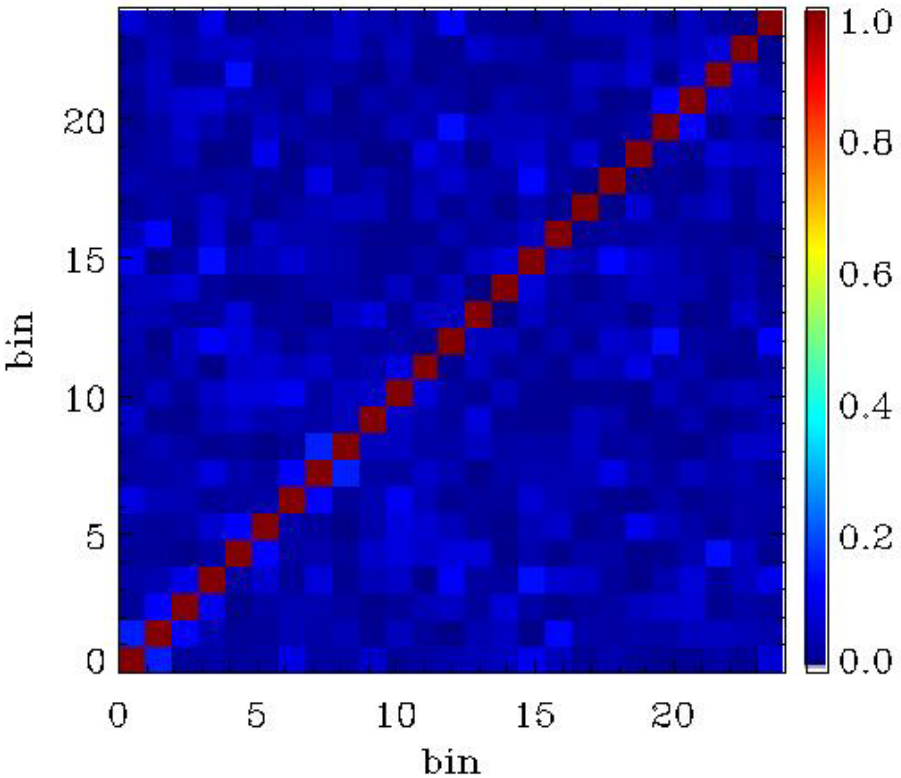
two cross power estimators

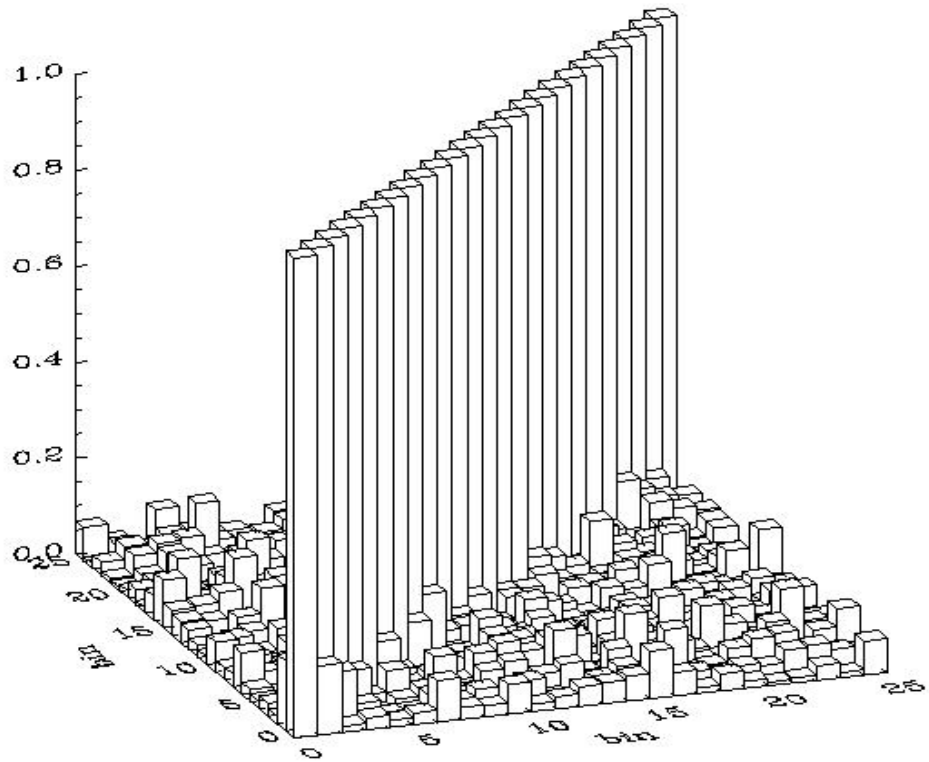


equivalent spectra with two different methods

- **Xspect** (Tristram et al., astro-ph/0405575)
- **SMICA-MCMD** (Patanchon et al., astro-ph/0311305)

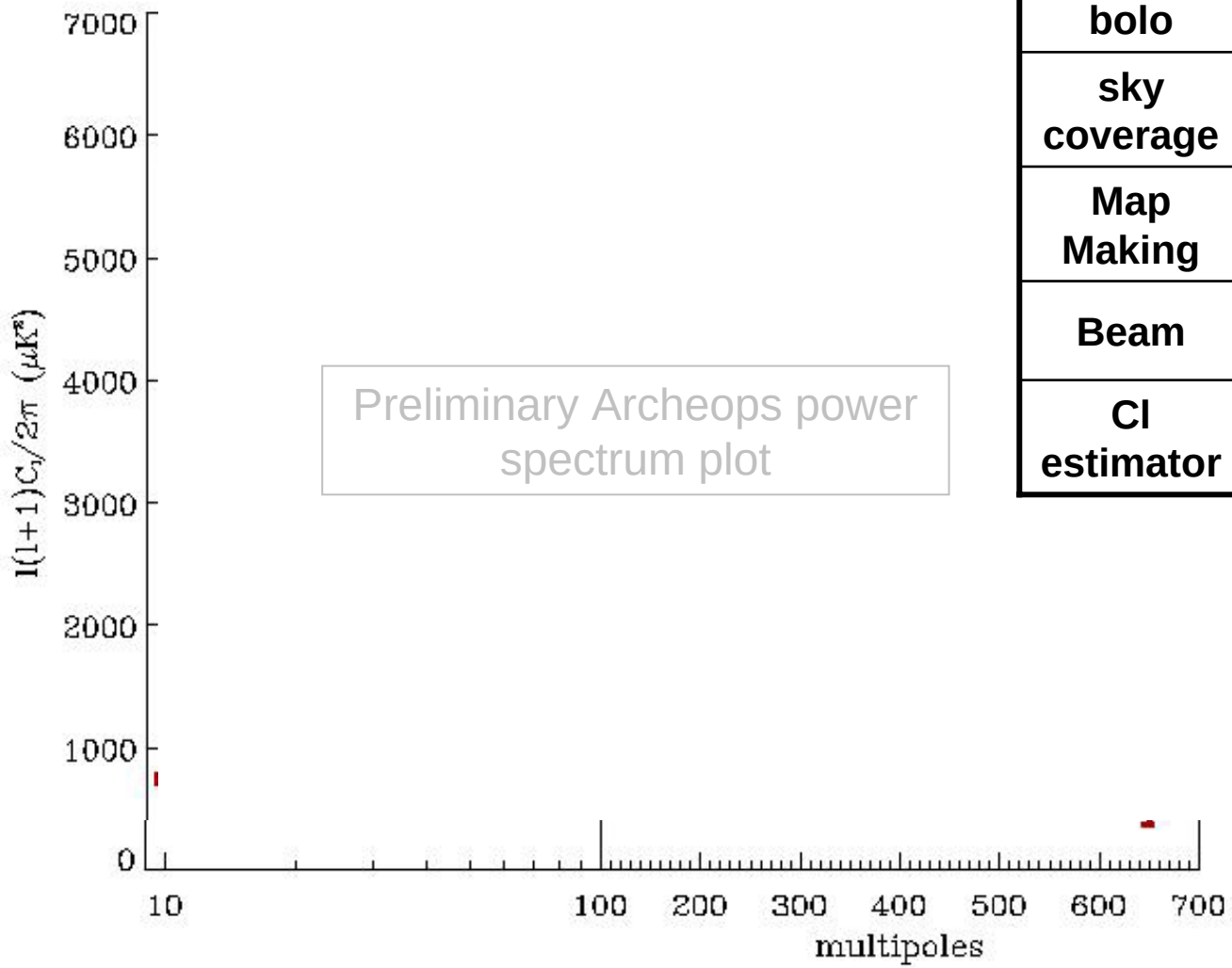
covariance matrix





off-diagonal terms < 12%

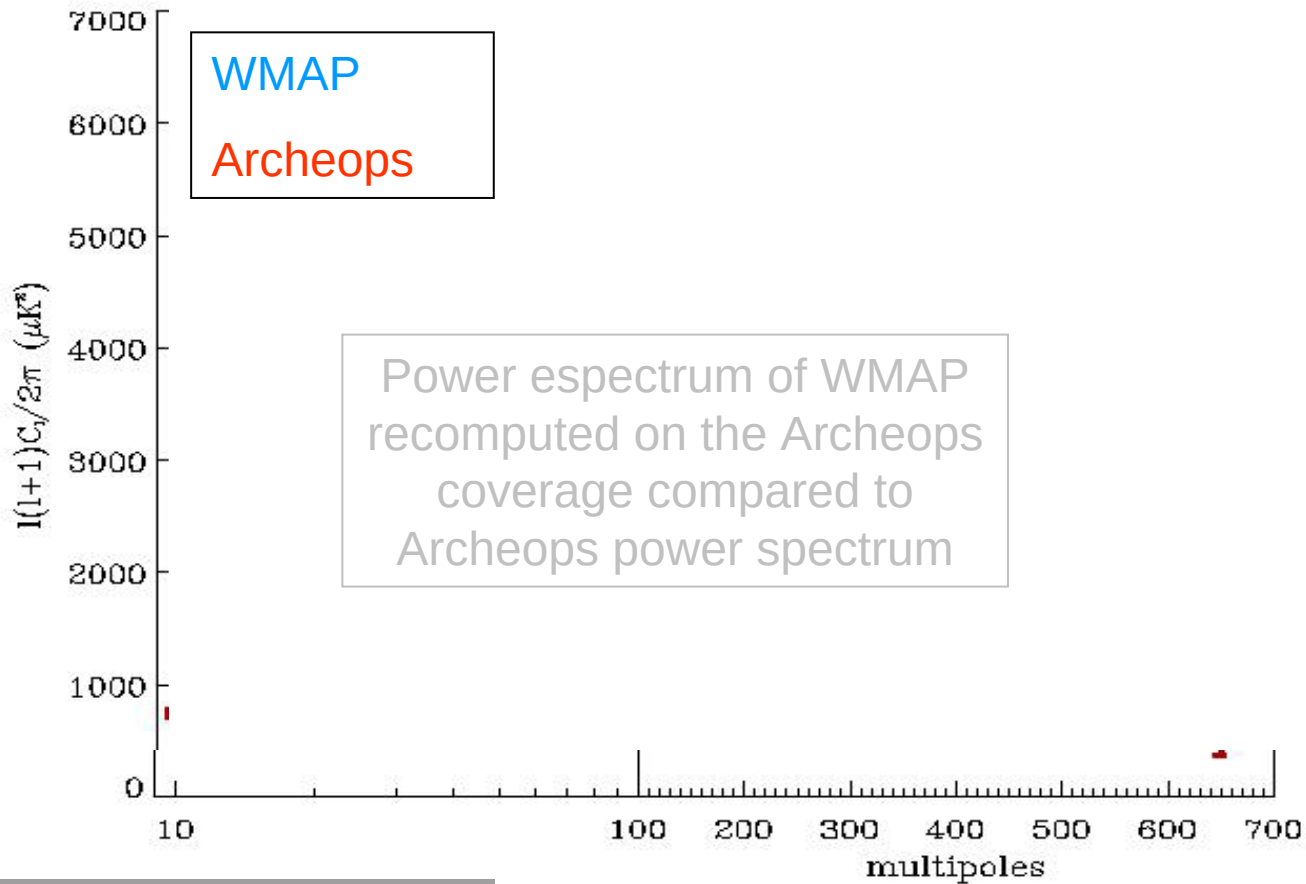
preliminary Archeops results



nb of bolo	2	6
sky coverage	12.6%	19.9%
Map Making	simple	MIRAGE
Beam	ellipticity	Asymfast
Cl estimator	MASTER	Xspect

spectra on Archeops coverage

linear fit with error bars in both coordinates



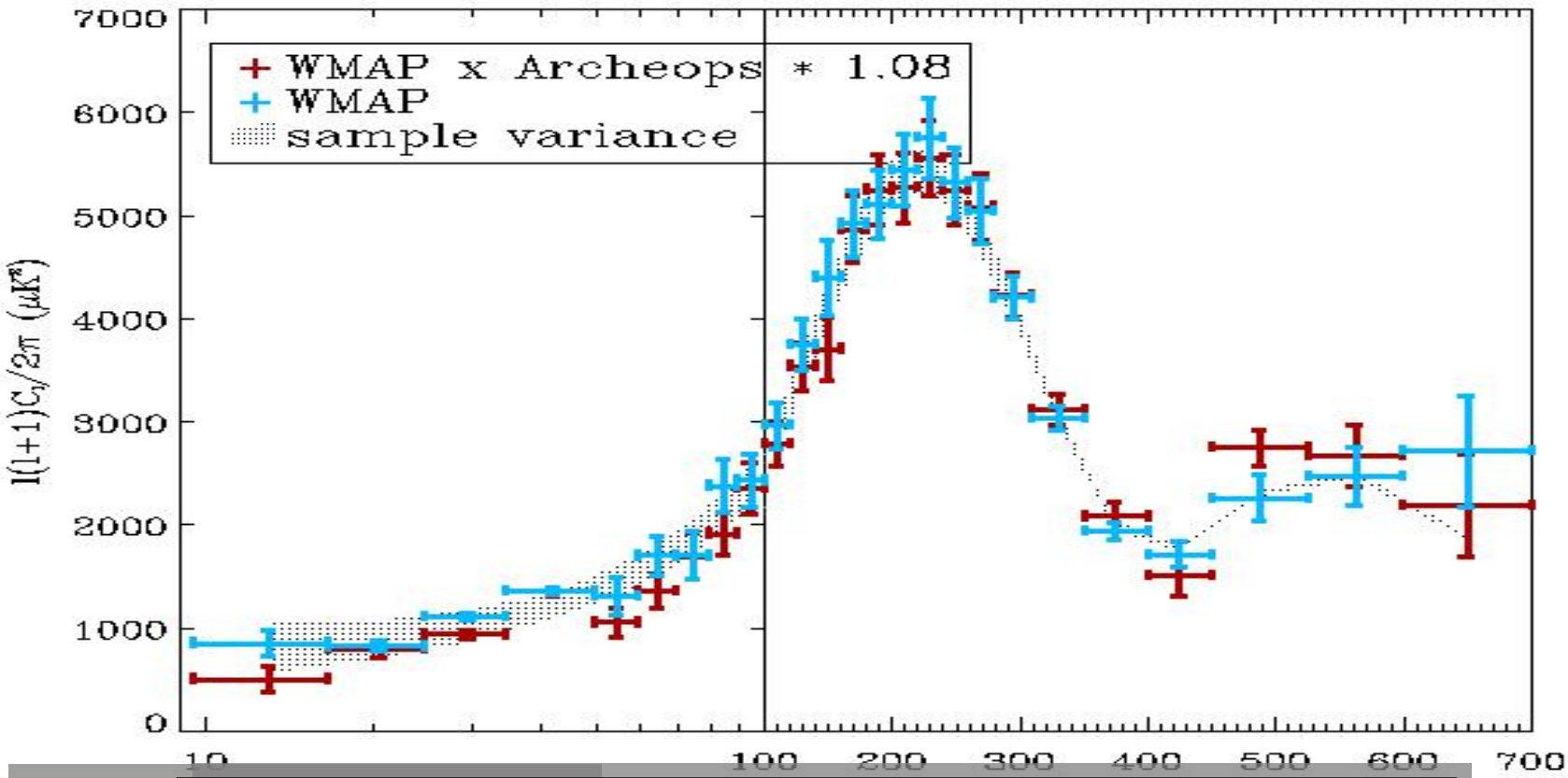
chi2 = 19.3/24

goodness of fit q = 0.74

cross correlation Archeops x WMAP

on Archeops coverage

linear fit with error bars in both coordinates



chi2 = 25.6 ; goodness of fit q = 0.37

we observe same sky structures at 5 frequencies (40, 60, 94, 143, 217 Ghz)

Conclusions

- new analysis :

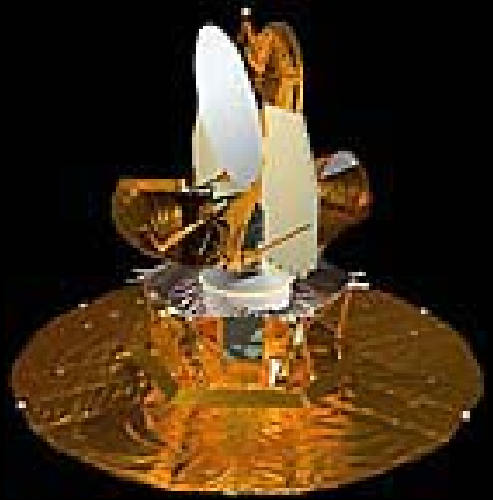
	Benoit et al. 2003	→	2004
larger multipole range	15-350	→	10-700
extra bolometers	2	→	6
larger sky coverage	12.6%	→	19.9%

- specific methods have been developed (**Asymfast**, **Xspect, …**)

☹ initial high level of foregrounds (atmosphere and dust)
☺ adapted data analysis
☹ only 11h integration time
☺ high sensitivity

→ the Archeops balloon results can honestly be compared to the 1st year WMAP satellite ones !

and perspectives…



WMAP

- joint Archeops / WMAP (1st and 2nd(?) year) analysis in progress
- multi-frequency SZ analysis in progress
- …

Planck HFI

- adapt methods developed for Archeops
- take advantage of the data analysis skills obtained with Archeops
- …