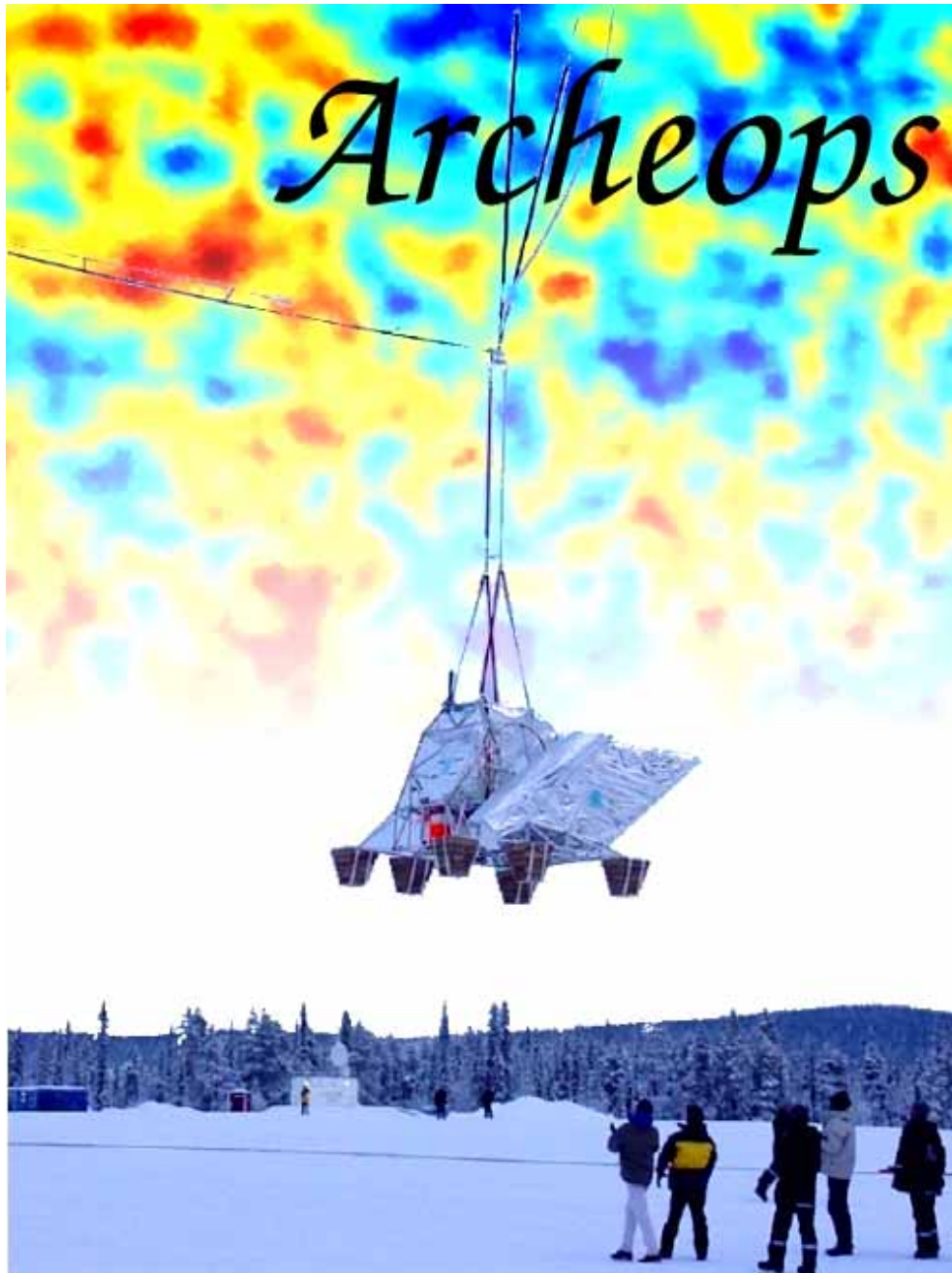


# CMB power spectrum

$$\ell = 10 - 700$$

**M. Tristram,**  
on behalf of the Archeops collaboration





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 main points

- Same concept as Planck HFI

same telescope, bolometers, electronics  
Spider web bolometers at 100 mK



Testbed for  
Planck

- Large sky coverage : 30%

Large circles on the sky during night-time  
19 hour flight during Arctic night



Constraints on  
low  $\ell$  ( $>10$ )

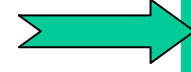
- High angular resolution : 10-12 arcmin



Constraints on  
high  $\ell$  ( $<700$ )

- Multiband photometer

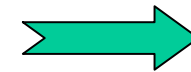
22 bolometers  
4 frequency bands : 143, 217, 353, 545 GHz



Good redundancy  
foreground sep.

- Polarized 353 GHz Channel

cf. next talk presented by N. Ponthieu...



Polarized  
Foregrounds



# bolometers

120 arcmin

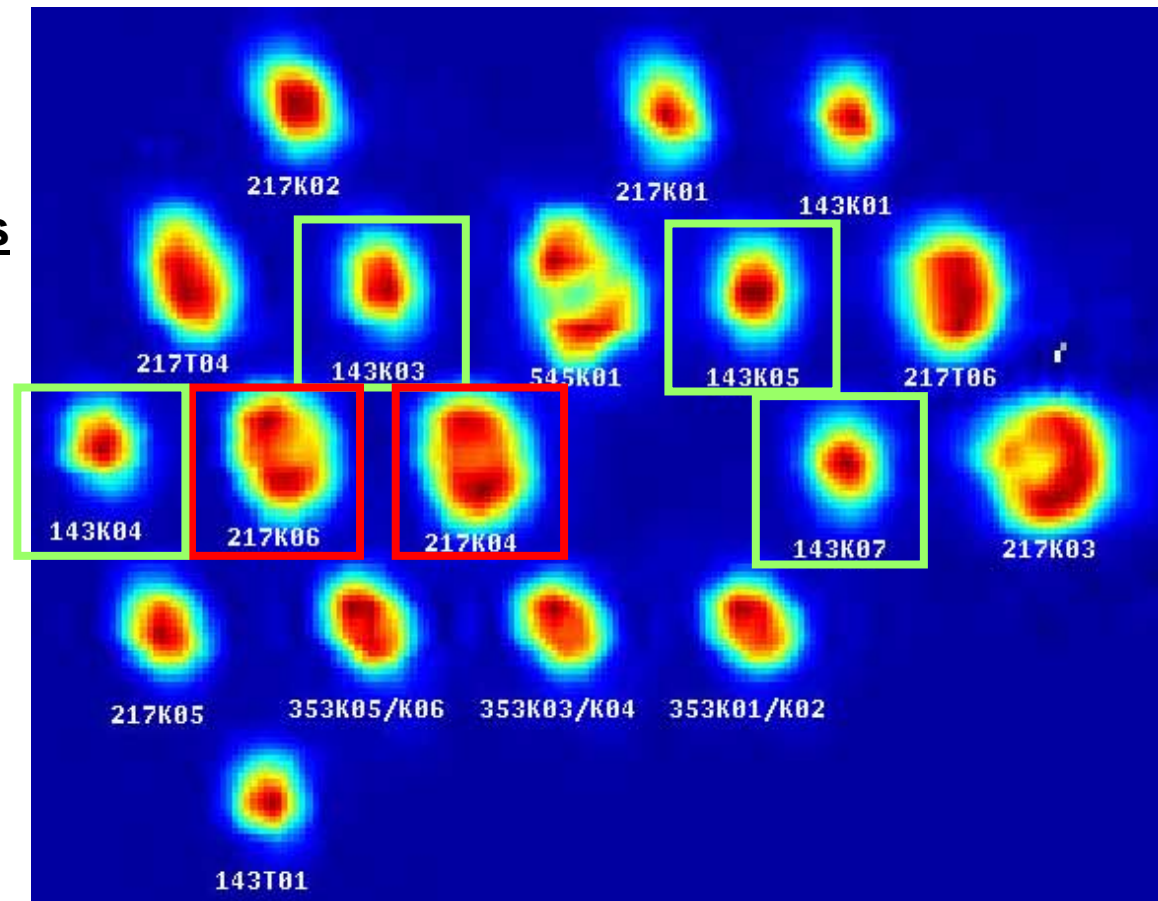
6 bolometers @ 2 frequencies

- 4 @ 143 GHz
- 2 @ 217 GHz

sensitivity

$$93 < s < 210 \mu\text{KCMB.s}^{1/2}$$

$$(s_{\text{WMAP}} = 1000/1600 \mu\text{KCMB.s}^{1/2})$$



# main beam : Asymfast

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

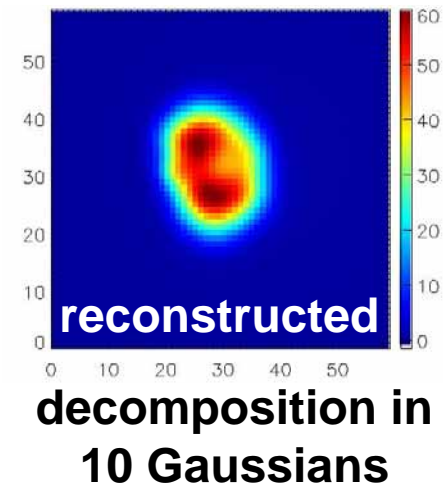
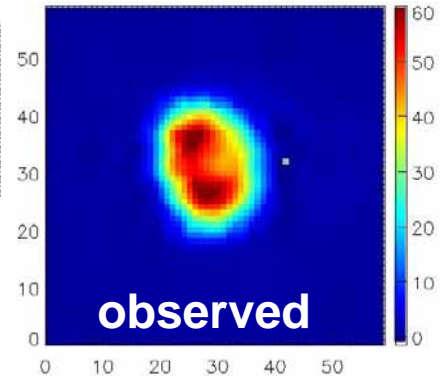
takes into account the **asymmetry** of the beams projected through the **scanning strategy**

## method

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



$B_\ell$   
asymmetric beam smoothing effect in multipoles



# Xspect,

## Cl estimator using cross power spectra

### method

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

Tristram et al., paper in preparation

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

correcting from time-order filtering effect

uncorrelated noise between different detectors

$$\langle \tilde{a}_{\ell'm}^i \tilde{a}_{\ell'm}^j \rangle = \sum_{\ell} M_{\ell\ell'}^{ij} F_{\ell'} B_{\ell'}^i B_{\ell'}^j \langle a_{\ell'm}^i a_{\ell'm}^j \rangle + \langle n_{\ell'm}^i n_{\ell'm}^j \rangle$$

pseudo-cross power spectra from 2 detectors

correcting from pixel weighting on the sky

correcting from main beam smoothing effect



# Xspect,

## CI estimator using cross power spectra

Tristram et al., paper in preparation

$$\langle n_{\ell'm}^i n_{\ell'm}^j \rangle = 0$$

noise is assumed + correlated between detectors  
(foregrounds, systematics cleaned data)

no noise estimation

$$M_{\ell\ell'}^{ij}$$

corrects from correlation induced by weighting  
per pixel and detector

computed by Xspect

$$F_{\ell'}$$

correction in multipole ordering  
Ordered Data the filtering apply in Time

simulations

$$B_{\ell'}^i$$

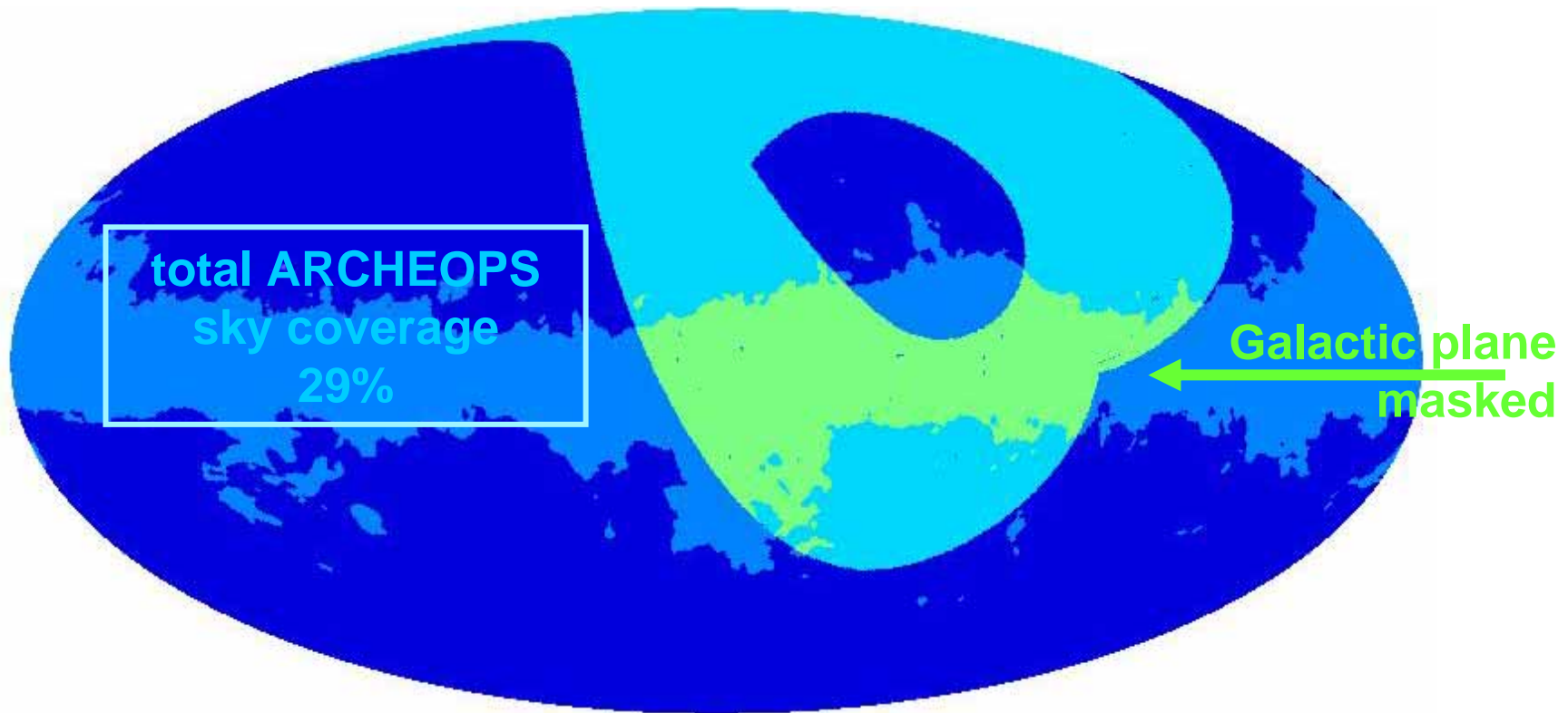
correction in multipole ordering  
effect of each of the main beam smoothing

Asymfast



# coverage and Galactic mask

Galactic mask computed with Schlegel maps cut in flux at 0.5 MJy/sr



**CMB sky coverage  
19.9%**

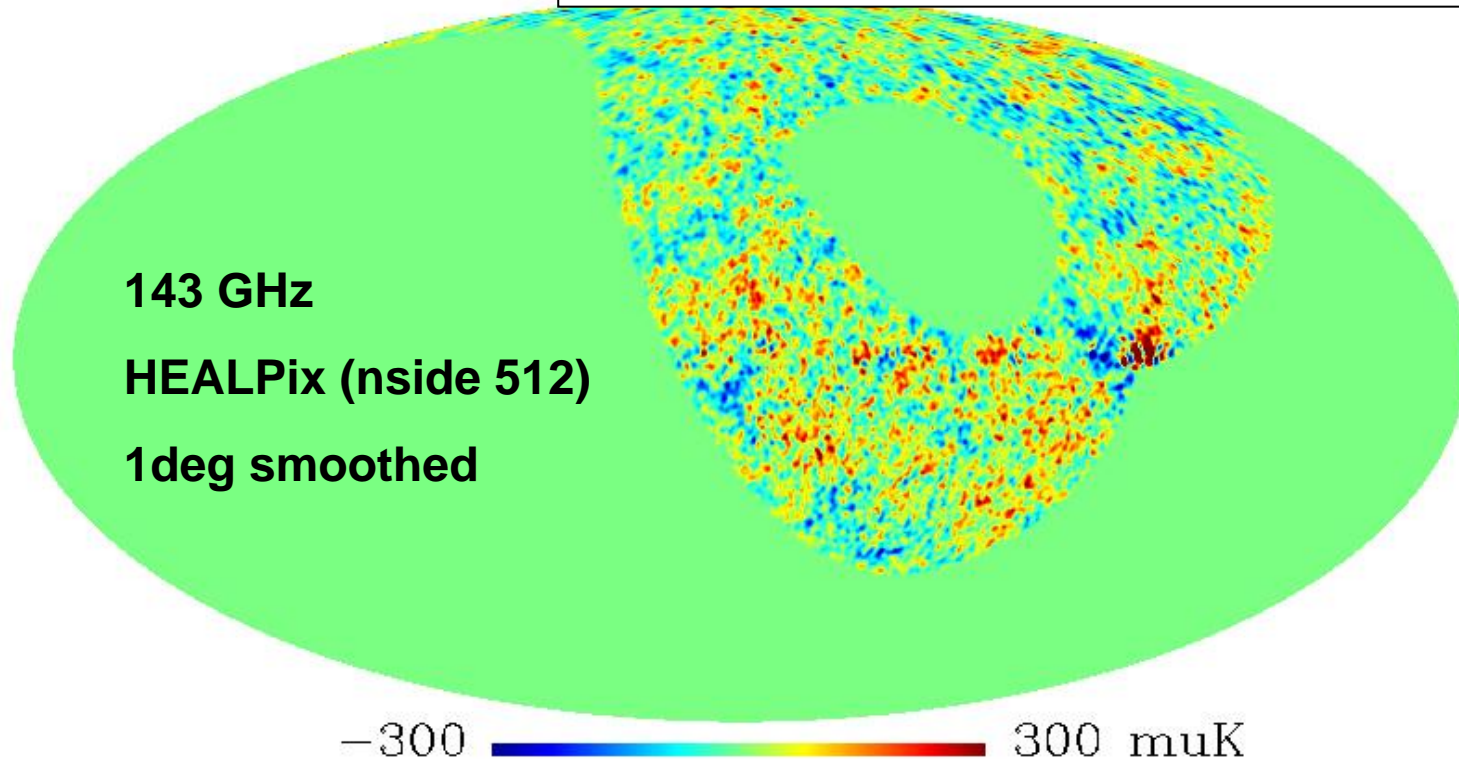




# map-making

optimal maps computed individually with MIRAGE

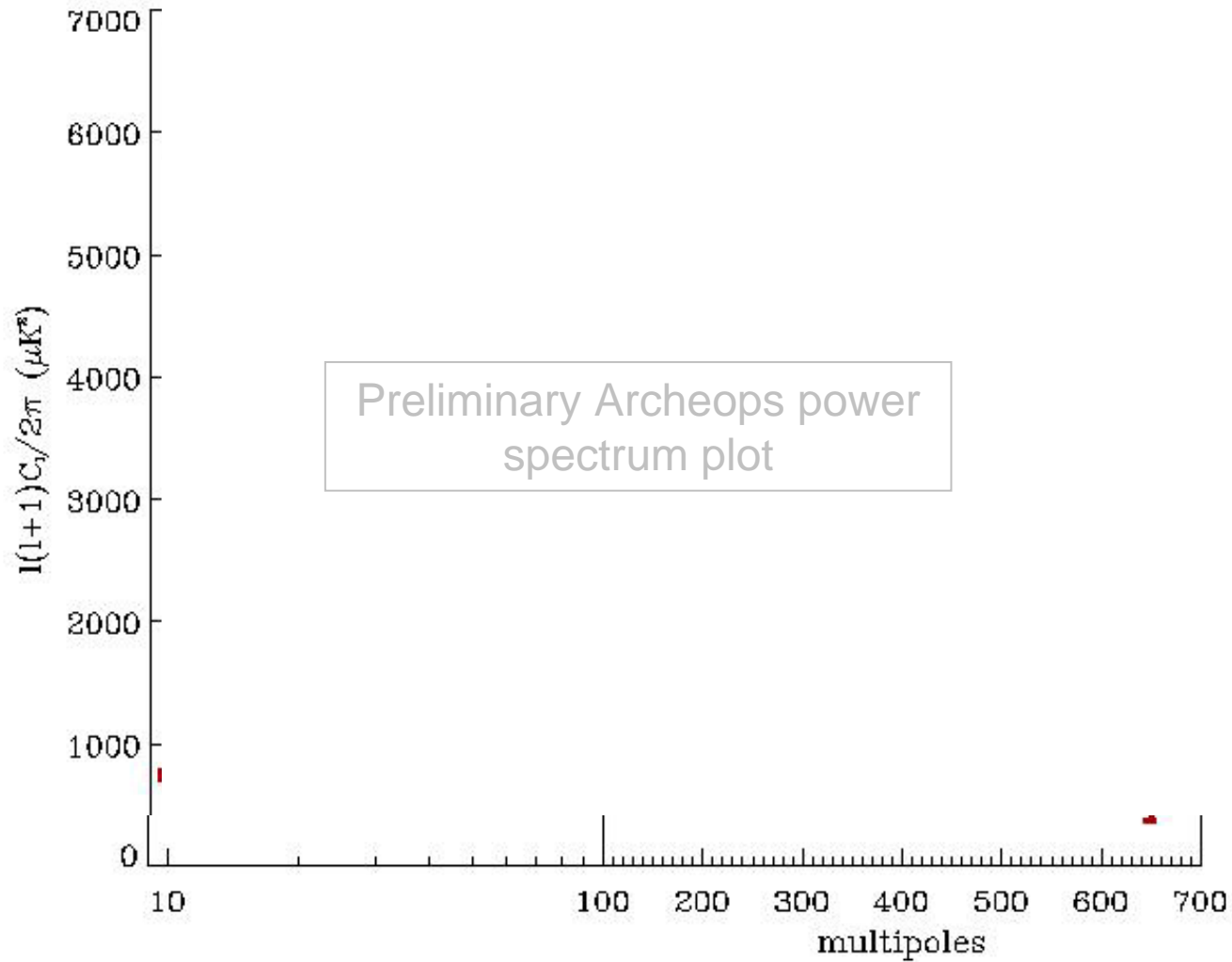
Yvon & Mayet, *astro-ph/0401505*, accepted in *A&A*



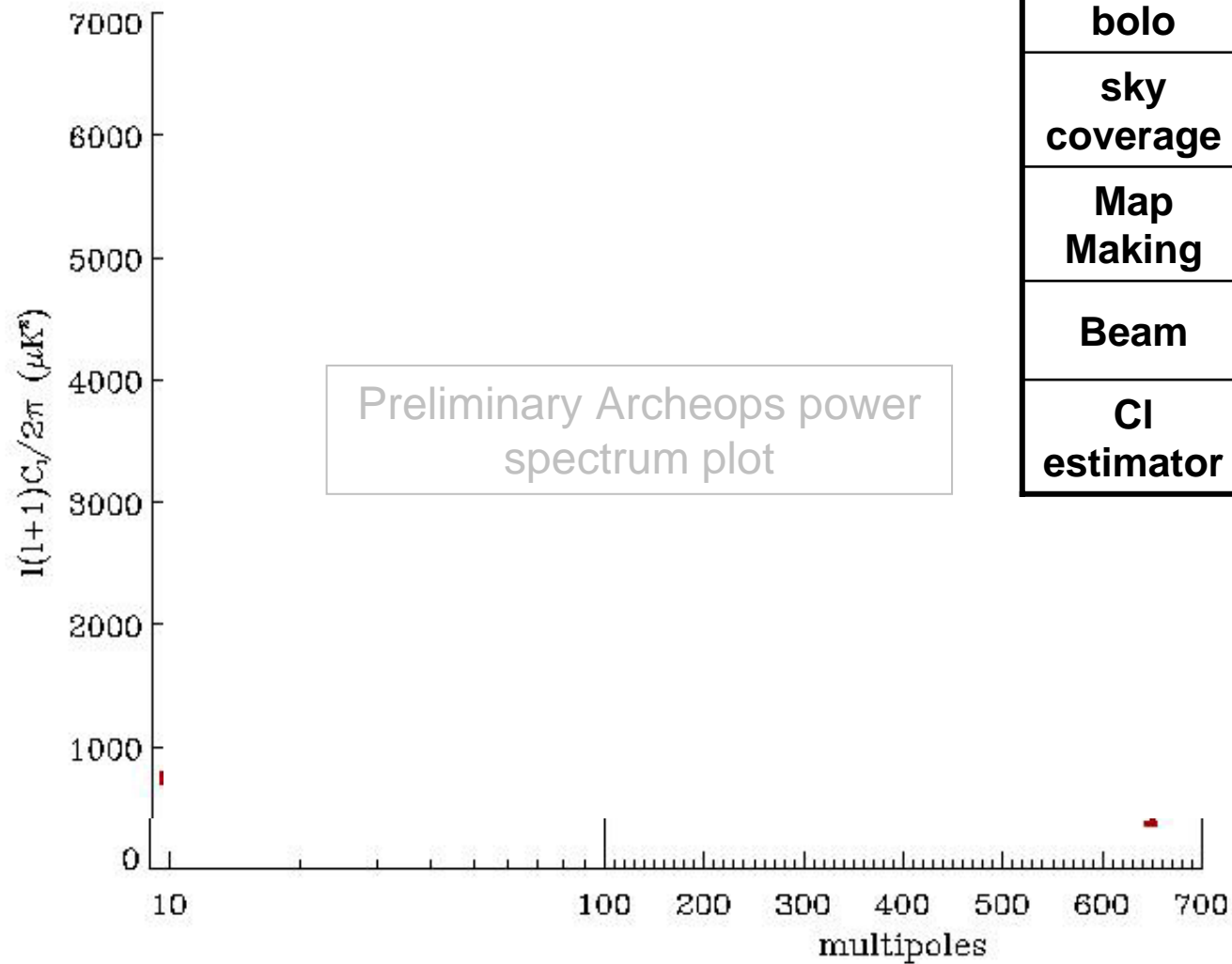
deals with non-white noise  
( $1/f$  and high frequencies features)



# preliminary Archeops results



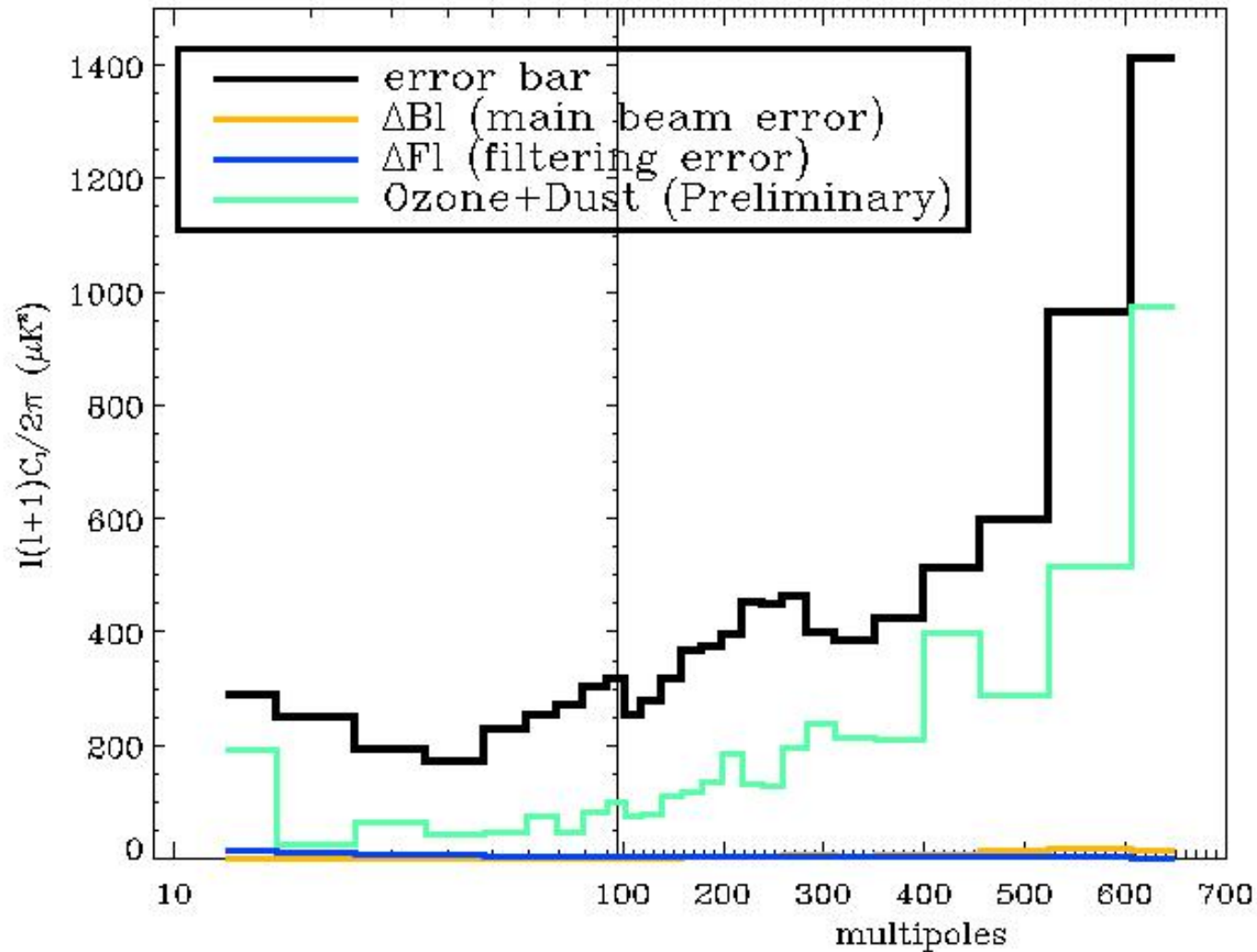
# preliminary Archeops results



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

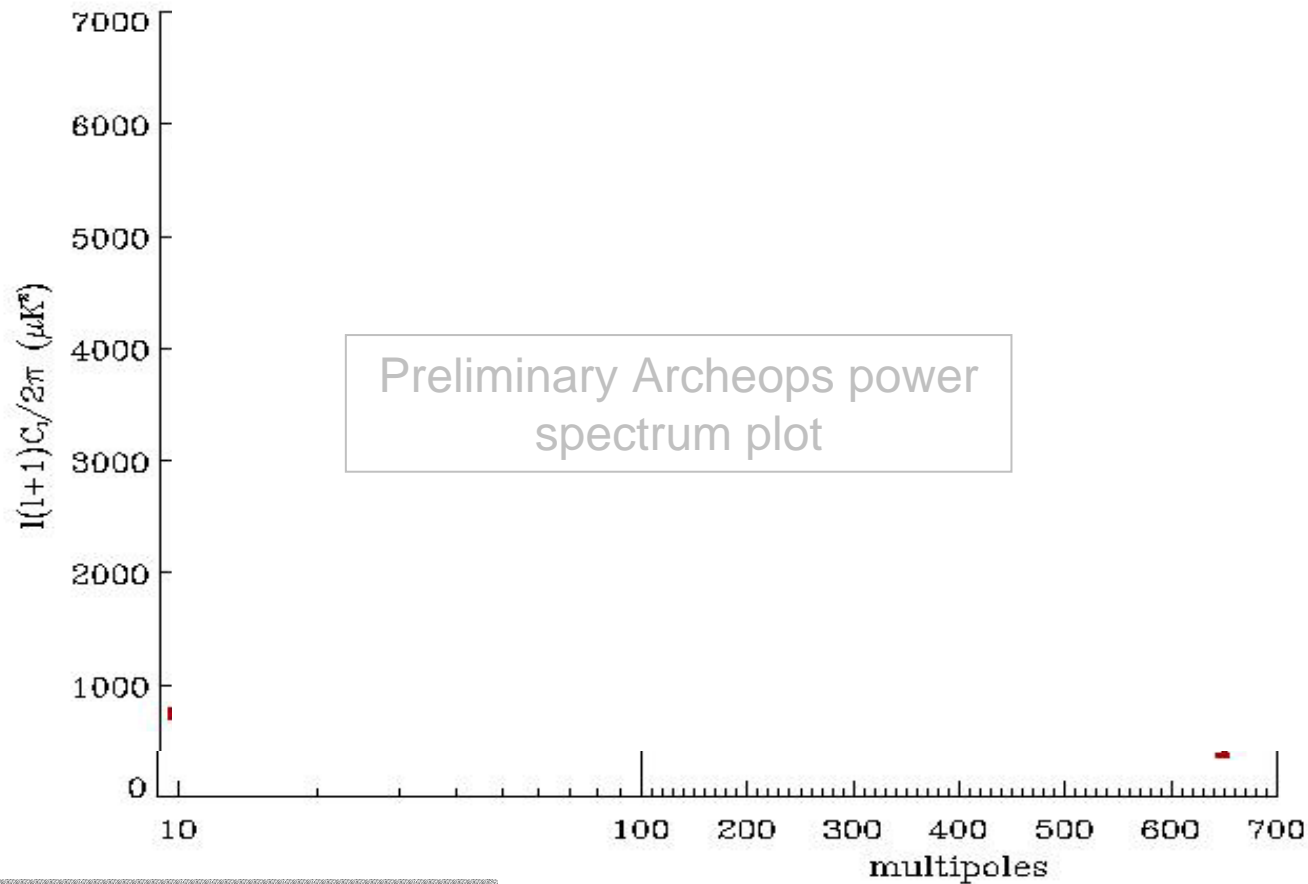


# systematics and foregrounds contamination



# spectra on Archeops coverage

linear fit with error bars in both coordinates



**chi2 = 19.3/24**

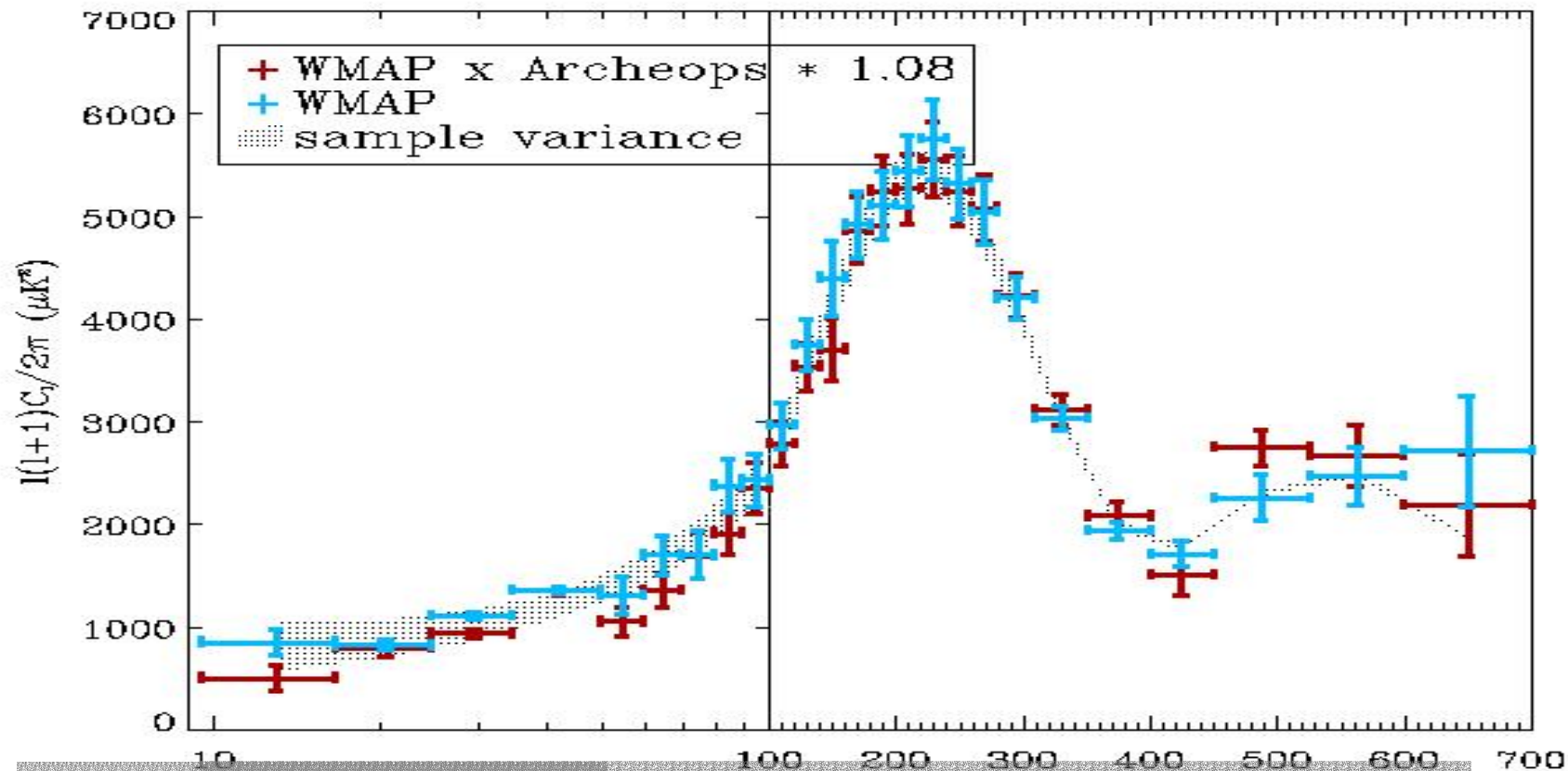
**goodness of fit  $q = 0.74$**



# cross correlation Archeops x WMAP

on Archeops coverage

linear fit with error bars in both coordinates



chi2 = 2  
goodne

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

# Conclusions

Benoit et al. → 2004  
2003

- new analysis :
  - larger multipole range → 10-700
  - extra bolometers → 6
  - larger sky coverage → 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...

- joint Archeops / WMAP (1<sup>st</sup> and 2<sup>nd</sup> year) analysis in progress
- Planck-HFI very promising !