





Saturday, January 15, 2011



# **Planck2011 Summary**

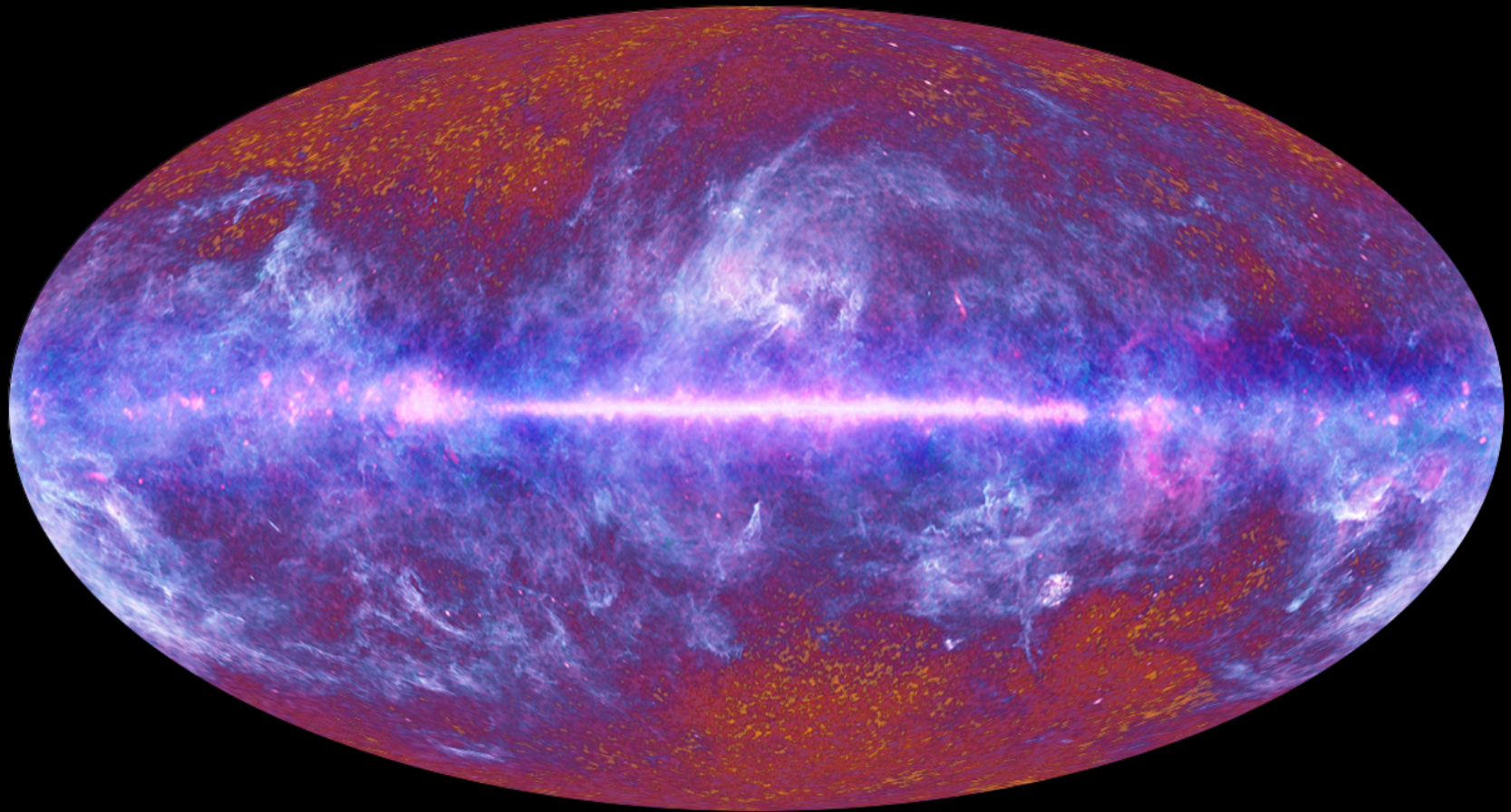
~~Rashid Richard Dick Bond~~

# The scientific results that we present today are a product of the Planck Collaboration, including individuals from more than 50 scientific institutes in Europe, the USA and Canada



Planck is a project of the European Space Agency -- ESA -- with instruments provided by two scientific Consortia funded by ESA member states (in particular the lead countries: France and Italy) with contributions from NASA (USA), and telescope reflectors provided in a collaboration between ESA and a scientific Consortium led and funded by Denmark.

25 papers & a large fraction of the papers at Planck2011 were unveiled for



The Planck one-year all-sky survey



(c) ESA, HFI and LFI consortia, July 2010

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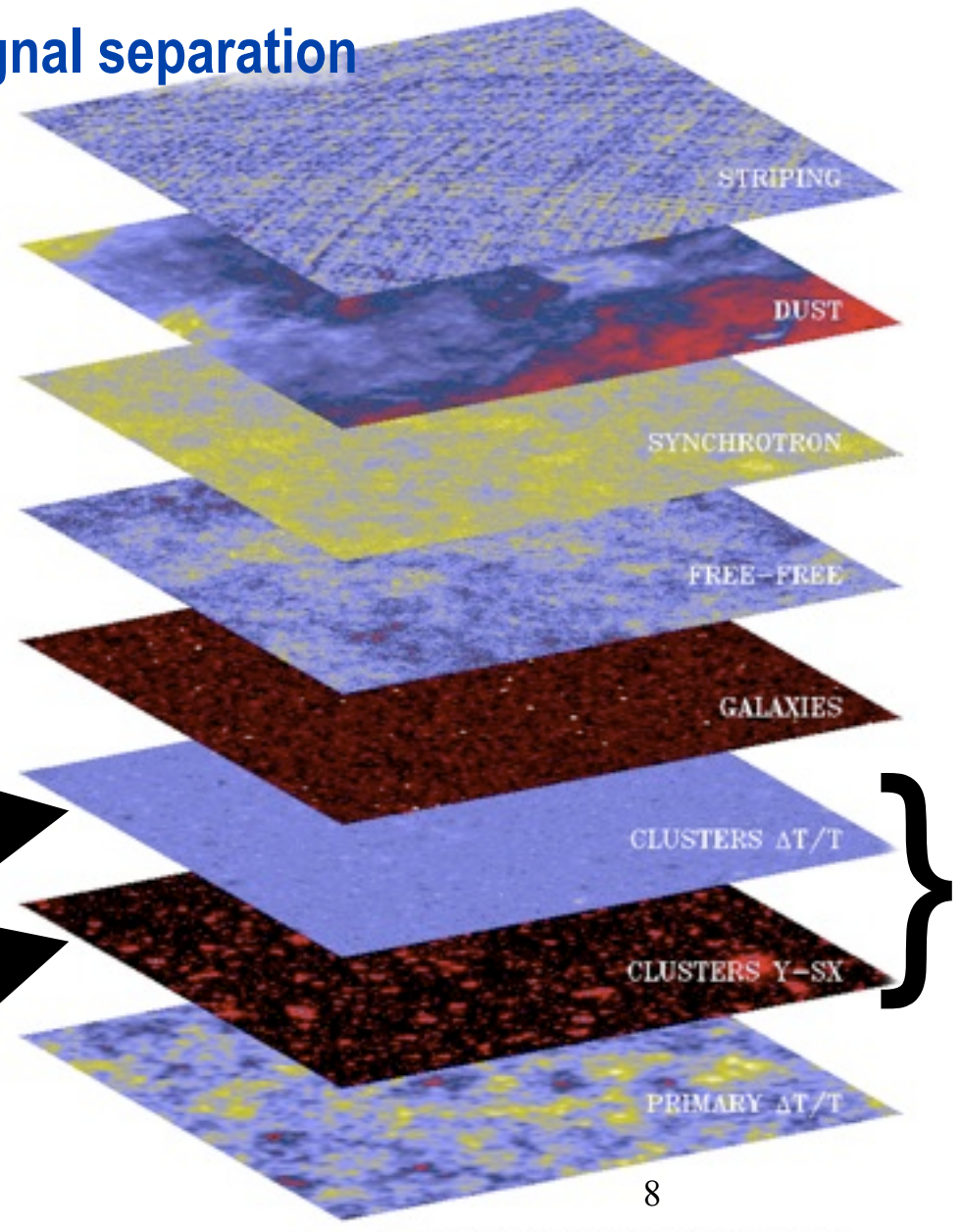
**PlanckEXT, EXT=many observatories & expts enabling the astro**

XMM Herschel Fermi WMAP GBT BLAST ACT SPT AMI CBI CBASS QUIET SDSS IRAS CO/HI-maps, ...

*the quest for the primordial within the primary CMB requires exquisite foreground removal, the quest for Milky Way maps & extended source maps requires accurate CMB etal removal*

**the TBD of Planck vintage 98: signal separation**

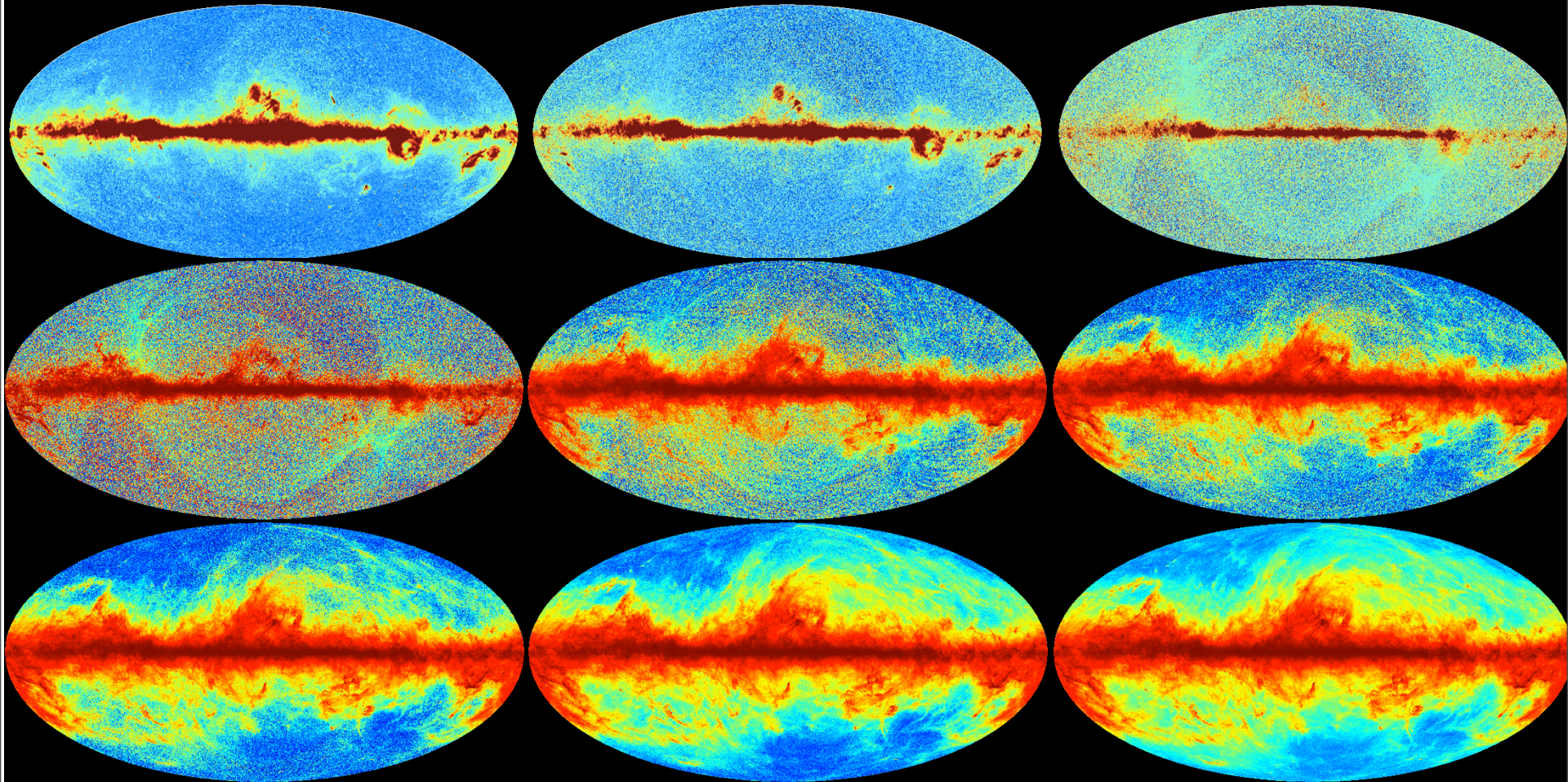
- striping
- dust
- synchrotron
- bremsstrahlung
- dusty galaxies
- kinetic SZ
- thermal SZ
- PRIMARY







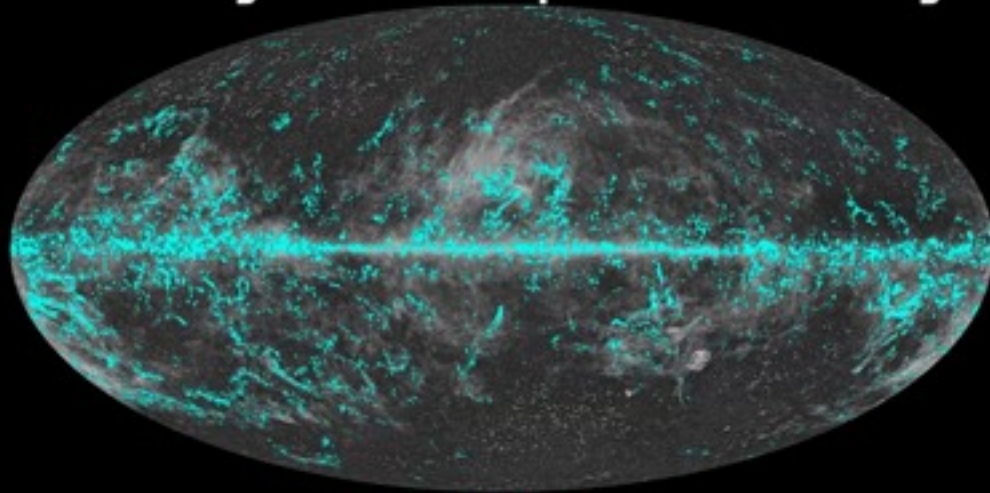
# The Planck Foregrounds sky



Needlet ILC method to remove CMB for HFI. so many separation methods - great, so many templates, and localized removals won out in some early papers. lessons learned?

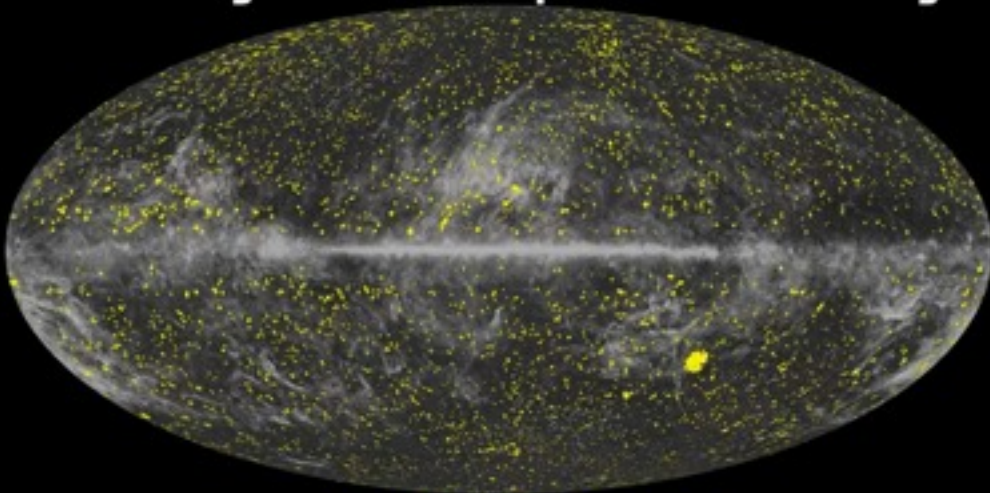


## Planck Early Release Compact Source Catalogue



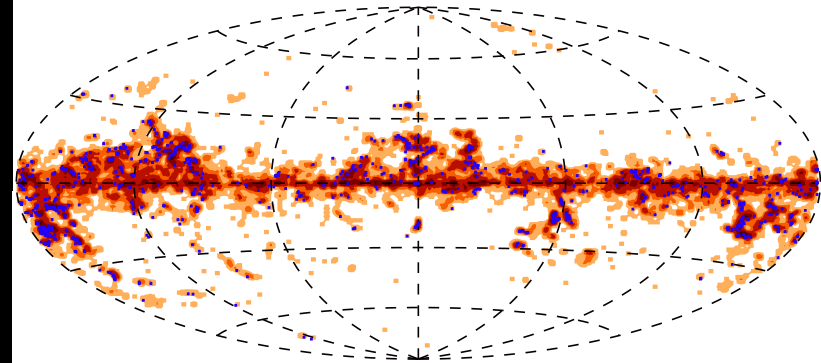
Galactic sources

## Planck Early Release Compact Source Catalogue



Extragalactic sources

- Reliability > 90% (using MC) with photometric accuracy <30%, no completeness stats and not flux limited.
- => radio/submm extragalactic sources, Galactic sources, +
- Have to take care at 100 GHz of possible CO.



- **915 cold cores** in catalog **ECC** (7-17K,  $1.4 < \beta < 2.8$ ), **10783 (C3PO)** seen in maps, most within 2kpc Herschel follow-up, some done
- precursors of pre-stellar cores, up to  $1e5 M_{\text{sun}}$
- *Cold Clumps aka cold cores* in groups & filaments, on edges of HI/IRAS loops

## *Delta T over Tea Toronto May 1987: first dedicated CMB conference, exptalists+theorists, primary+secondary $\Delta T/T$*

A tentative list of topics organized according to angular scale, with theory and observation intertwined, is:

- very small angle anisotropies - VLA results, secondary fluctuations via the Sunyaev-Zeldovich effect, primeval dust emission, and radio sources
- small angle anisotropies - current results, optimal measuring strategies, statistical methods for small signals in larger noise, which universes can we rule out, the reheating issue, future detectors and techniques, CMB map statistics, polarization
- intermediate and large angle anisotropies -  $5^\circ - 10^\circ$  results, future experiments at  $\sim 1^\circ$ , COBE and other large angle analyses, theoretical  $C(\theta)$ 's and their angular power spectra, Sachs-Wolfe effect in open Universes, the isocurvature CDM and baryon stories,  $\Delta T/T$  from gravitational waves, the cosmic string story.

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**radio source counts**

**ambient/blank-field tSZ effect from clusters & gals** *dominant Poisson 'self'-clustering* *sub-dominant cc-clustering*

**dusty gals** *gg-clustering term is much more important than for clusters, resolution to see both*

**“clustered shots” (peaks for halos) with pressure/thermal dust emission profiles**  
**effect of energy injection / explosions- a big pre-COBE forecast issue IGM ~ ISM**

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## **radio source counts**

Planck, ACT, SPT (WMAP) deZotti model good, but steeper for  $> 70$  GHz

**ambient/blank-field tSZ** effect from **clusters & gals** *dominant Poisson sub-dominant*

ACT, SPT power Planck, ACT, SPT blind detection *'self'-clustering cc-clustering*

**dusty gals** *gg-clustering term is much more important than for clusters, resolution to see both*

Planck, ACT, SPT, ACTxBLAST, Herschel

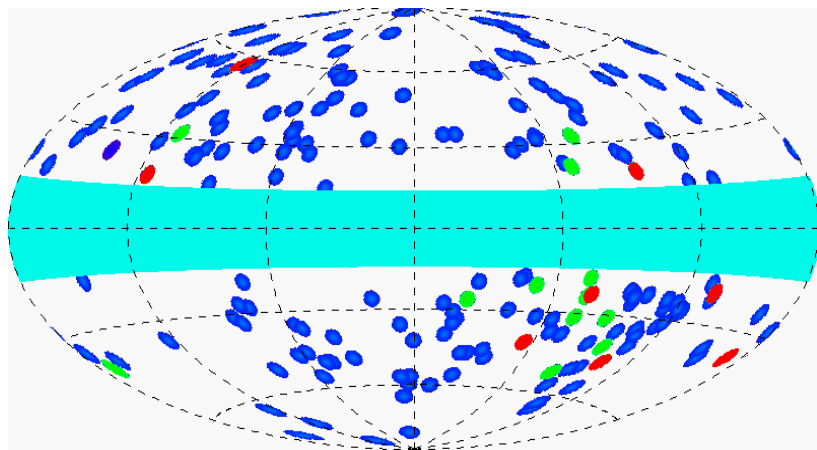
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**effect of energy injection / explosions- a big pre-COBE forecast issue IGM  $\sim$  ISM**

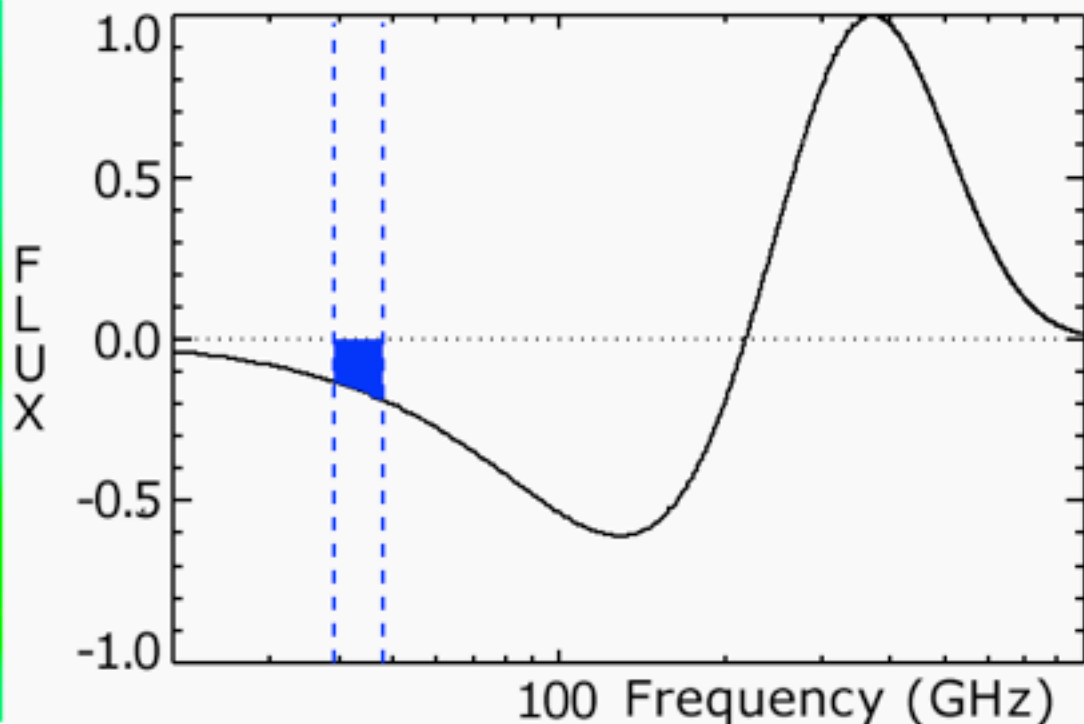
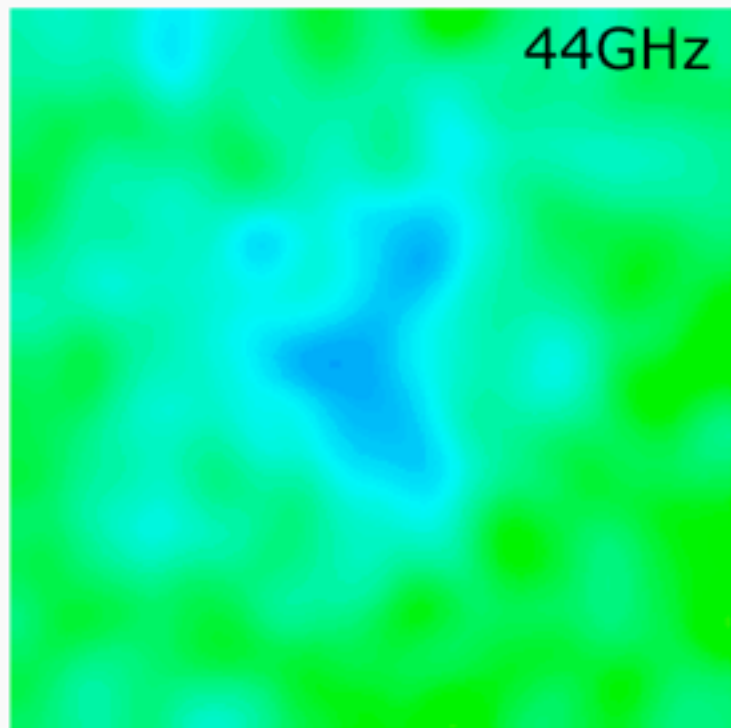
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## PlanckEXT, EXT=many observatories & expts enabling the astro

- **SZ - 189 SZ clusters. SZ scaling relations appear as expected for X-ray clusters (no deficit, assuming universal profile), apparent SZ deficit for optical clusters (jury out on cause, but seen in ACTxSDSS-LRGs as well)**
- CIB - clustering clearly detected at 217-857 GHz, with diminishing correlation as band separation increases. **imaged** Source model with halo model fits the spectra, claim one-halo dominates over Poisson at  $l=2000$ . (**BLAST, ACTxBLAST, Planck agree, Herschel a little higher, <bias>, source population uncertainty propagates into interpretation uncertainty.**)
- Spinning dust - AME clearly seen in Perseus and rho-Ophiuchus regions with a spectrum pulled out in excellent agreement with theory. a long journey with a great leap forward, draine & lazarian will be pleased.
- Radio src - counts consistent with ACT/SPT (at higher flux range), lower than de-Zotti model. Spectral steepening above 70 GHz.
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**ESZ 20 new + 169 in X/Opt cats**  
**(many new in SZ, Ethermal view)**  
 PlanckXMM dedicated time on newbies  
 ~95% reliable, validation, S/N ~ 6 cut  
 + cross-correlate with X/SDSS cats, Y-"M"  
 scaling OK in shape, puzzle in amp for  
 optical maxBCG/LRG  
 new SZ reported  
 by ACT, SPT, AMI, .. more coming



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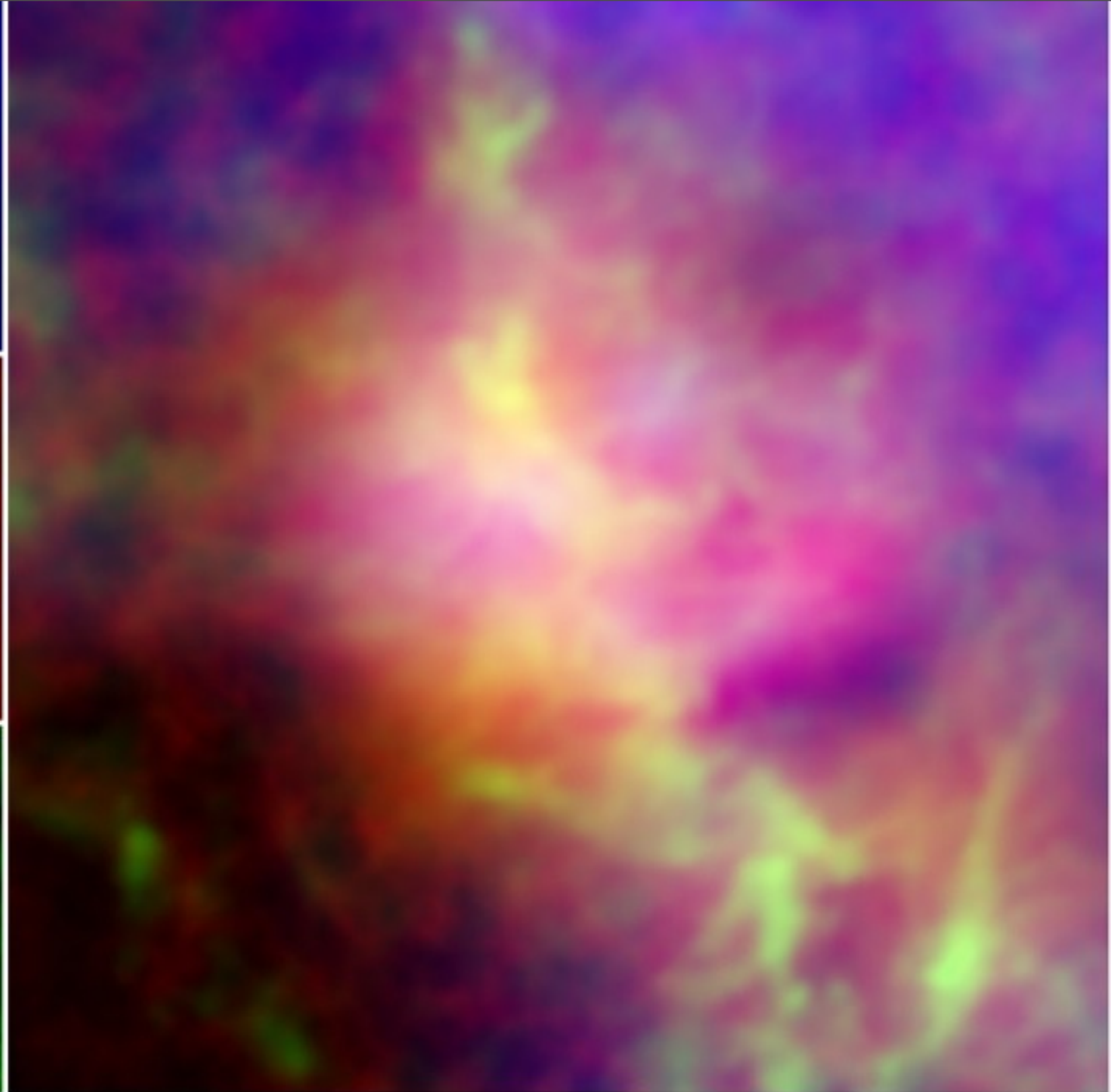
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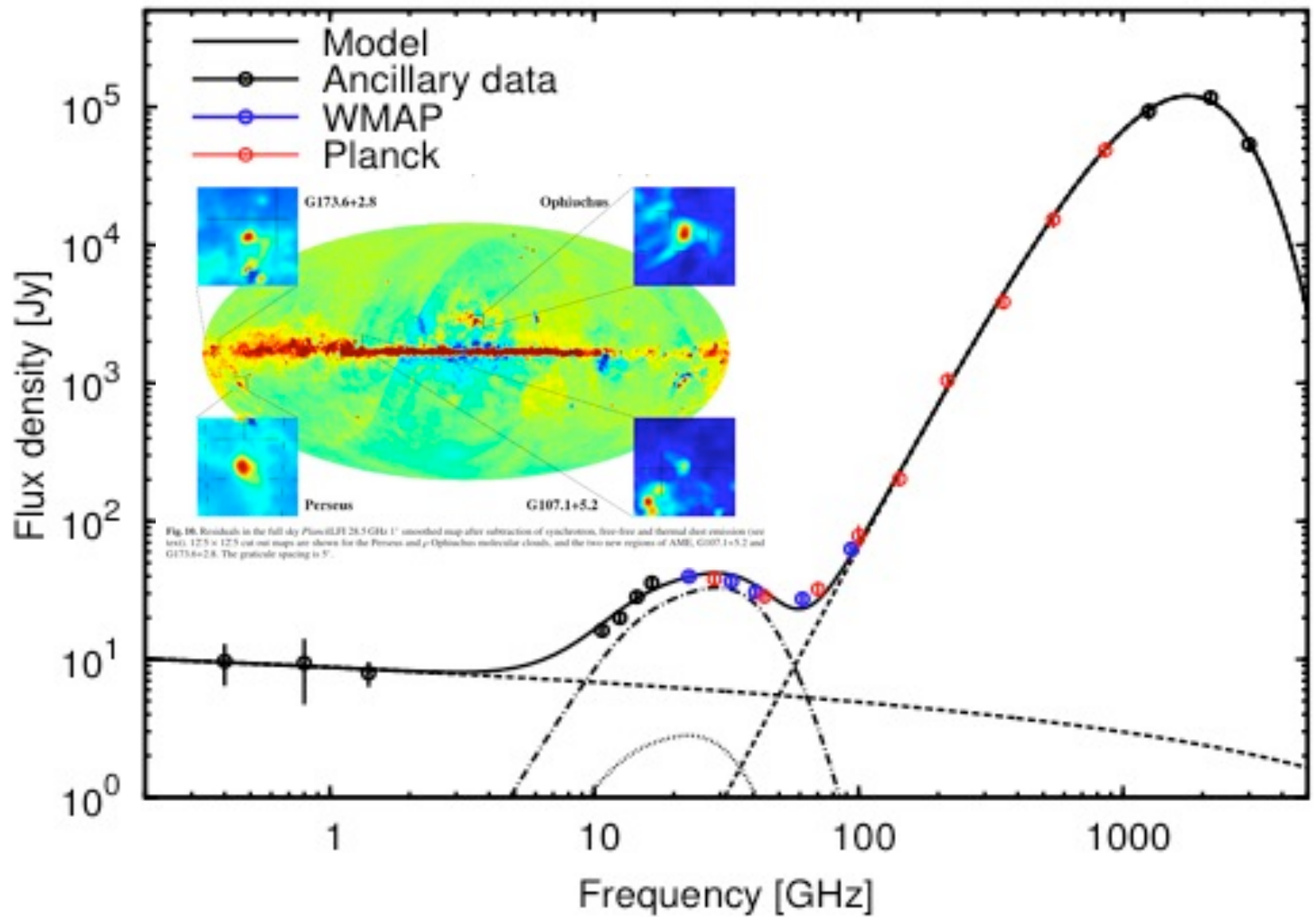
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**Radio 0.4 GHz**

**Planck 30 GHz**

**Planck 857 GHz**





**Fig. 4.** Spectrum of G160.26-18.62 in the Perseus molecular cloud. The

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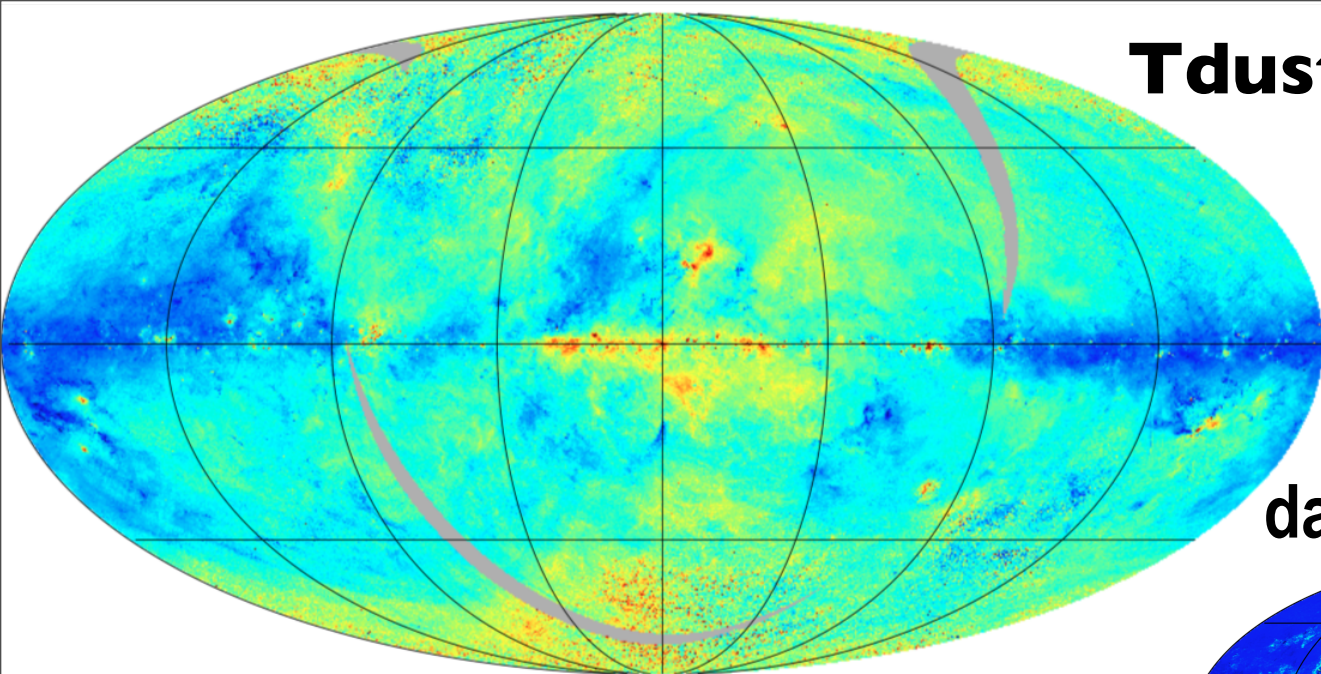
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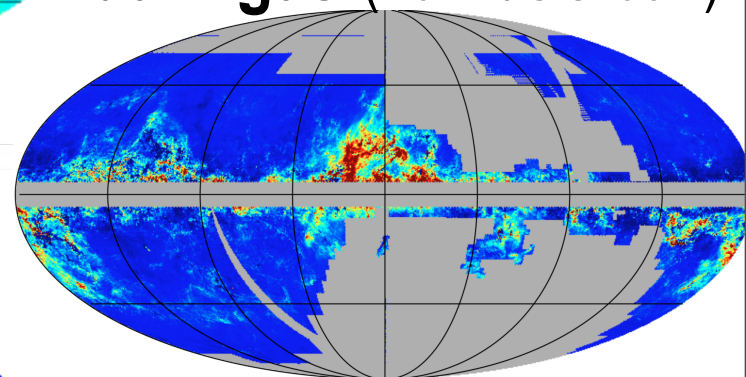
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**T<sub>dust</sub>**  $\beta$  fixed @1.8  
*Planck*+*IRAS*

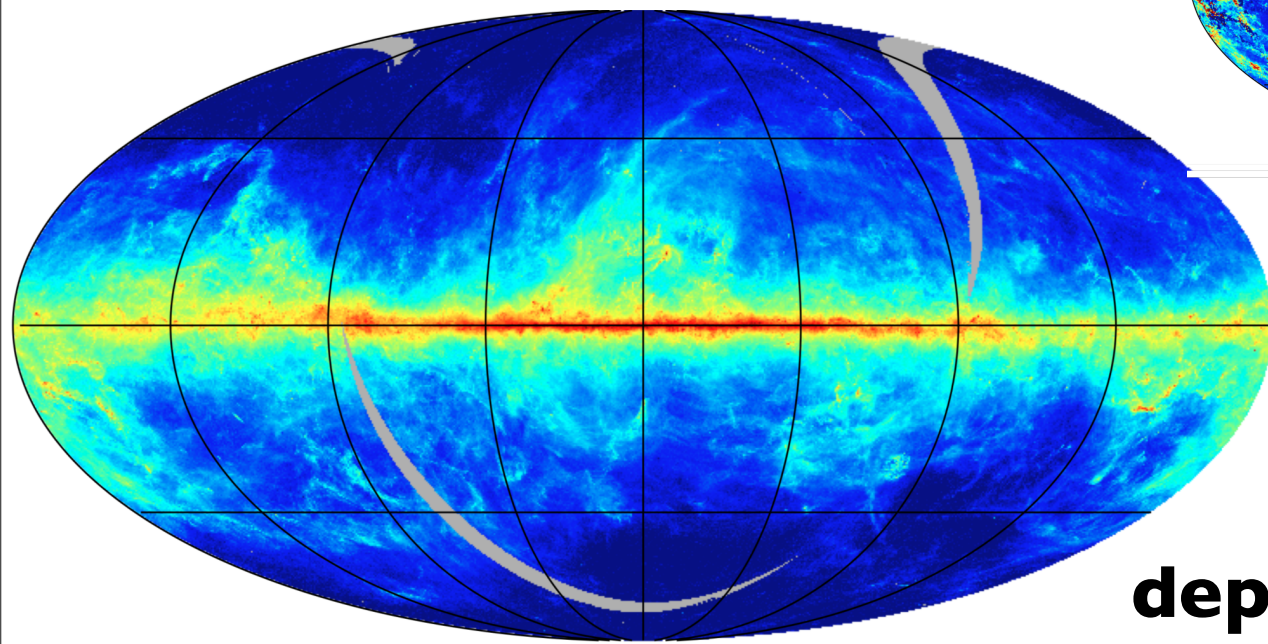



14.0  24.0 K

**dark gas** (no HI/CO corr)

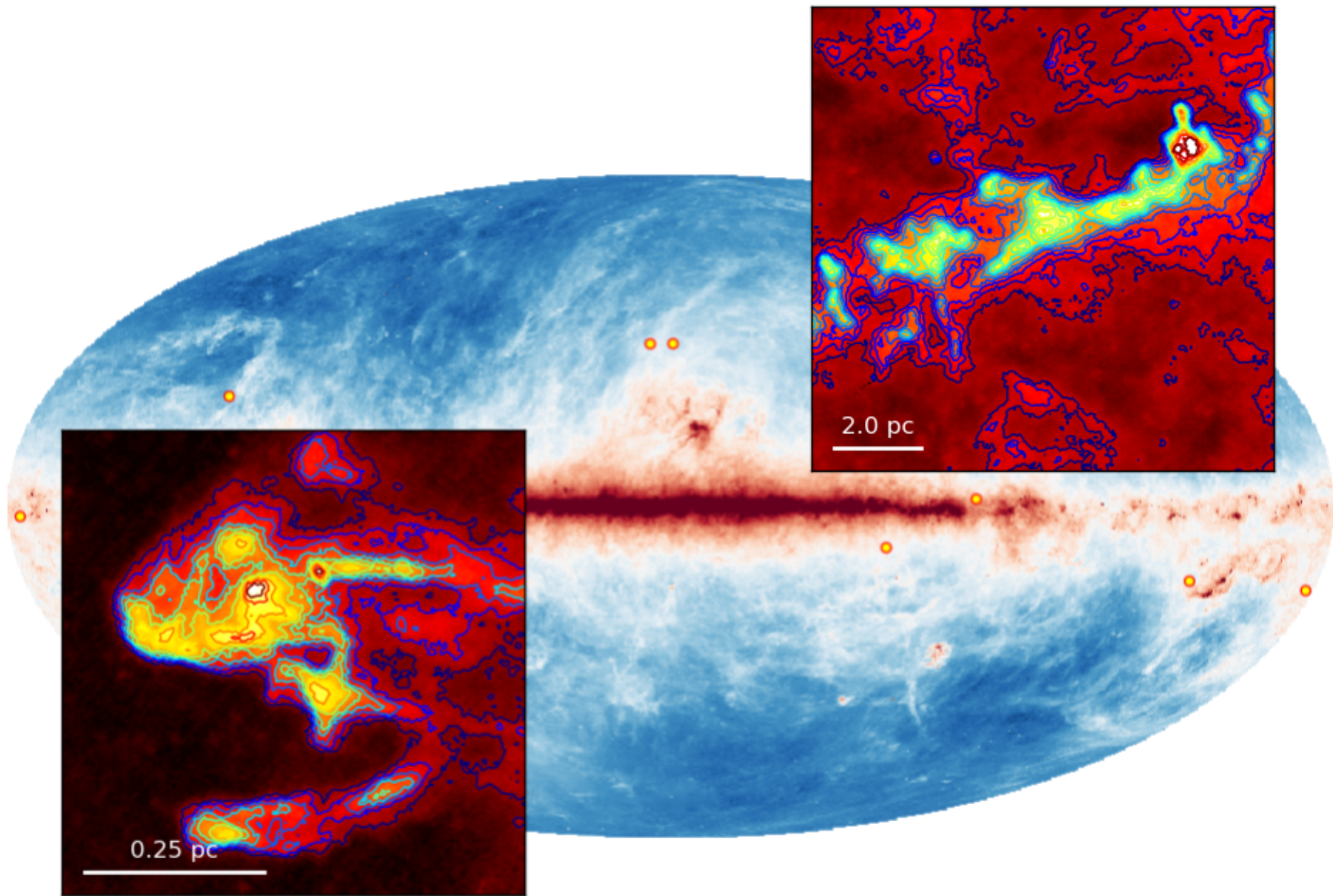


-0.50  3.0 10<sup>21</sup> Hcm<sup>-2</sup>



-5.3  -2.0

**depth T<sub>dust</sub>**



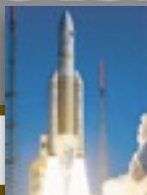
**IRAS**

**Planck**

**Herschel**

# the GALAXY WIDE WEB

Filaments permeate the ISM on all scales

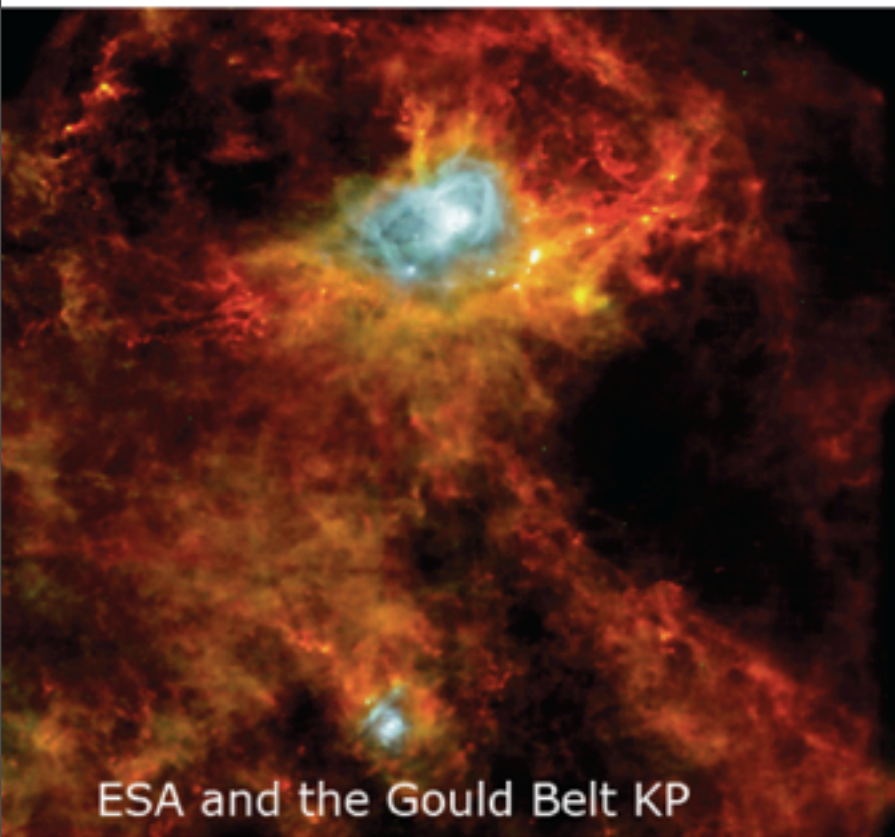


**Herschel**

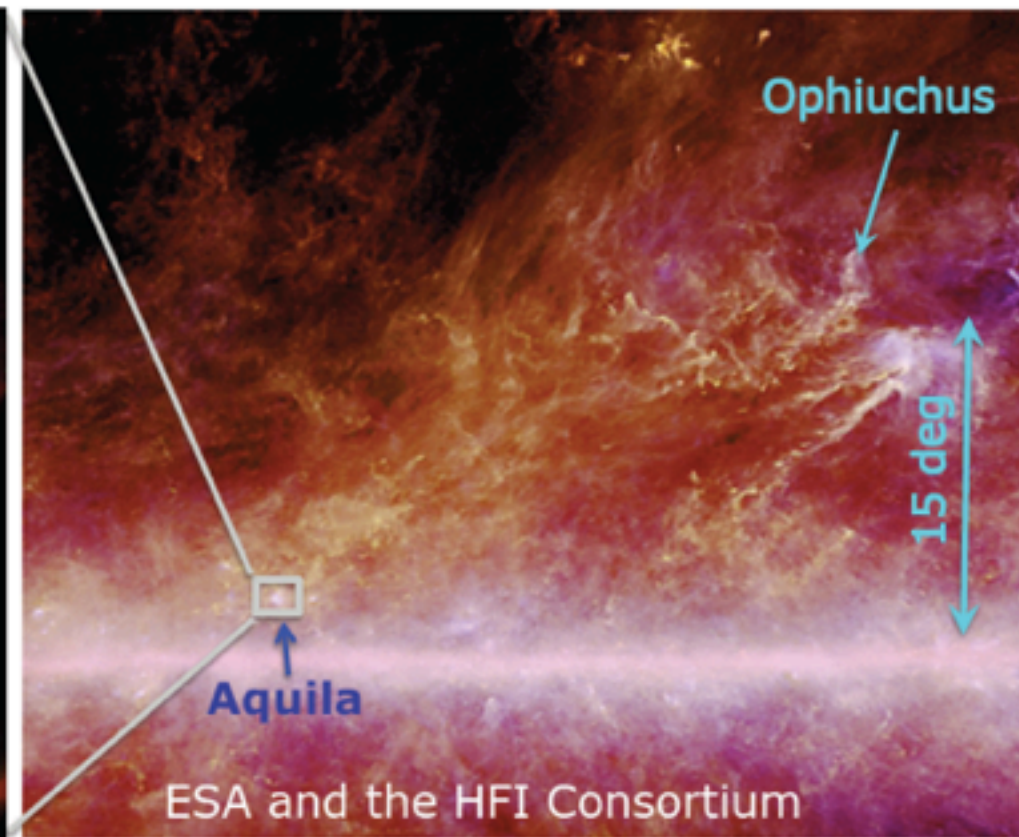
SPIRE 500  $\mu\text{m}$  + PACS 160/70  $\mu\text{m}$

**Planck**

HFI 540/350  $\mu\text{m}$  + IRAS 100  $\mu\text{m}$



ESA and the Gould Belt KP



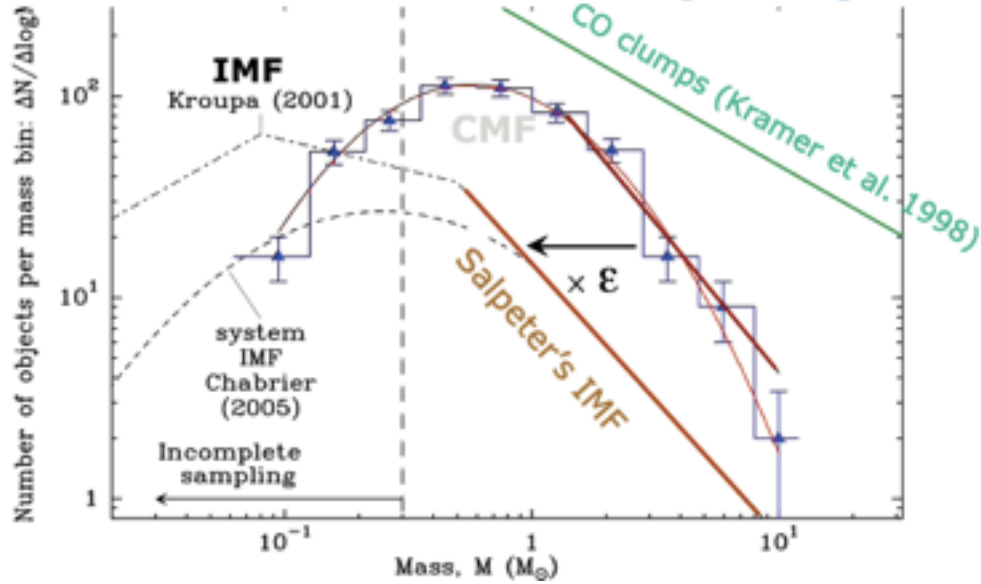
ESA and the HFI Consortium

Göran Pilbratt | Planck 2011: The mm & submm sky in the Planck era | Paris | 10 January 2011 | vg #16

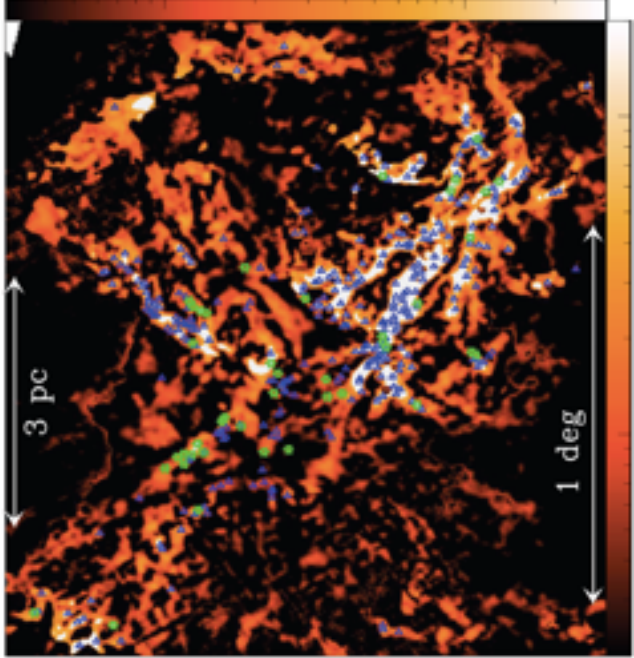
**Herschel ATLAS** is a key legacy survey of 550 sq deg, 300 sq deg & lots of science done



**Prestellar Core Mass Function (CMF) in Aquila Complex**



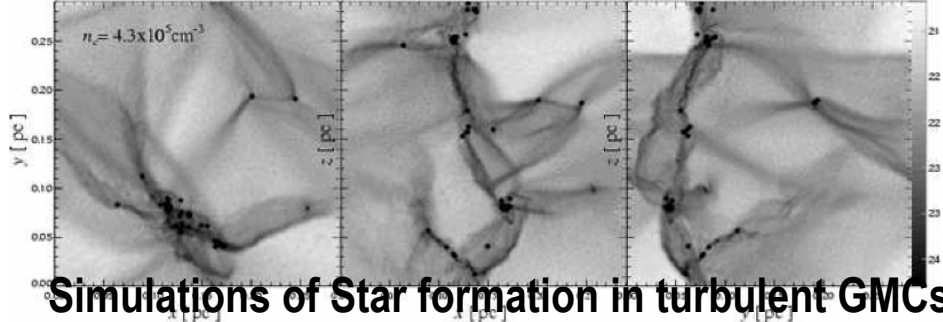
**Aquila curvlet  $N_{H_2}$  map ( $cm^{-2}$ )**



André et al. 2010, A&A special issue

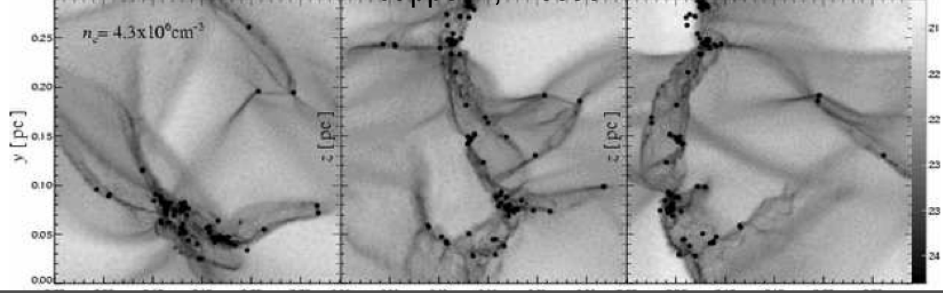
ISMer-cosmologist cross talk is good and increasing, stimulated by Planck et al

$n(M)dM$ , morphology of filaments, clustering/power spectra, “bulk/turbulent flows”  
**SIMPLICITY in COMPLEXITY?**  
 but so much chemistry etc



**Simulations of Star formation in turbulent GMCs**

Jappsen, Klessen



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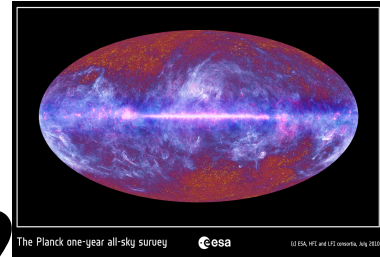
# gastrophysics

= gastrointestinal disorder? or



*interplanetary dust*

= gourmand's paradise?



in paris, the latter @planck2011

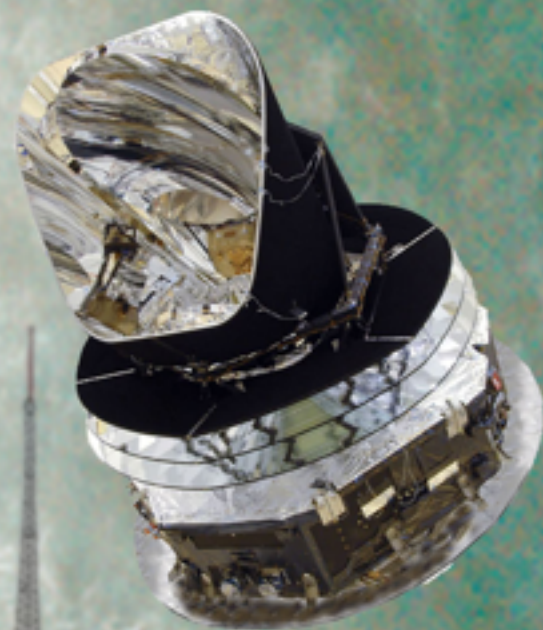


$\exists$  beauty in complex information, but  
how best to measure it - compress into  
fewer bits of high Quality (cf. entropy) -  
what art our science should/must be

**merci francois pajot, jean loup puget, the LOC, those who take care of us for registration, our patient AV friends, ... and Delphine Prival Catherine Cougrand, Stephane Caminade and many more. AND for the banquet venue - brilliant choice!!**

THE MILLIMETER AND SUBMILLIMETER SKY  
IN THE PLANCK MISSION ERA

**PARIS, FRANCE**  
JANUARY 10-14 2011  
CITÉ DES SCIENCES



[HTTP://WWW.PLANCK2011.FR](http://www.planck2011.fr)