



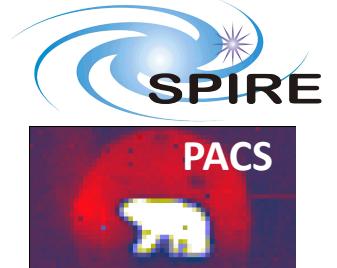
HERSCHEL MAP-MAKING WORKSHOP  
ESAC, Madrid, Jan 30 2013

# HOBYS: data reduction, map-making, and source extraction

Martin Hennemann – HOBYS consortium  
AIM Paris-Saclay, Service d'Astrophysique, CEA Saclay

<http://hobys-herschel.cea.fr>





# HOBYs Framework

F. Motte, A. Zavagno, S. Bontemps et al. (2010):

**HOBYs** – The Herschel imaging survey of OB Young Stellar objects

Aim: Identification & characterisation of OB star precursor cores, their cloud environment & feedback effects

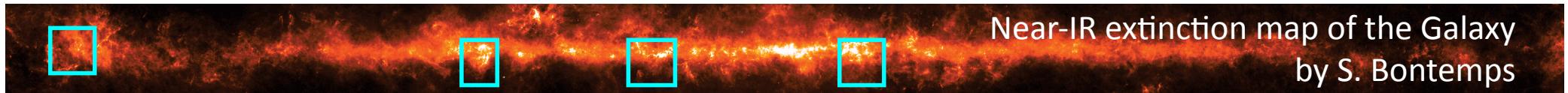
Programme: FIR & submm mapping of massive galactic cloud complexes out to 3 kpc distance (+ several well-behaved HII regions)

Team: SPIRE consortium SAG3 “Star formation”

N. Schneider, P. Didelon, T. Hill, D. Arzoumanian, Q. Nguyen Luong, Ph. André, T. Csengeri, A. Men'shchikov, V. Minier, N. Peretto, A. Abergel, L. D. Anderson, M. Attard, **Z. Balog**, J.-P. Baluteau, M. Benedettini, J.-Ph. Bernard, P. Cox, L. Deharveng, D. Elia, C. Fallscheer, J. Di Francesco, A.-M. di Giorgio, M. Griffin, P. Hargrave, M. Huang, J. Kirk, **V. Könyves**, S. Leeks, J. Z. Li, **A. Marston**, P. Martin, S. Molinari, G. Olofsson, P. Palmeirim, P. Persi, M. Pestalozzi, S. Pezzuto, D. Polychroni, M. Reid, **A. Rivera**, H. Roussel, D. Russeil, K. Rygl, S. Sadavoy, P. Saraceno, M. Sauvage, T. Sousbie, E. Schisano, B. Sibthorpe, L. Spinoglio, S. Stickler, L. Testi, **D. Teyssier**, **R. Vavrek**, D. Ward-Thompson, G. White, C. Wilson, A. Woodcraft



# HOBYS: A large-scale imaging survey



Near-IR extinction map of the Galaxy  
by S. Bontemps

Image (all) cloud complexes forming OB-type stars <3 kpc from the Sun: 10 regions

~250 high-mass protostars are expected

statistics to study the precursors of stars up to  $20 M_{\odot}$

Wide-field PACS/SPIRE imaging (70, 160, 250, 350, 500  $\mu\text{m}$ ) with 20"/sec

HPBW = 6"-36.9" @ 0.7-3 kpc => 0.05-0.3 pc cloud structures

Complementarity:

Progenitors of low-mass stars (~0.02 pc): Gould Belt Survey (André et al.), EPOS  
low-mass (Krause/Launhardt et al.)

Precursors of OB star clusters (1 pc clumps?): Hi-GAL (Molinari et al.)

Progenitors of OB stars in IRDCs/ISOSS: EPOS high-mass (Krause/Ragan et al.)



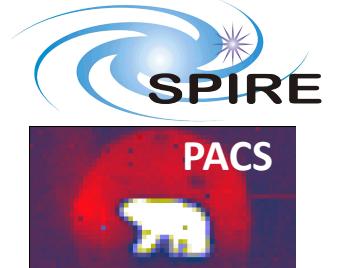
# HOBYS: A large-scale imaging survey

| Region       | Area (deg <sup>2</sup> ) | Dist (kpc) | SPIRE+PACS Time (hr) | People                    |
|--------------|--------------------------|------------|----------------------|---------------------------|
| Vela         | 3.1                      | 0.7        | 13                   | Giannini+, Hill+, Minier+ |
| Mon R1-R2    | 2.0                      | 0.8        | 15                   | Raynor+, Didelon+, ...    |
| Rosette      | 1.5                      | 1.5        |                      |                           |
| Cygnus X     | 6                        | 1.4        | 25.5                 | ...                       |
| M16/M17/Sh40 | 2.5                      | 1.7        | 10.5                 | White+, Hill+             |
| NGC 6334     | 1.7                      | 1.7        | 7                    | Russeil+, Tige+           |
| NGC 6357     | 1.7                      |            | 7                    |                           |
| W3/KR140     | 1.5                      | 2.2        | 6.5                  | Martin, Rivera+           |
| NGC 7538     | 0.6                      | 2.8        | 2.5                  | Di Francesco, Fallscheer+ |
| W48          | 3.9                      | 3.0        | 16.5                 | Rygl, Nguyen Luong+       |

HII regions displaying evidence of triggered star formation:

Sh104, RCW79, RCW82, RCW120, RCW71, AFGL4029, IRAS16132-5039,  
Sh241, M16 under responsibility of Marseille & HSC





# HOBYS data reduction

Close interaction with SPIRE & PACS ICCs

PACS: HIPE script initially developed by M. Sauvage

Second order deglitching in chunks (Implementation by H. Aussel)

HP filtering with filter width = scan leg length OR Export for  
Scanamorphos

SPIRE: HIPE script developed by P. Panuzzo and N. Schneider

Pipeline tasks and Destriper

Compared to HGBS:

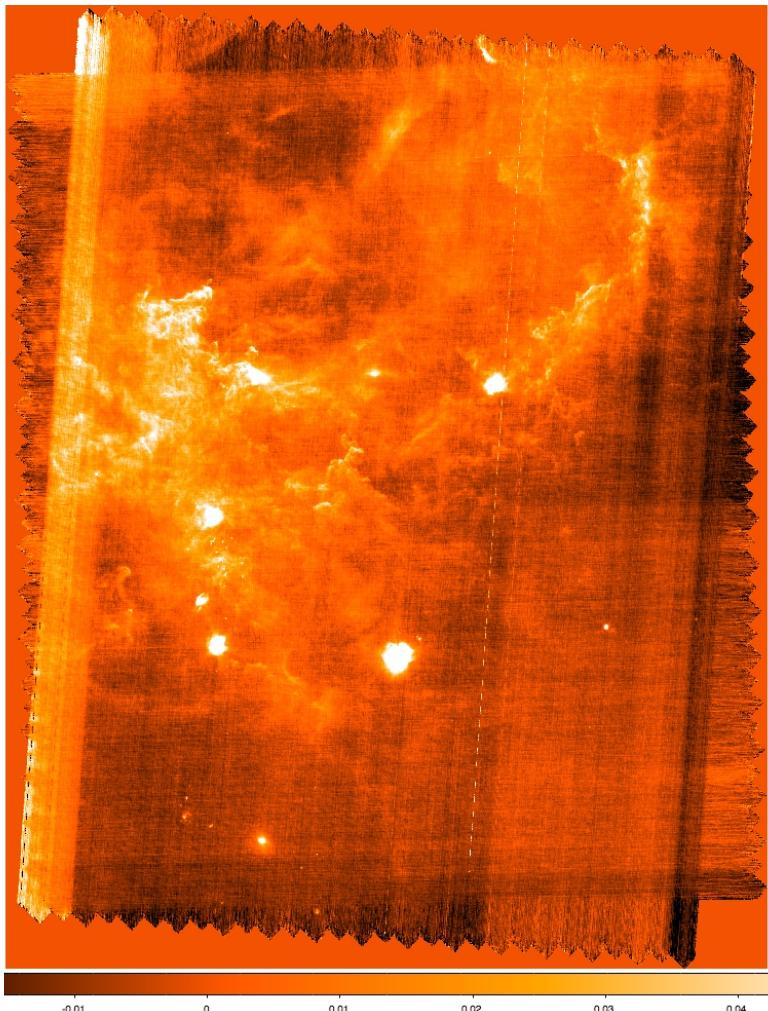
Scanning at 20"/s: less apparent problems

Additional saturation observations/non-linearity problems



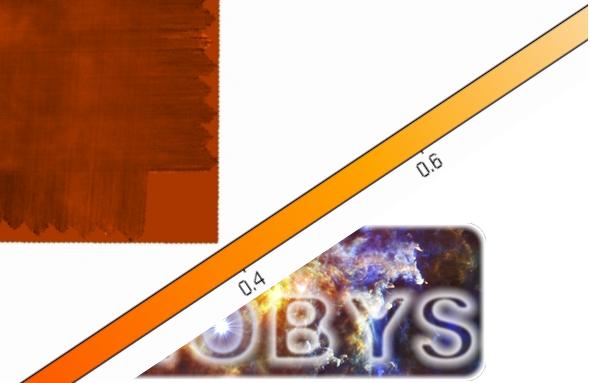
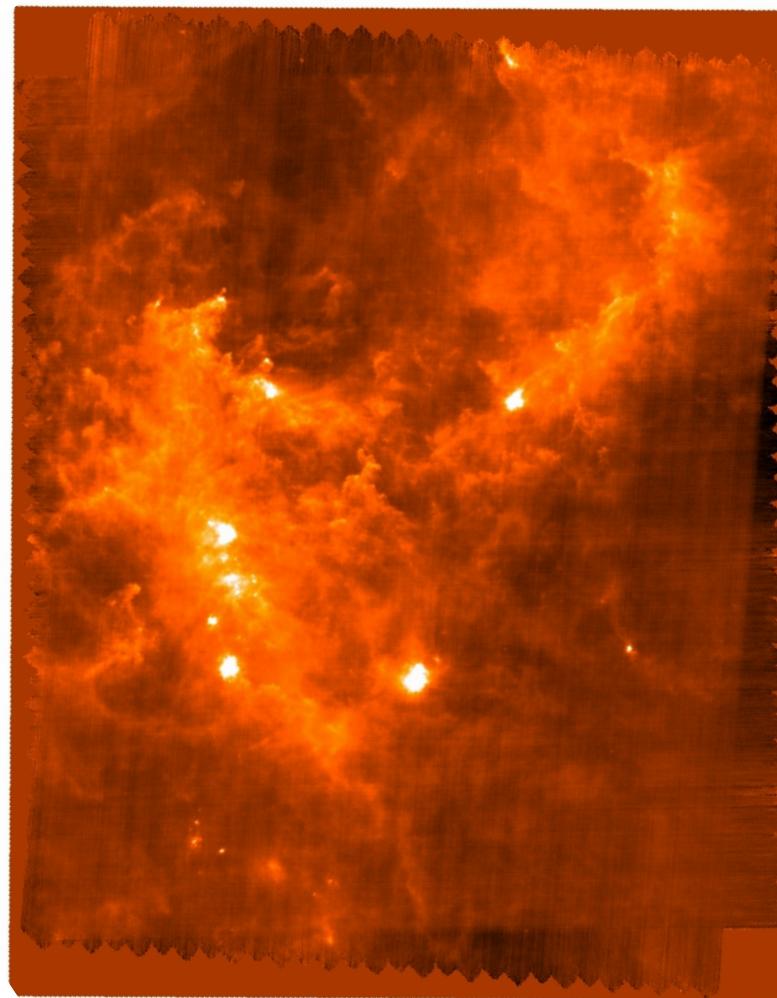
# PACS SDP map evolution: Rosette

PACS 70um MADMap



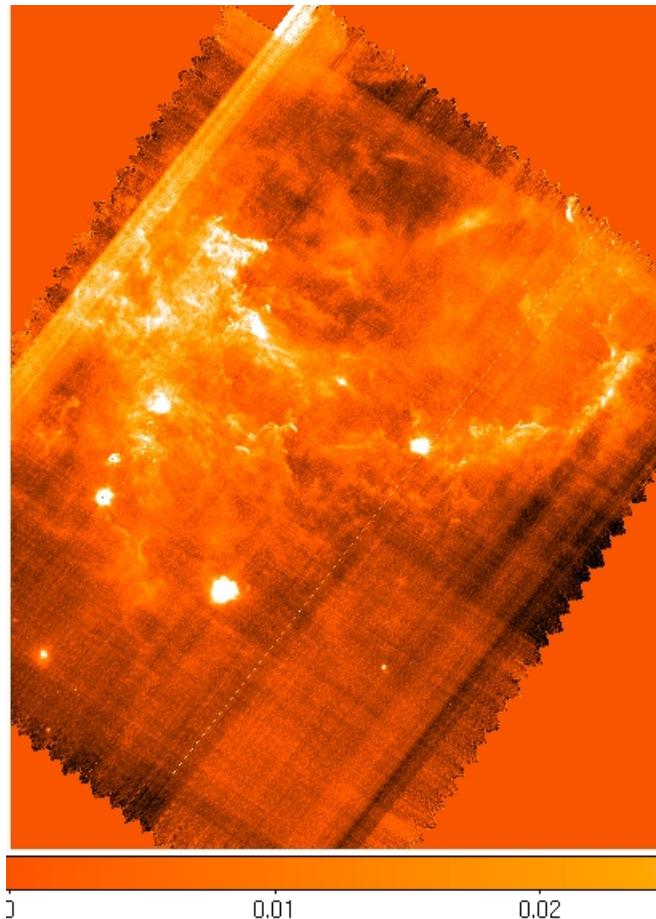
November 19, 2009

PACS 160um MADMap



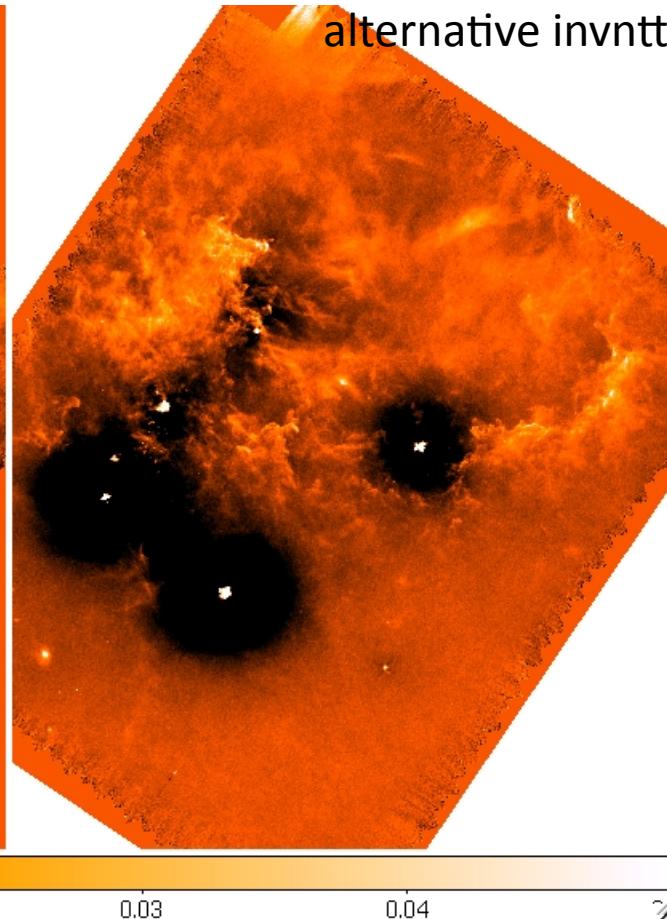
# PACS SDP map evolution: Rosette

PACS 70um photProject



PACS 70um MADMap

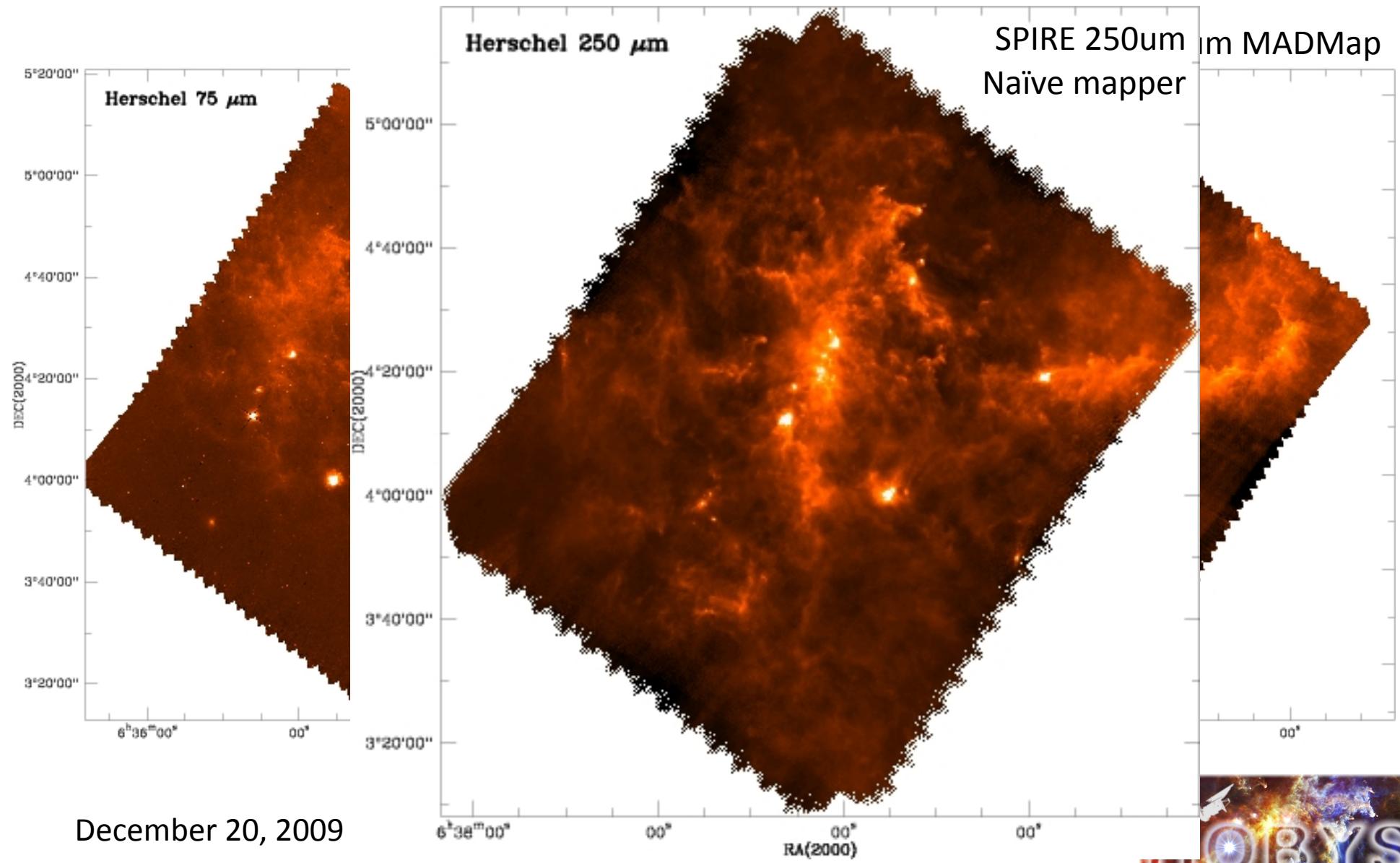
alternative invntt



November 24, 2009

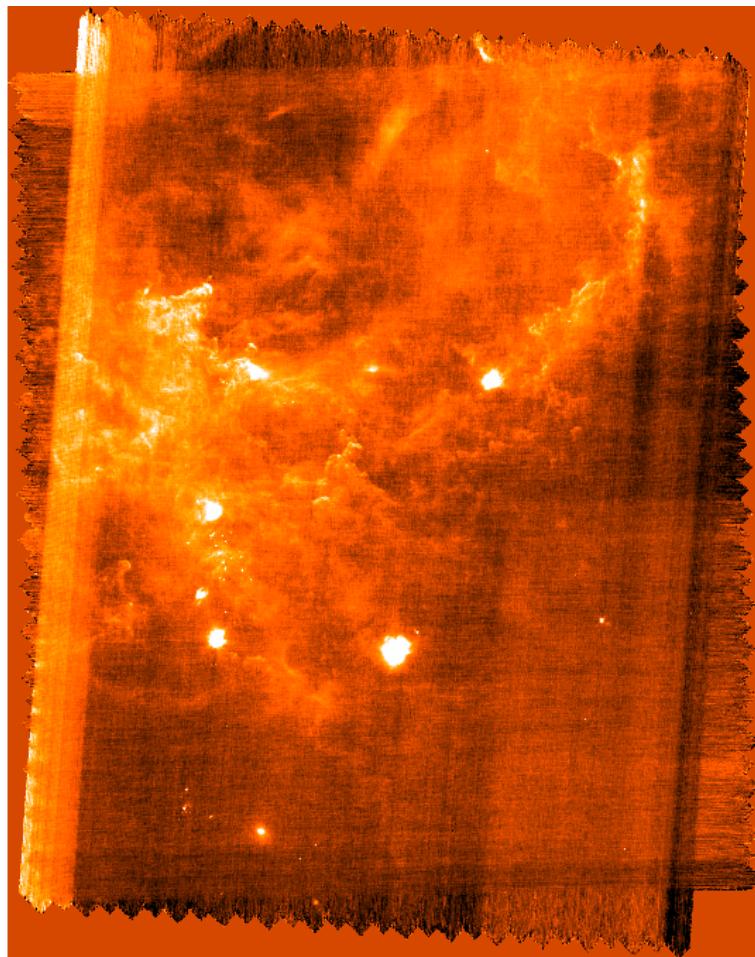


# PACS SDP map evolution: Rosette

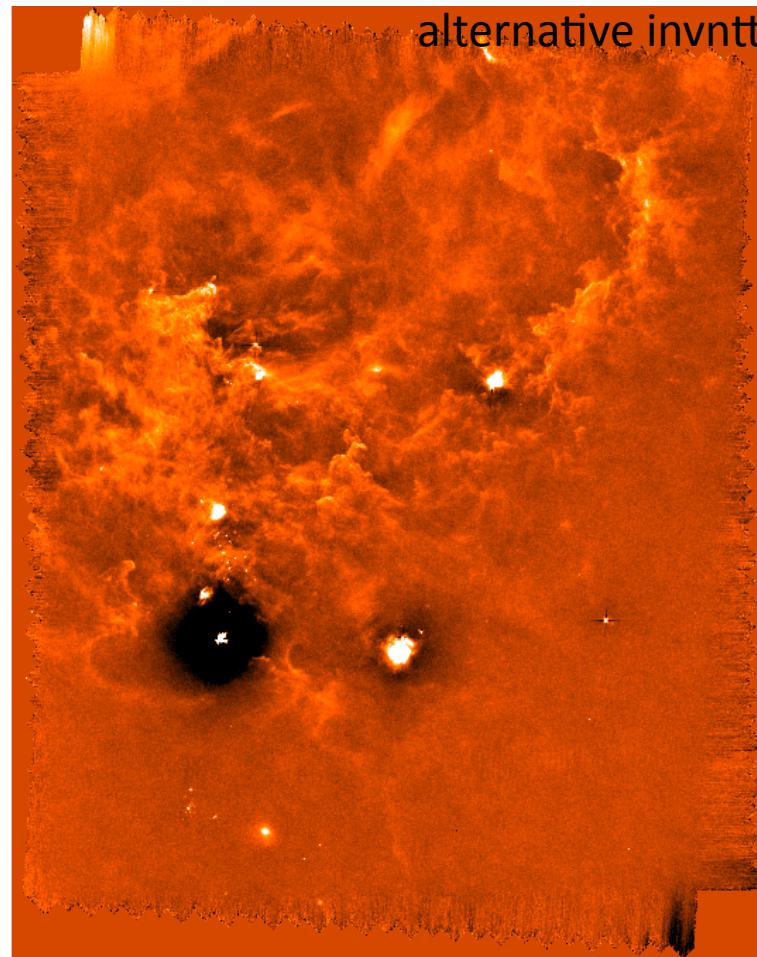


# PACS SDP map evolution: Rosette

PACS 70um L2-deglitching MADMap



PACS 70um L2-deglitching MADMap

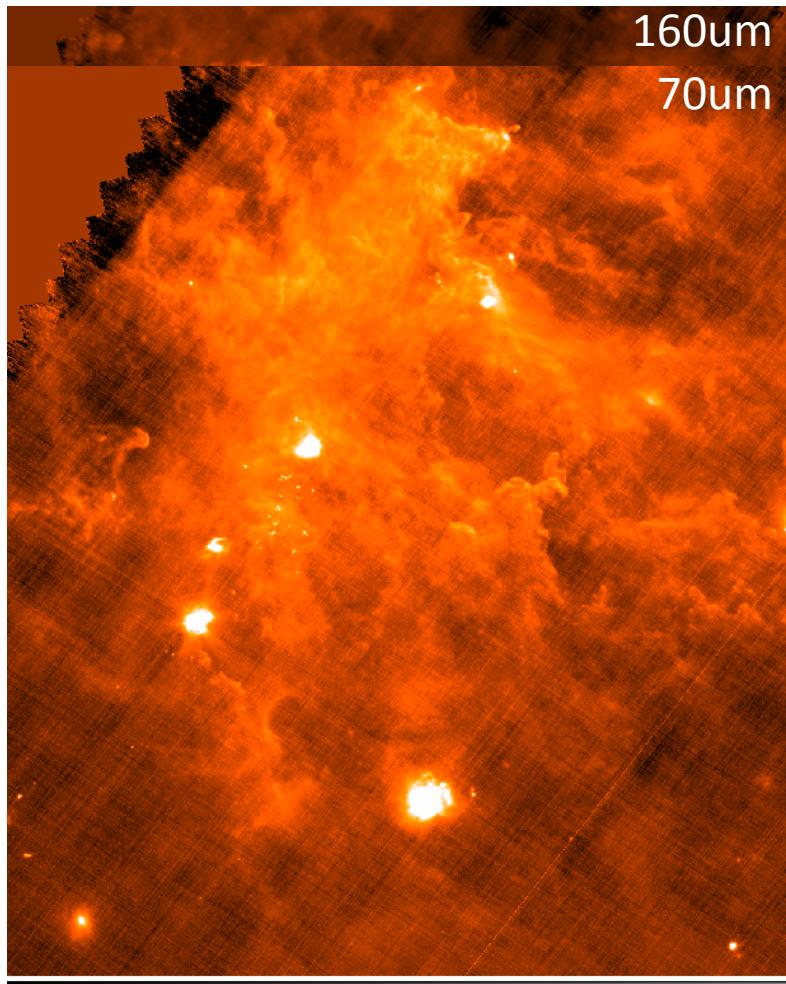


January 6, 2010

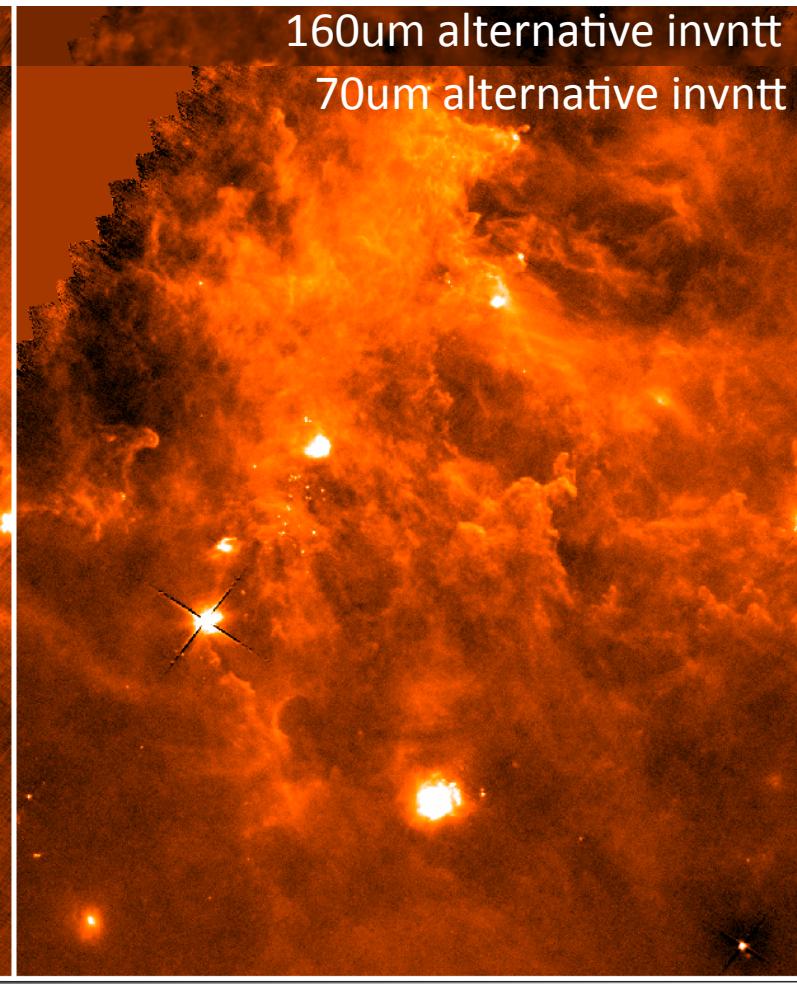


# PACS SDP map evolution: Rosette

PACS L2-deglitching photProject



PACS L2-deglitching MADMap

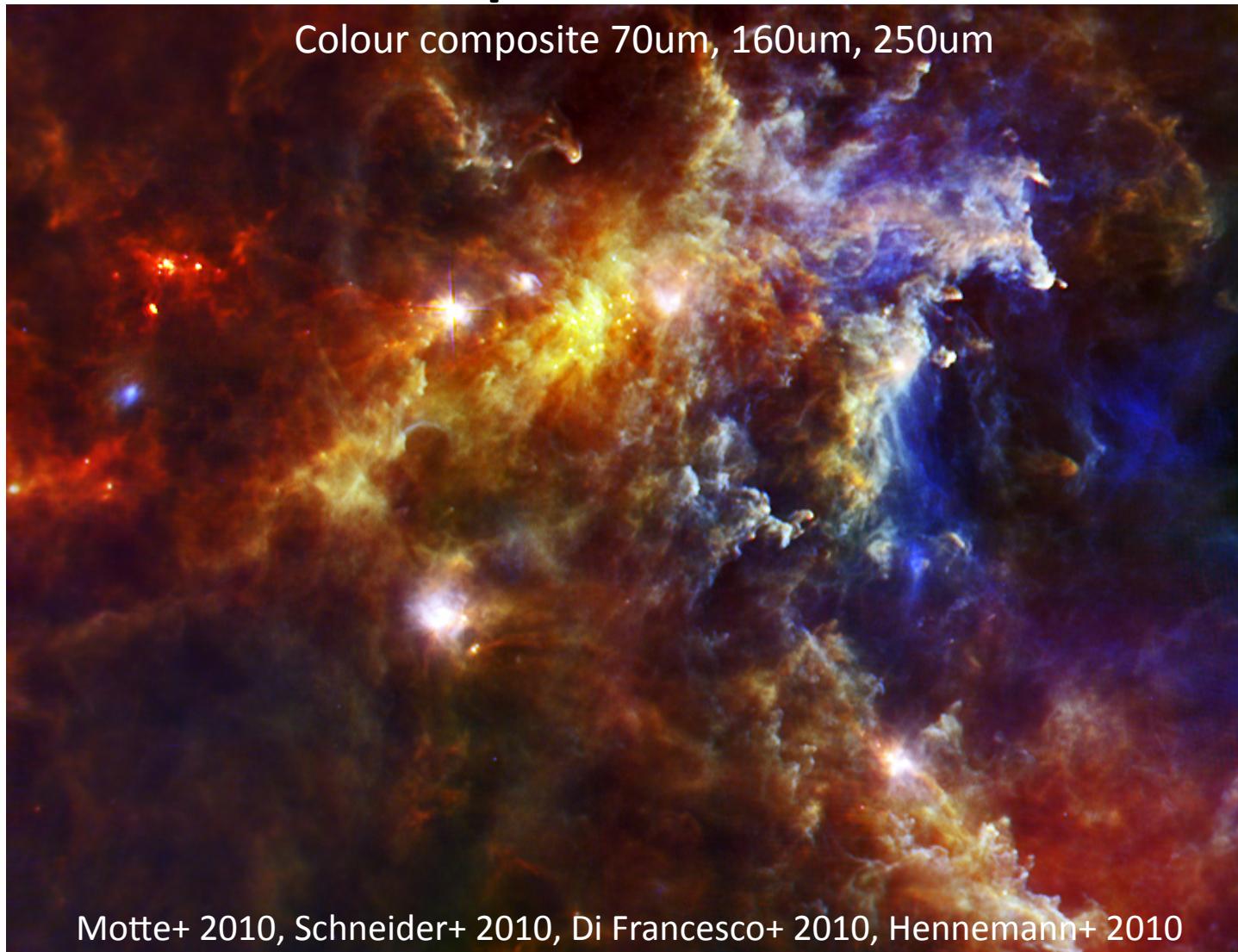


February 5, 2010



# PACS SDP map evolution: Rosette

Colour composite 70um, 160um, 250um



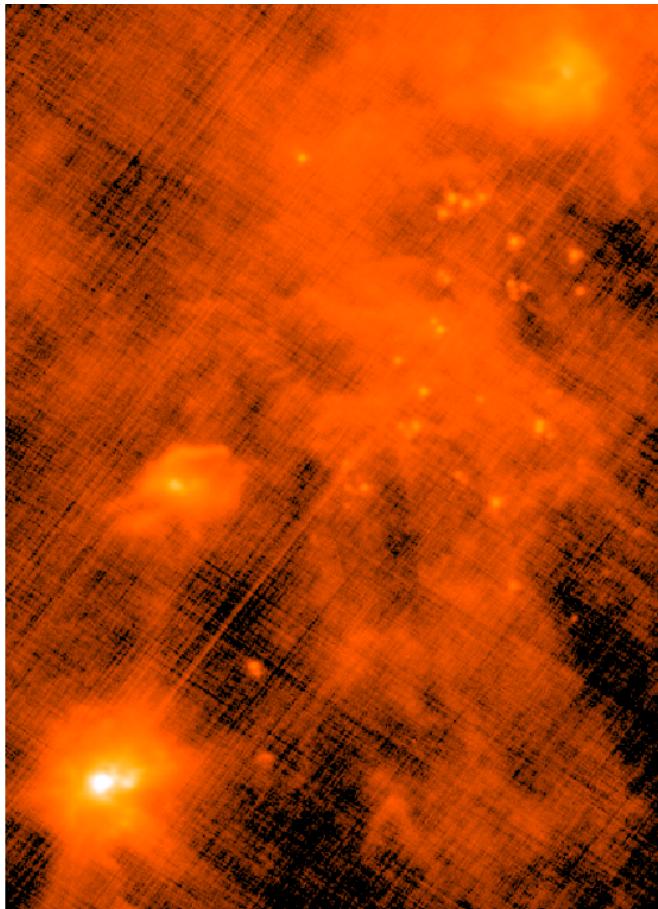
Motte+ 2010, Schneider+ 2010, Di Francesco+ 2010, Hennemann+ 2010

March 2010

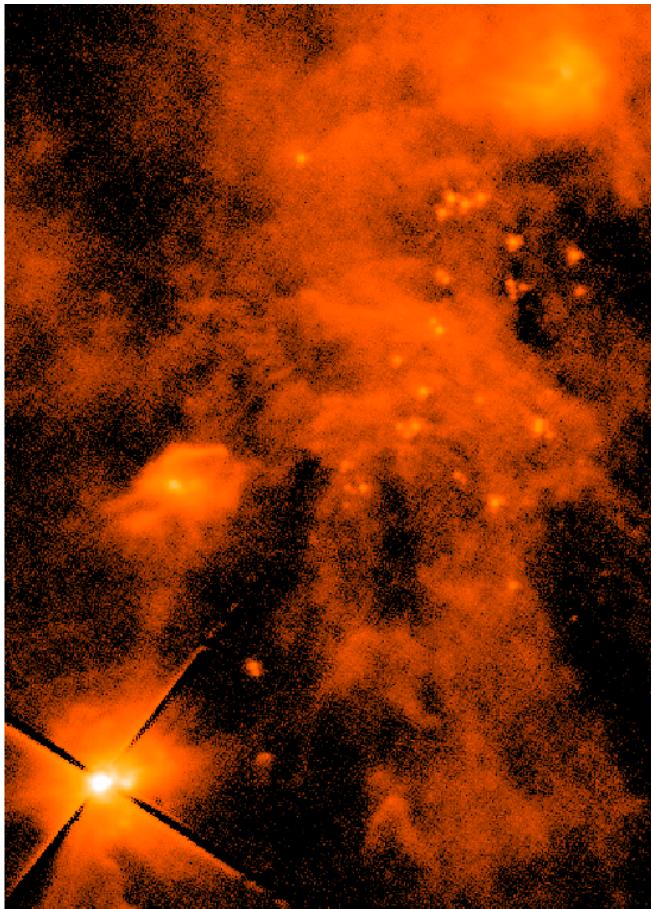


# PACS SDP map evolution: Rosette

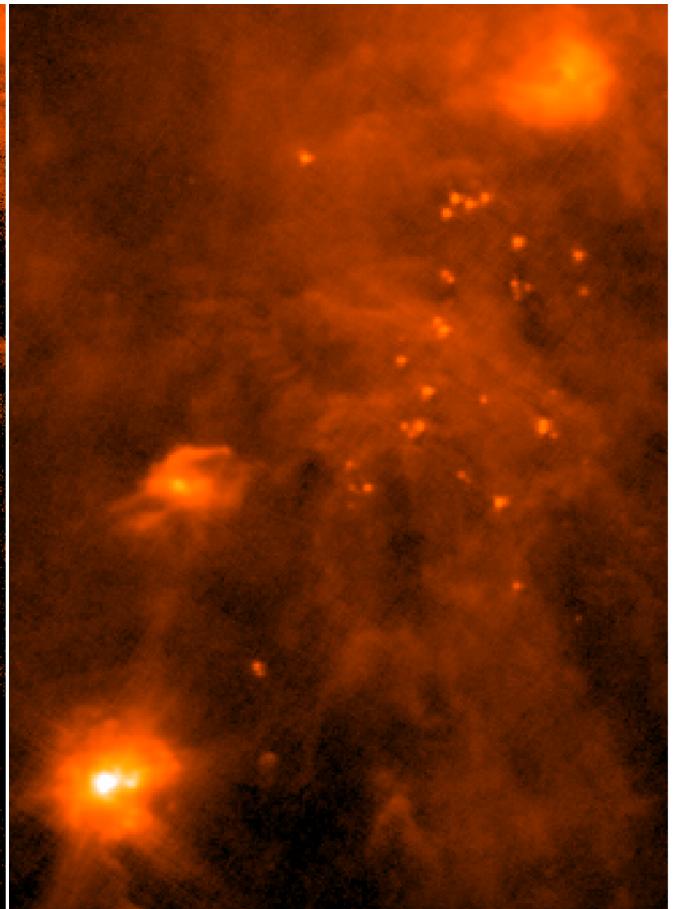
PACS 70um photProject



PACS 70um MADMap



PACS 70um scanamorphos



July 14, 2010: Storm of the Bastille

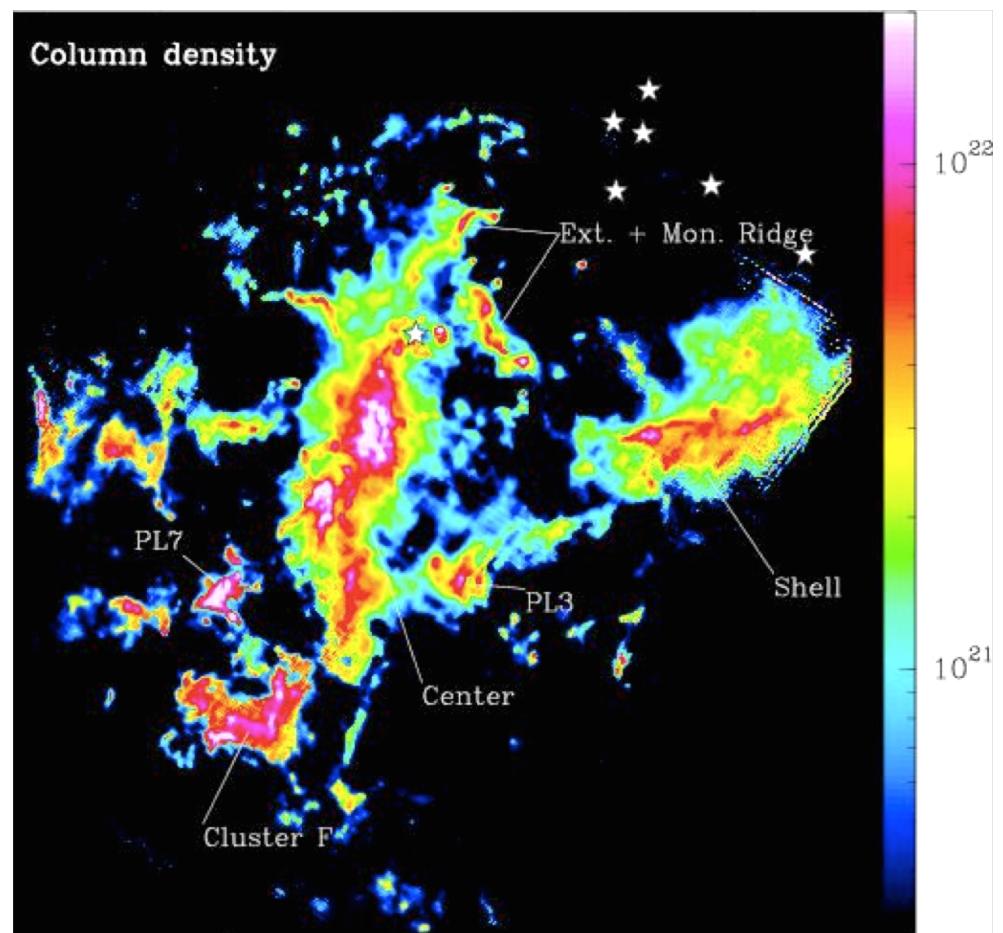
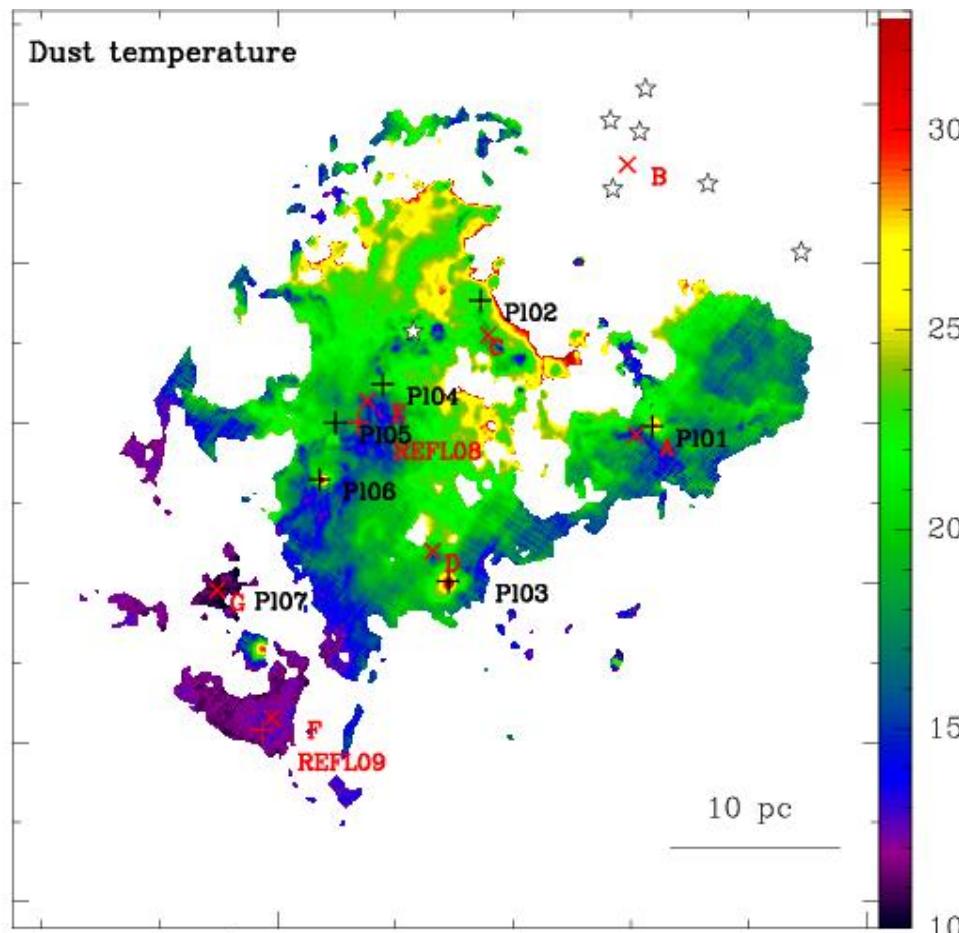


# Dust temperate & Column density

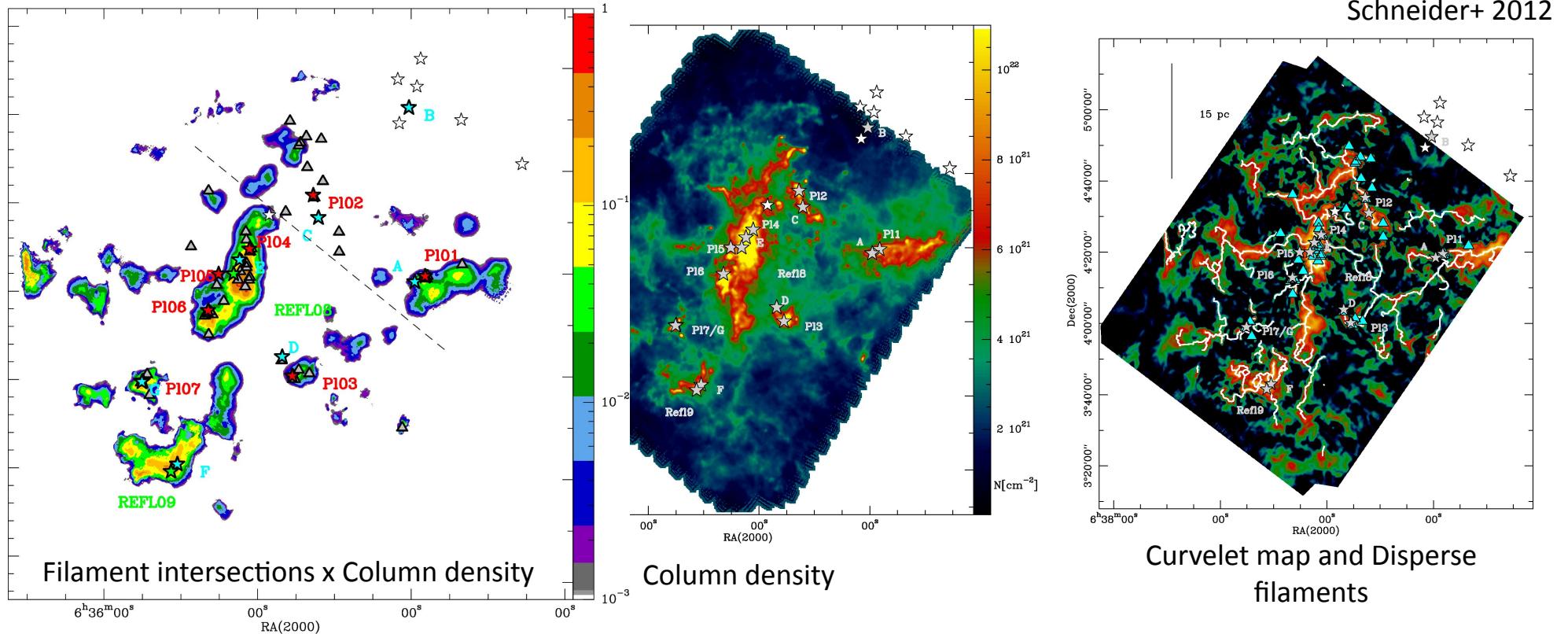
Zero offsets from model using PLANCK + IRAS by J.-Ph. Bernard+ 2010

Schneider+ 2010: Modified blackbody fitting pixel-by-pixel to 160 – 350/500um

Temperature (30 K to 10 K) gradient from HII region into cloud



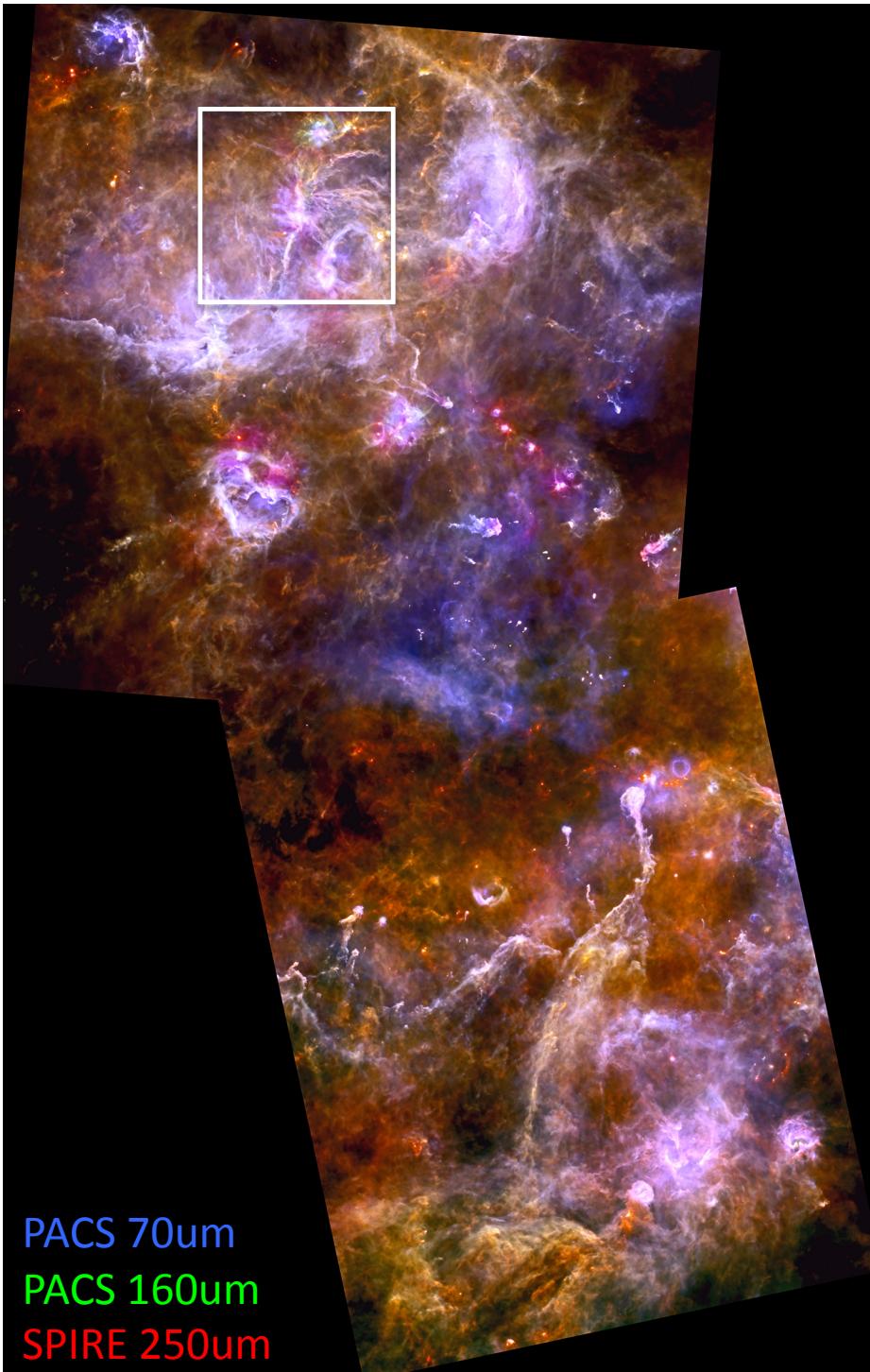
# Filamentary structure in the Rosette Molecular cloud



Massive stars/clusters form where *filaments merge* (Dale & Bonnell 2011, 2012)

Radiation has **little impact** on dense gas because photo-ionizing flux is absorbed





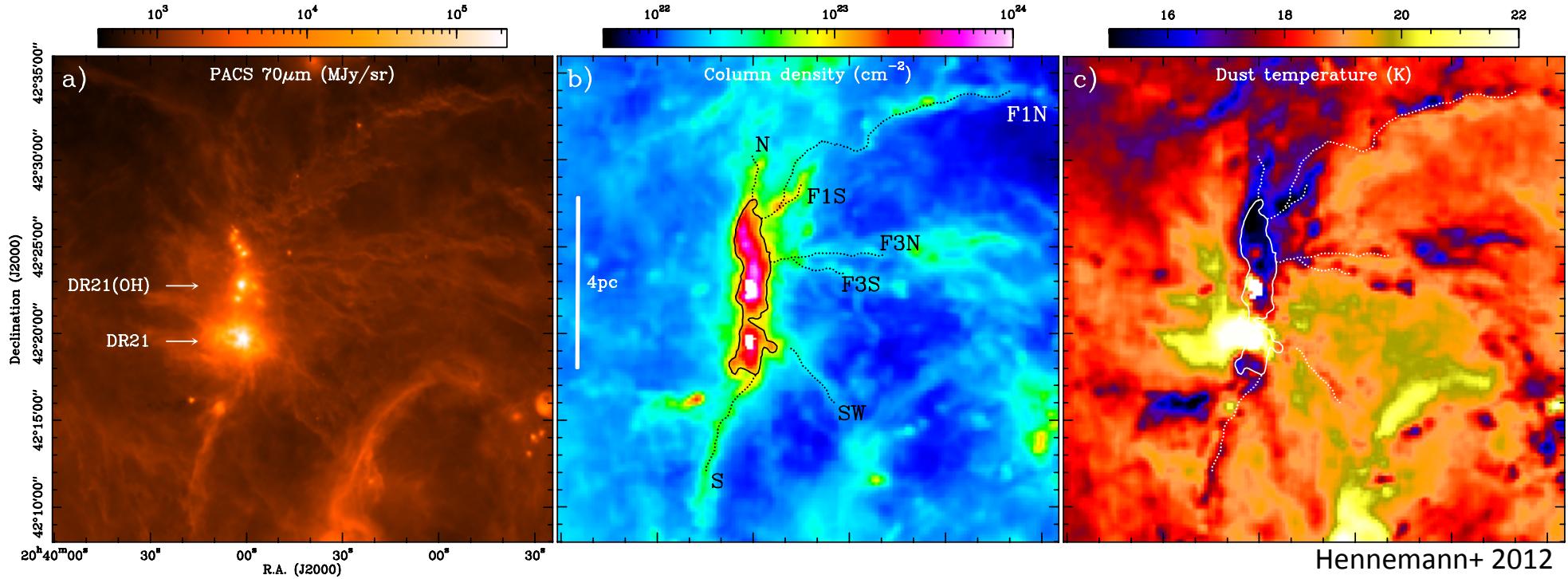
# Cygnus X: DR21 ridge

Most massive structure in Cygnus X at 1.4 kpc

(... Schneider+ 2006/2010, Motte+ 2007, Roy+ 2011, Rygl+ 2012)



# Sub-filaments accreting onto the ridge



70um: filamentary streamers (Marston+ 2004)

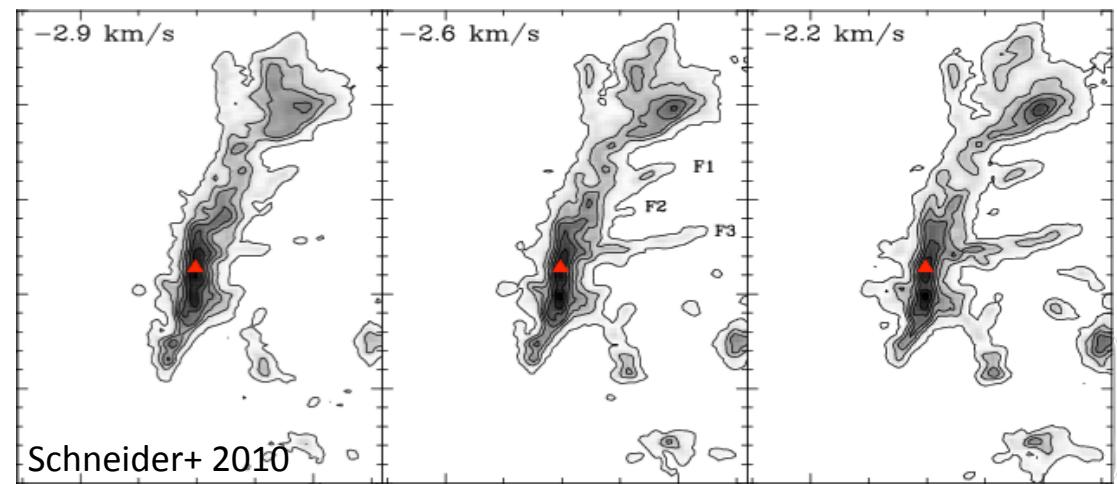
$^{13}\text{CO}(1-0)$  by Schneider+ 2010:

3 sub-filaments with velocity gradients

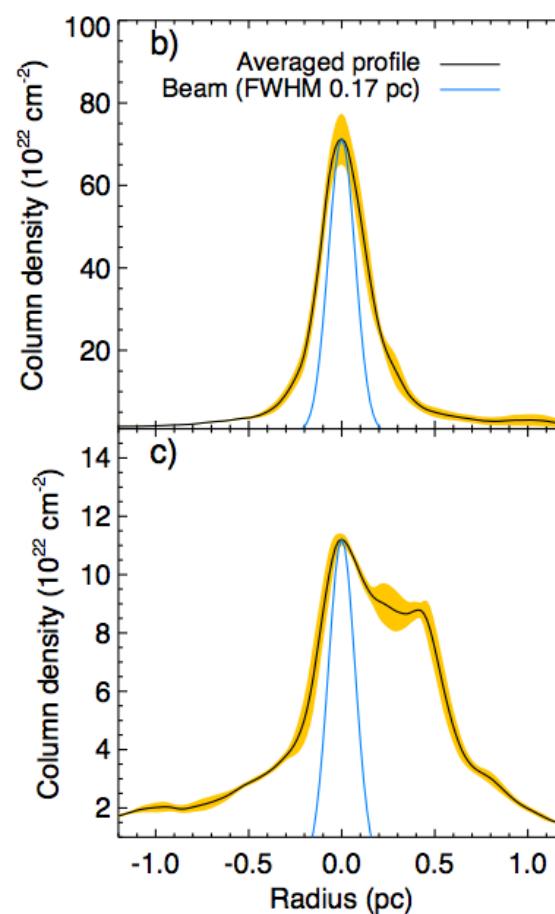
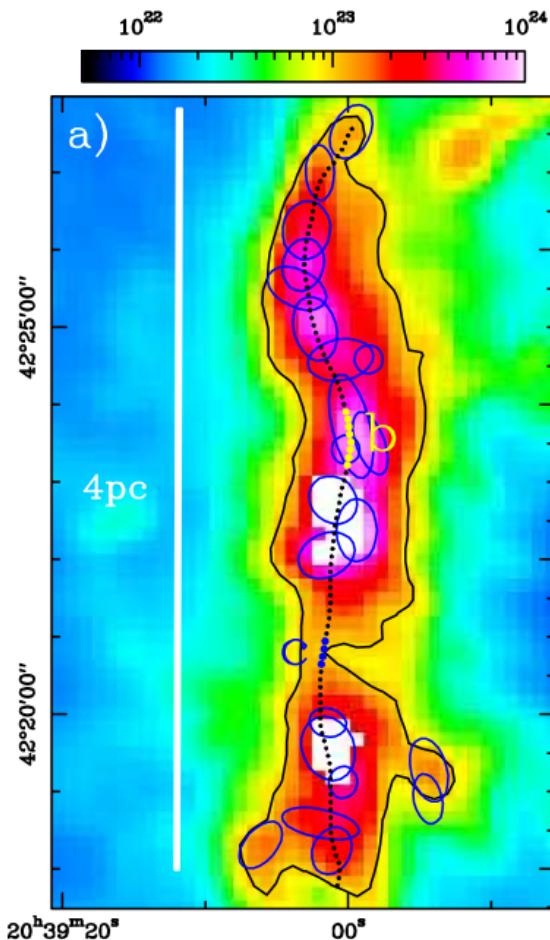
F3 connected to DR21(OH) clump

Herschel → column density:

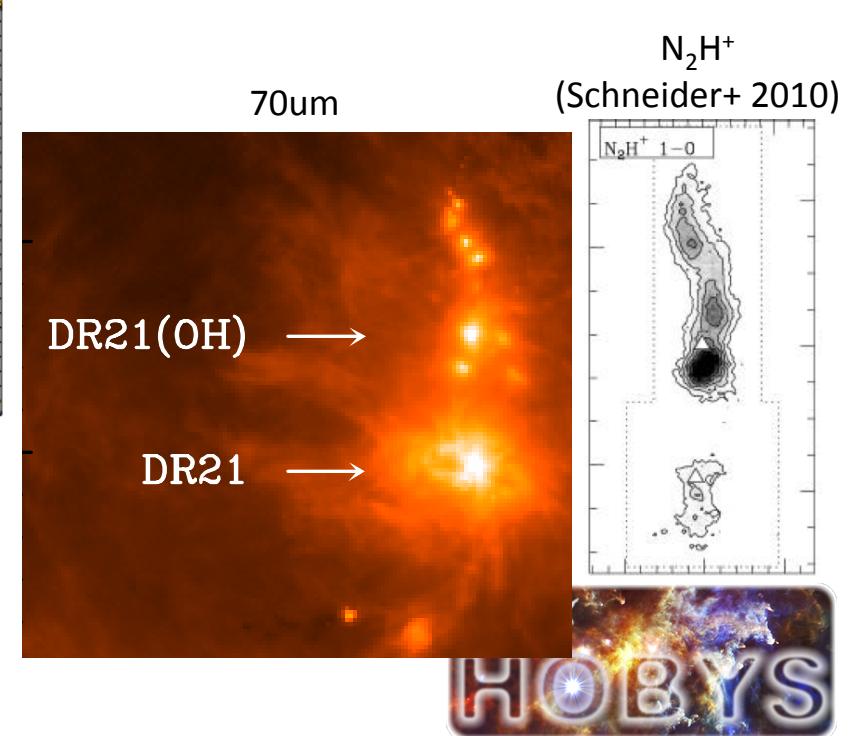
Sub-filaments gravitationally unstable



# Filamentary structure of the DR21 ridge



Secondary component  $\sim 10^{23} \text{ cm}^{-2}$   
Branching in northern sub-filaments  
Merging of individual north-south filaments?  
Advanced merging in south, continuing northwards?



# HOBYS Cygnus X: Extraction of compact objects

OB star precursor candidates: Massive Dense Cores (MDCs)

First statistical samples from mm-mapping:

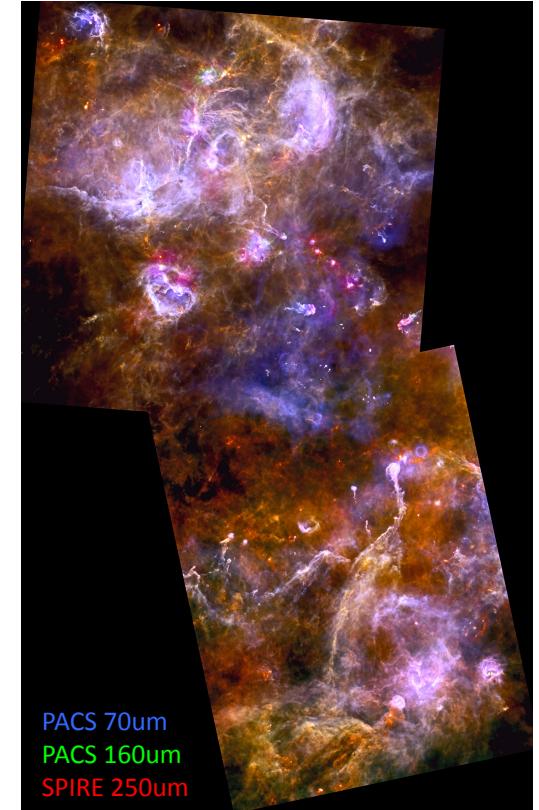
Cygnus X (Motte+ 2007): 129 DCs including 33 MDCs ( $> 40 \text{ Msun}$ ), all protostellar

Herschel HOBYS observations:

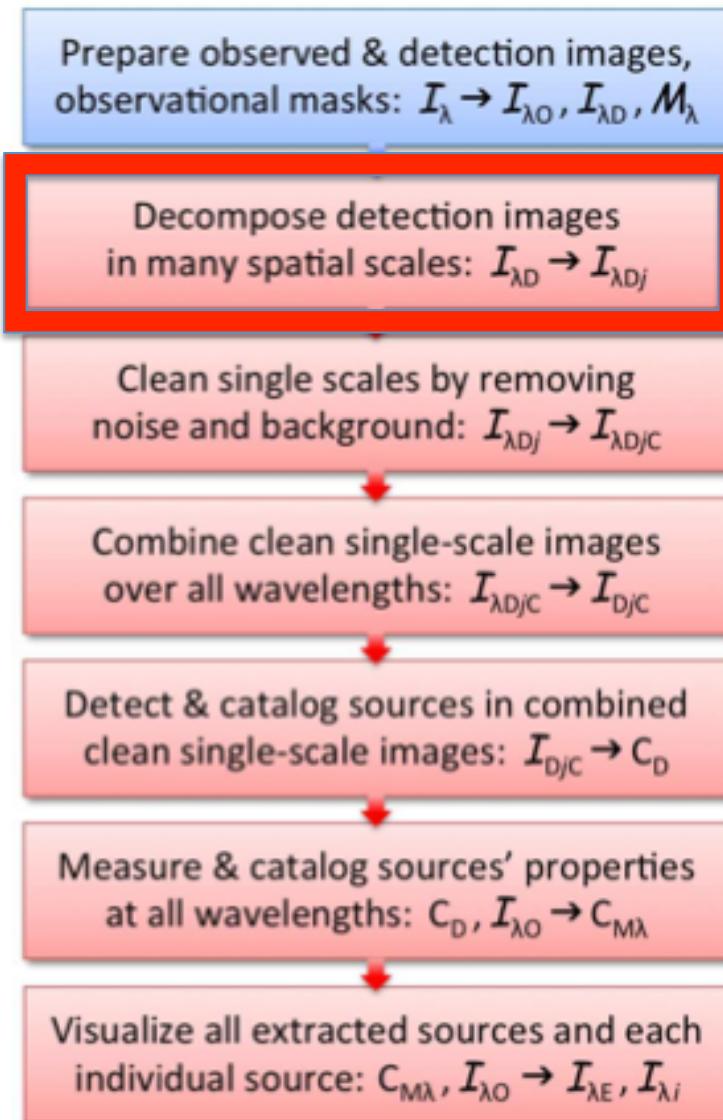
larger coverage & higher dynamic range → better statistics, low- to high-mass regime

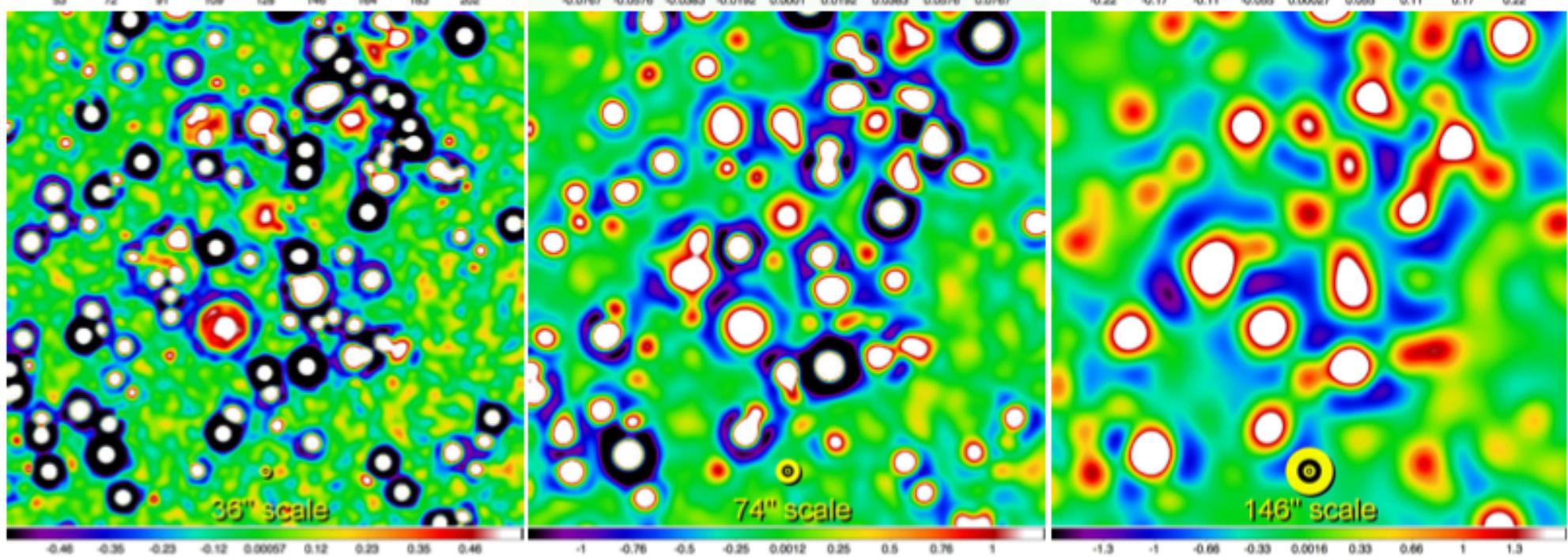
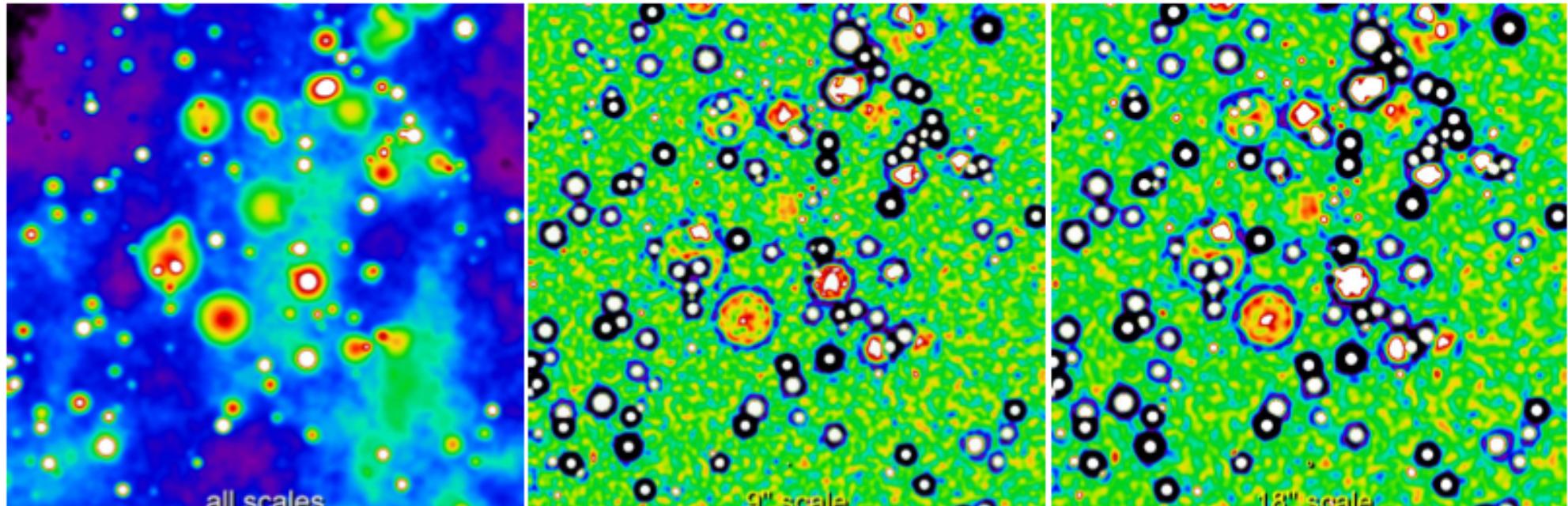
FIR-submm photometry → (better) constraints on  $T_{\text{dust}}$ , (bolometric) luminosity

Multi-scale, multi-wavelength source extraction: *getsources*  
(Mensh'chikov+ 2012)

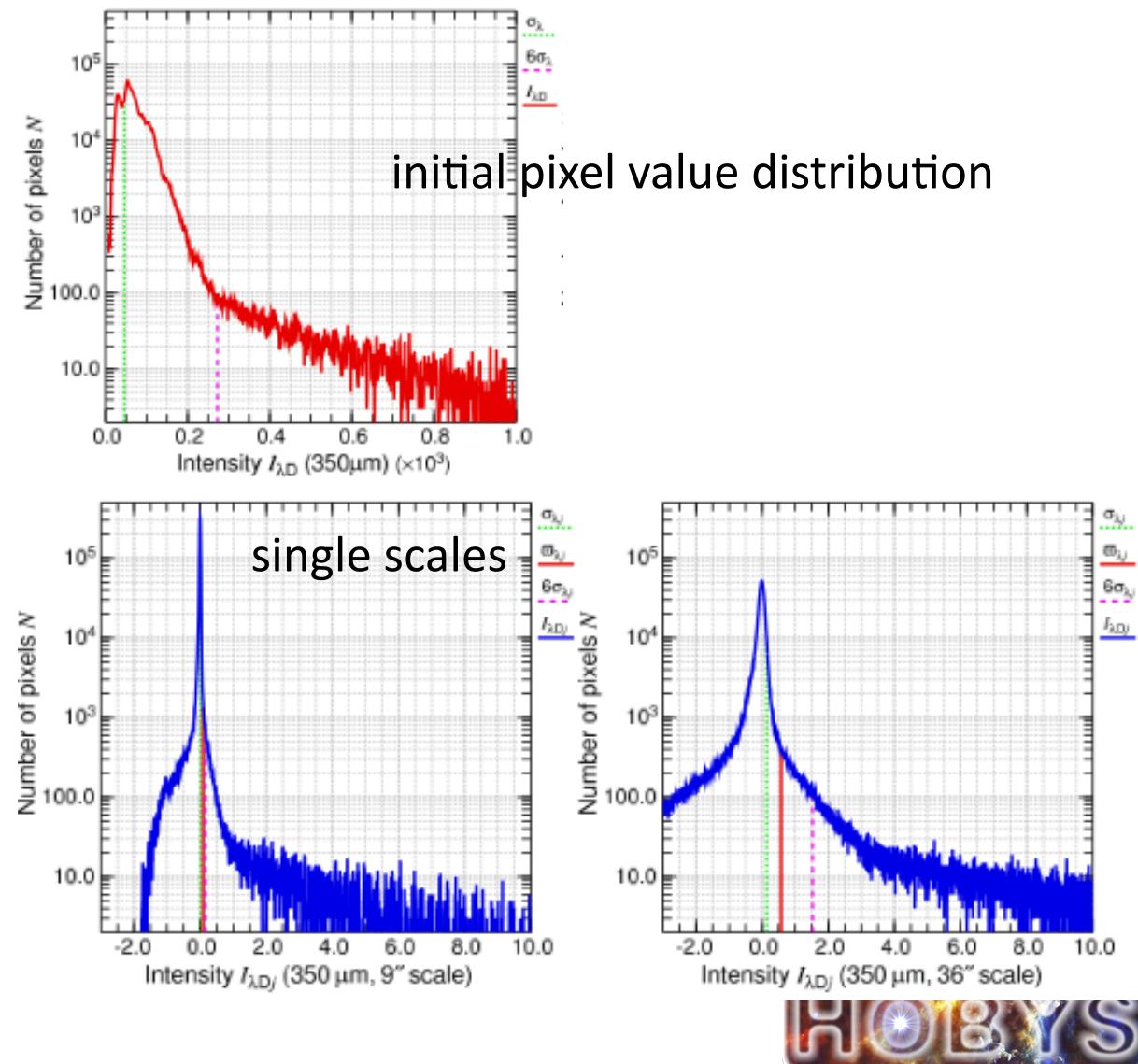
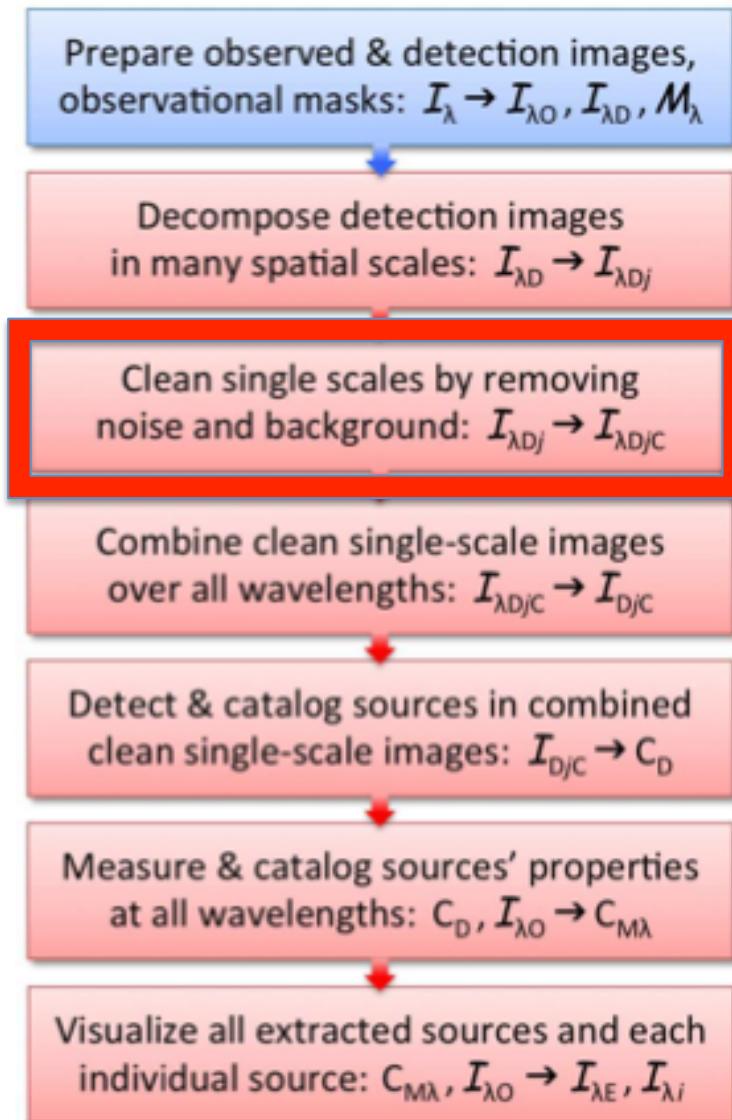


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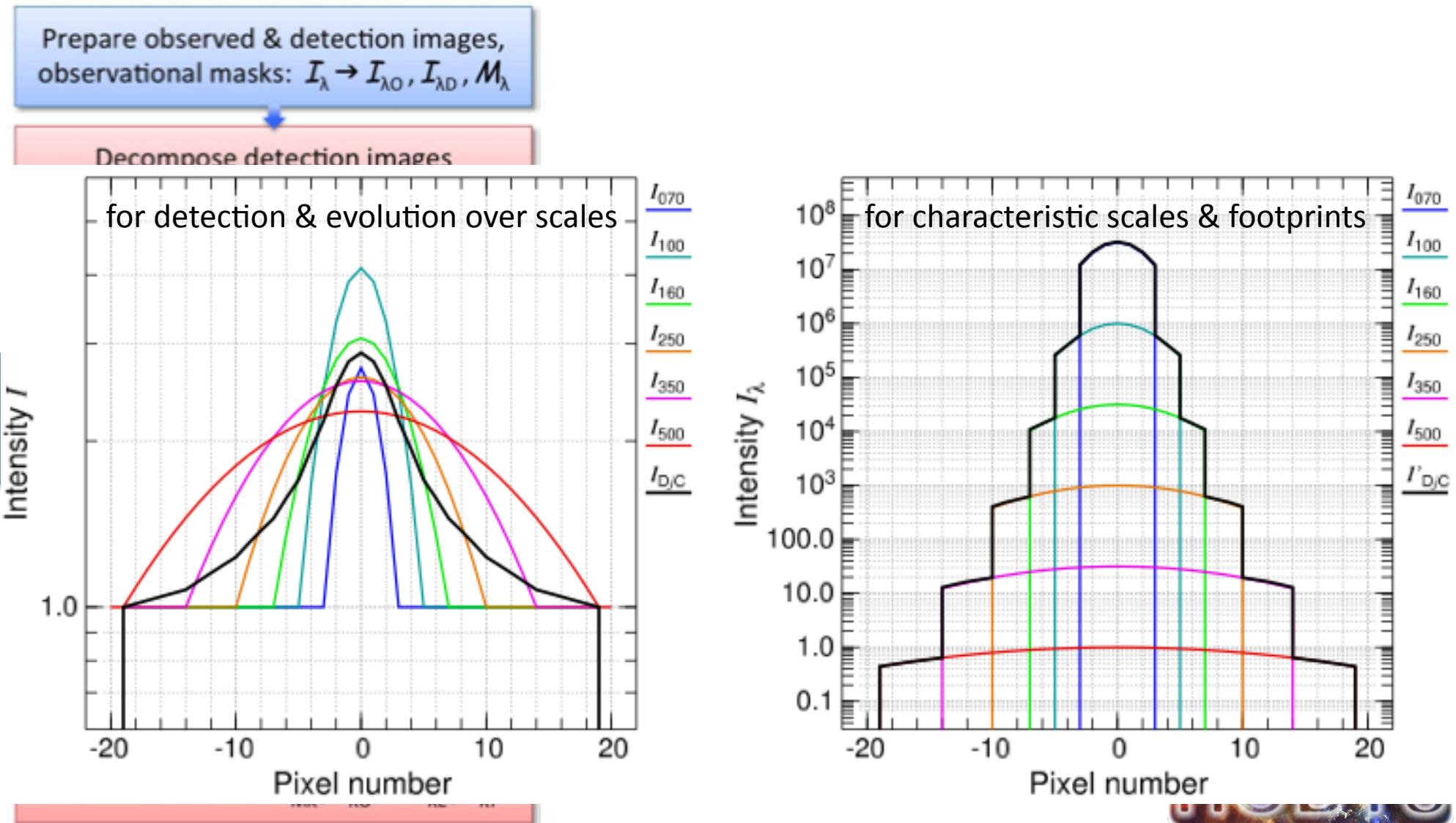




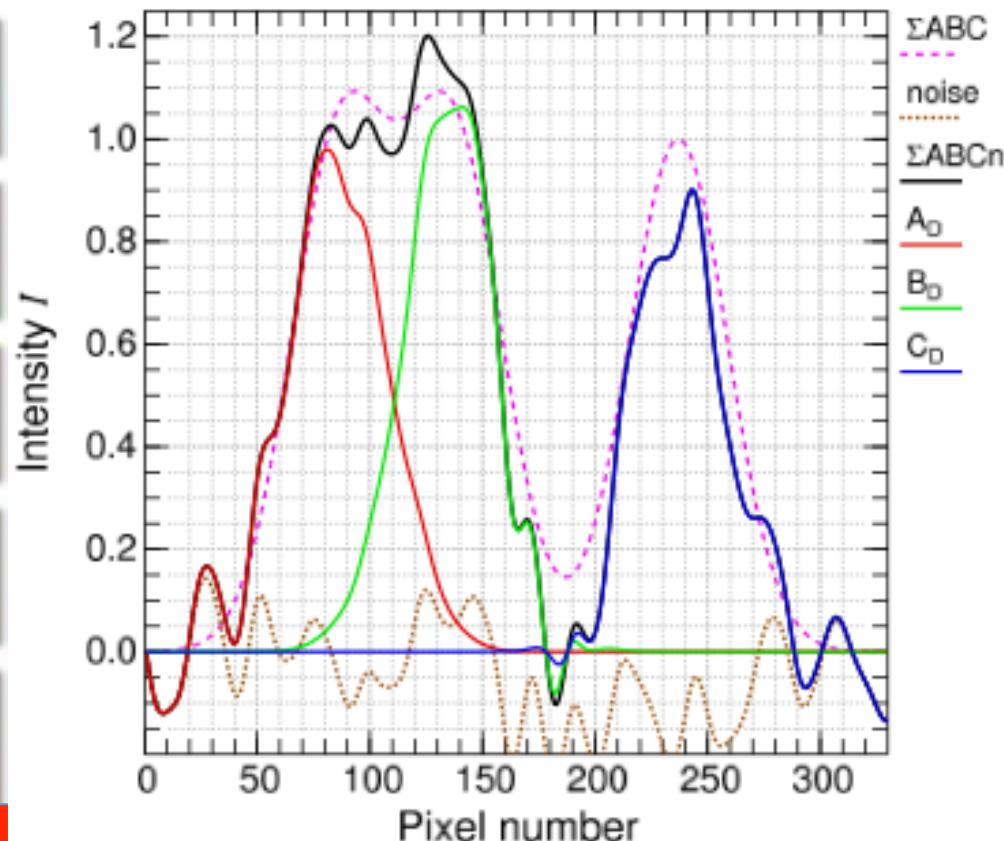
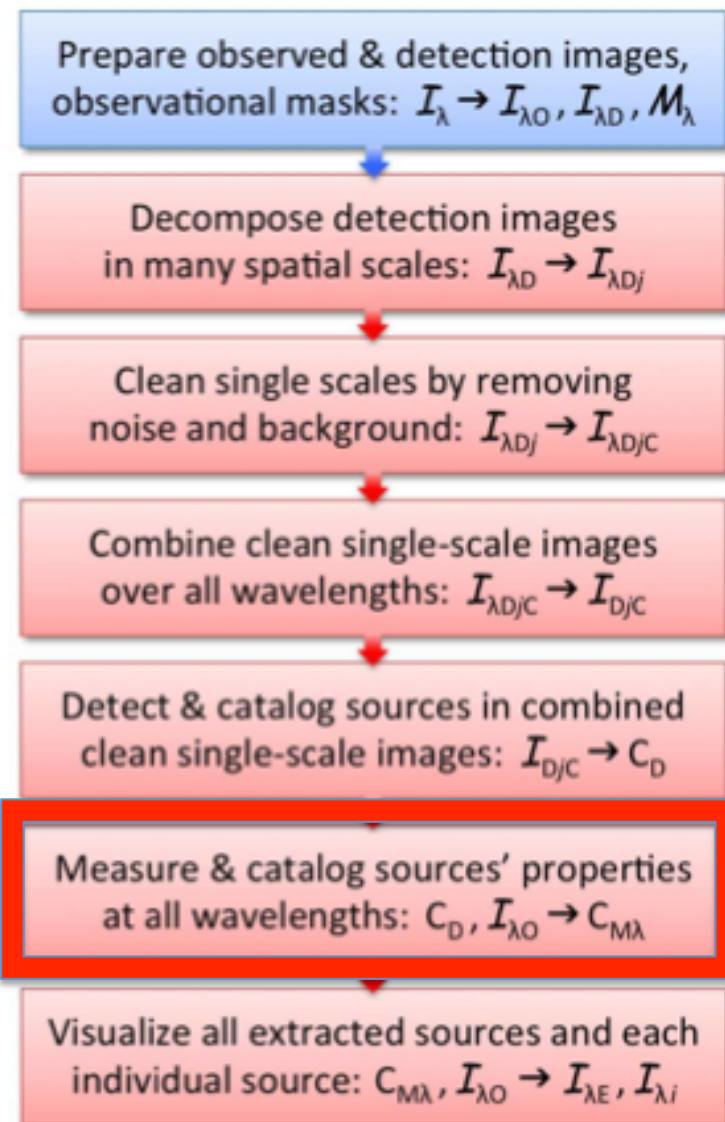
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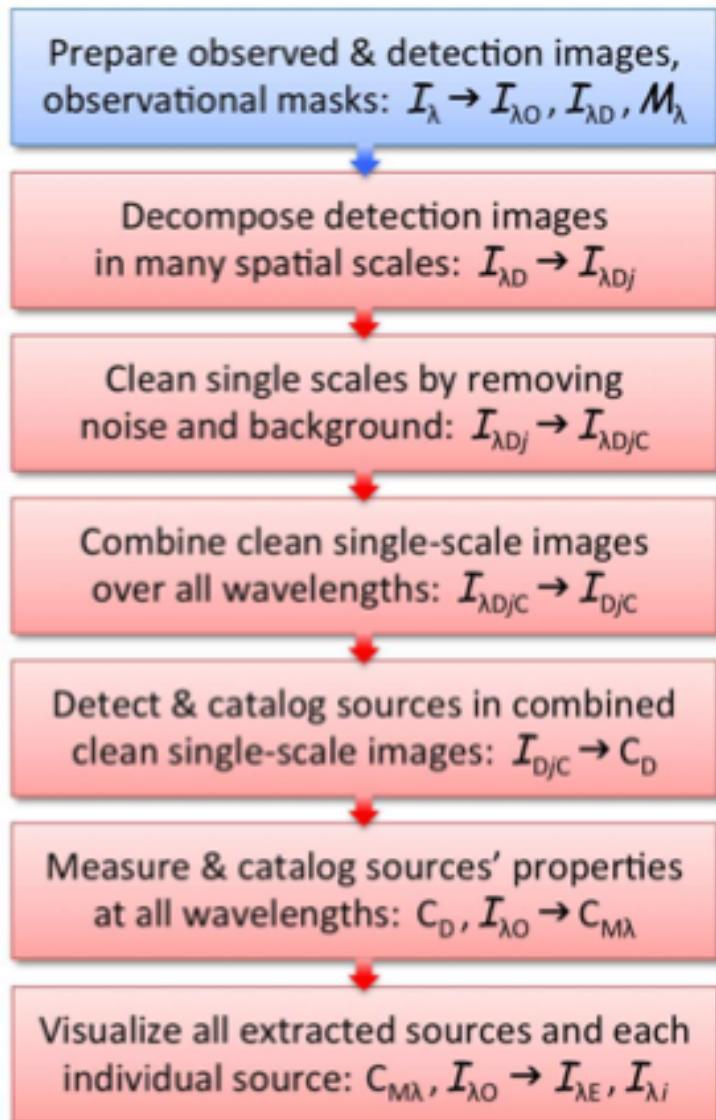
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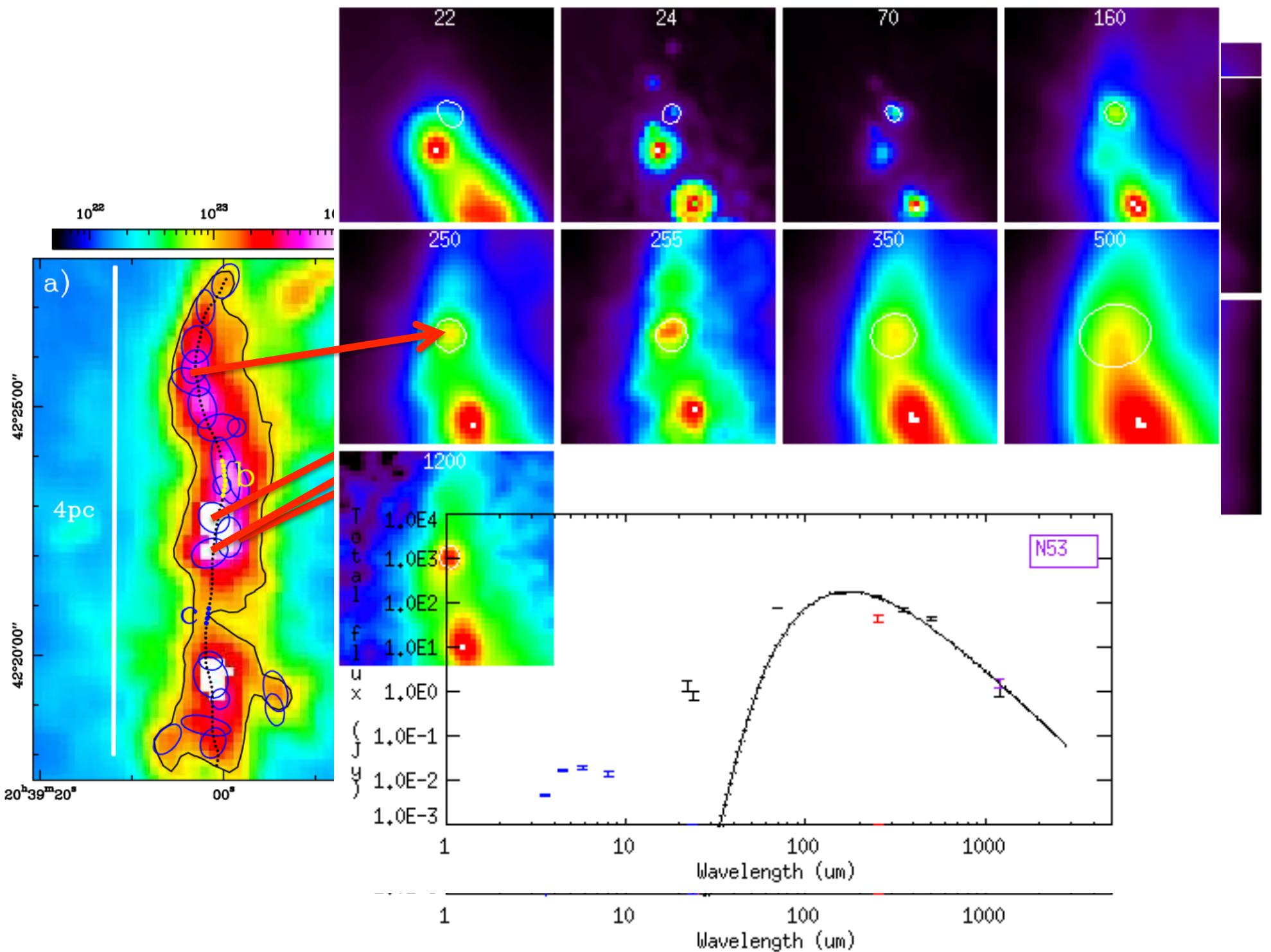


# Multi-scale, multi-wavelength source extraction: *getsources* (Mensh'chikov+ 2012)



- Second, final extraction using “flattened” detection maps:
  - Remove sources to create rms map
  - Divide by rms map
- Benchmarking on simulated maps and observed maps
- *xfilaments*: Additional step to remove filaments scale-by-scale (Mensh'chikov in prep.)
- available later this year...







HERSCHEL MAP-MAKING WORKSHOP  
ESAC, Madrid, Jan 30 2013

HOBY'S data reduction, map-making, and  
**Thank You!**  
source extraction

Anyone else leaving tonight:  
**TAXI to airport at 5...5:30pm?**

<http://hobys-herschel.cea.fr>

