# Status of SAG 3 Key Projects

**Two SPIRE/PACS wide-field surveys entirely approved by HOTAC**

- ***Probing the origin of the stellar IMF*** (**Gould Belt** survey)

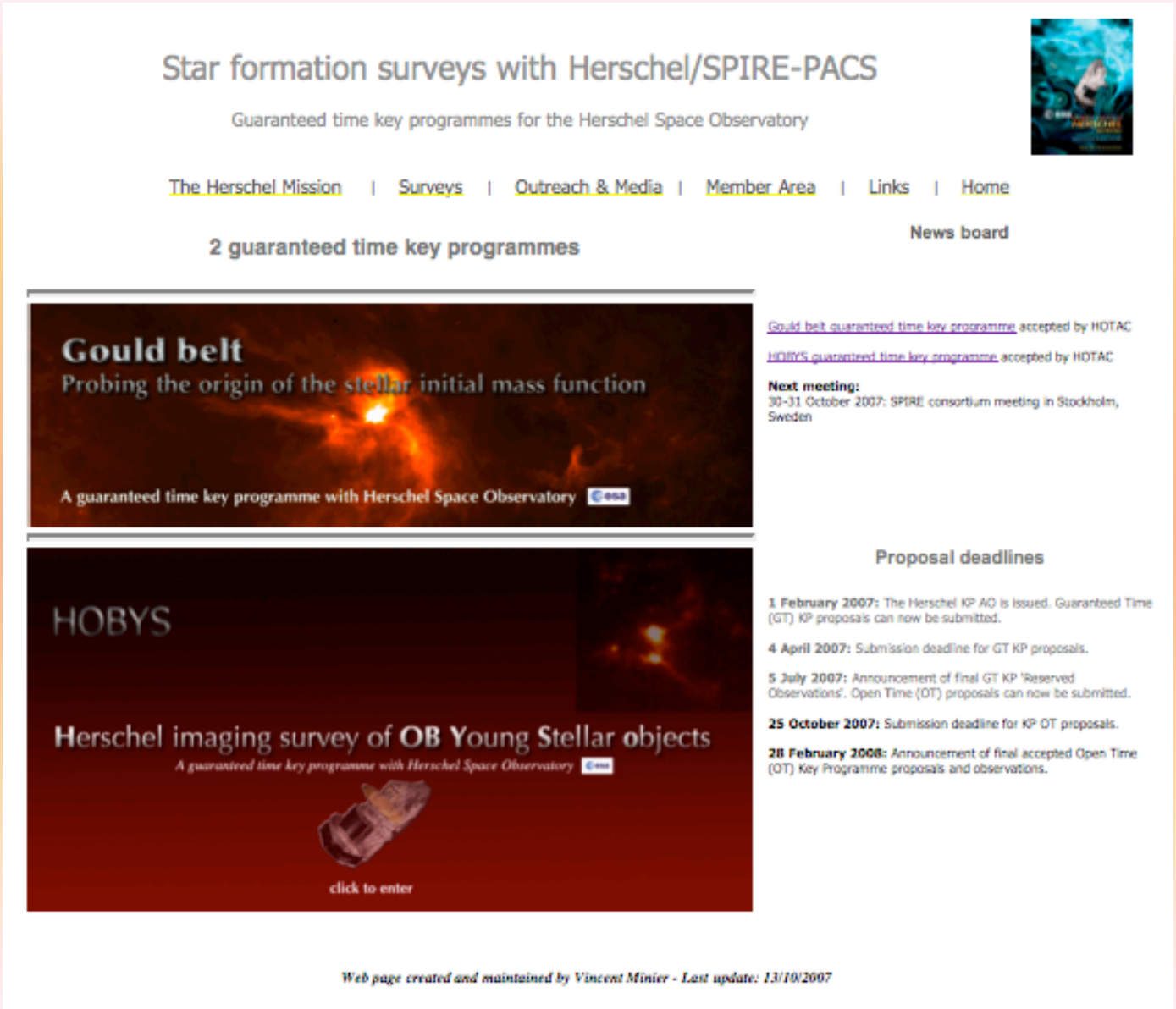
  Joint SPIRE/PACS GT KP based on a total of **461 hr of GT**
  (235 hr from SAG 3, 17 hr from SAG 4, rest from PACS consortium and HSC)
  Total survey area ~ **160 deg$^2$**

- ***The birth of high-mass stars*** (**HOBYS** survey)

  Joint SPIRE/PACS GT KP based on a total of **126 hr of GT**
  (85 hr from SAG 3, rest from PACS consortium and HSC)
  Total survey area ~ **22 deg$^2$**
  *Coordinators: F. Motte, A. Zavagno, and S. Bontemps*

# Dedicated Website

*http://starformation-heschel.iap.fr/*



http://starformation-herschel.iap.fr/gouldbelt/

# The Gould Belt GT Key Programme

**Co-PIs:**
Philippe André
Paolo Saraceno

**The project**
Proposal
Consortium & Constitution

**Publication**
Dusty'04[1]

**Software**
HerschelSPOT

## Probing the origin of the stellar initial mass function: A wide-field Herschel photometric survey of nearby star-forming cloud complexes

Herschel provides a unique opportunity to study the earliest stages of star formation. What is the origin of the stellar initial mass function (IMF)? This issue is central in local star formation research and for understanding whether the IMF is truly universal or is likely to depend on metallicity, pressure, or temperature. As prestellar cores and young (Class 0) protostars emit the bulk of their luminosity at ~80-400 microns, the Herschel imaging instruments SPIRE and PACS are ideal for takinga census of such objects down to ~0.01-0.1 Msun in the nearby (0.5 kpc) molecular cloud complexes. We propose an extensive imaging survey of the densest portions of the Gould Belt with SPIRE at 250-500 and PACS at 110-170 microns down to a 5-sigma column sensitivity NH2~10^21 cm^-2 or Av~1. Our goal is to make a complete, homogeneous mapping of the Av>3 regions with SPIRE and of the Av>6 regions with PACS, and representative areas at Av~1-3 levels with both instruments. The survey sensitivity is well matched to the expected cirrus confusion limit, so we should detect structures throughout the maps. The target clouds span a range of physical conditions, from active, cluster-forming complexes to quiescent regions with lower star formation activity. We should detect hundreds Class 0 protostars and thousands prestellar condensations in the entire ~145 deg^2 SPIRE survey, i.e. ~10 times more cold objects than already identified from the ground. These numbers should allow us to derive an accurate prestellar core mass function. The temperature and density structures of the nearest ( 0.2 kpc) cores will be resolved, revealing the initial conditions for individual protostellar collapse. The large spatial dynamic range of the proposed survey will probe the link between diffuse cirrus-like structures and compact self-gravitating cores. Our main scientific goal is to elucidate the physical mechanisms for the formation of prestellar cores out of the diffuse medium, crucial for understanding the origin of stellar masses.

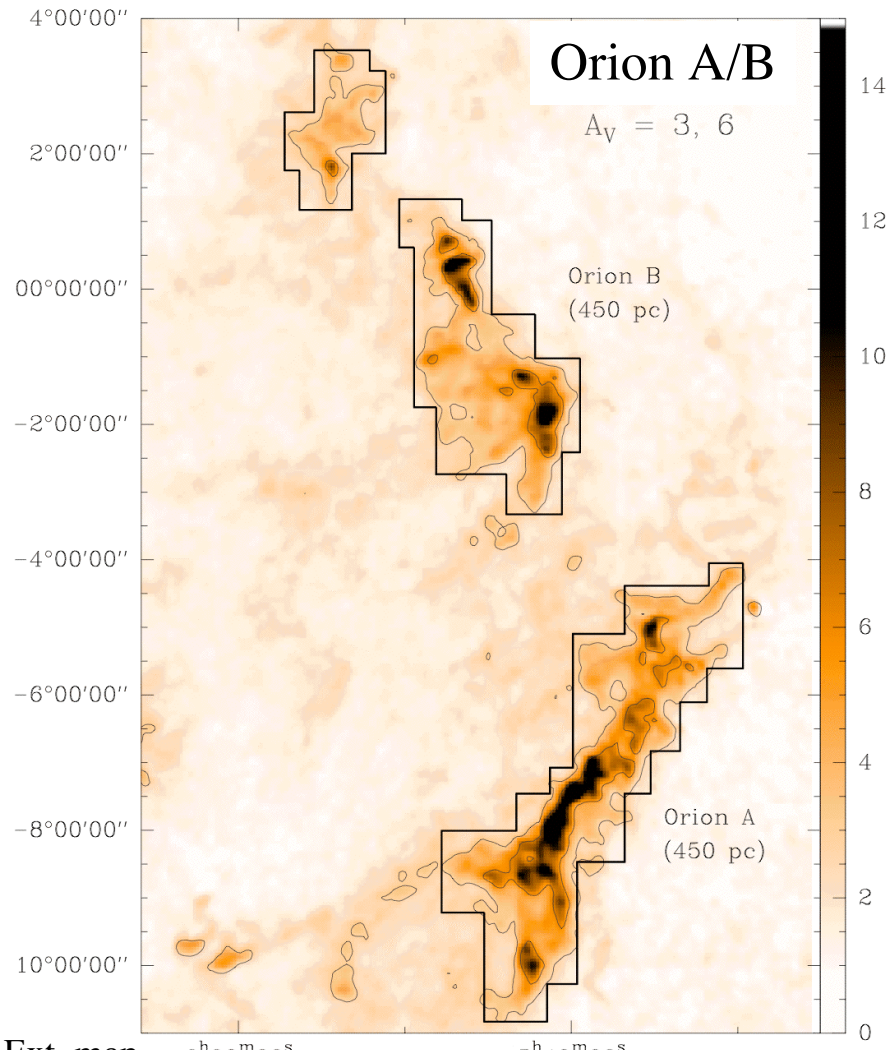
### Summary table (targets and submitted AORs)

| Cloud complex | AOR SPIRE/PACS* | Teams | AOR PACS** | Teams |
|---|---|---|---|---|
| Taurus summary AOR | field image | Cardiff/Saclay | field image | Saclay |
| Ophiuchus summary AOR | field image | Saclay/Cardiff | field image | Saclay |
| Pipe nebula summary AOR | field image | Saclay | field image | Saclay |
| Polaris flare summary AOR | field image | Orsay/Saclay | field image | SAG3/SAG4 |
| Lupus summary AOR | field image | Rome/RAL | field image | Rome/Leuven |
| Coalsack summary AOR | field image | Saclay | field image | Saclay |
| Cham I-III & Musca summary AOR | field image | HSC/Saclay | field image | Leuven/HSC |
| Corona Australis summary AOR | field image | RAL/Cardiff | field image | Heidelberg |
| Serpens/Aquila rift summary AOR | field image | Rome/RAL/ Saclay | field image | Rome/Arcetri |
| Perseus summary AOR | field image | Rome/Canada | field image | Rome |
| IC 5146 summary AOR | field image | Marseille | field image | Saclay |
| Cepheus flare summary AOR | field image | Canada | field image | SAG3/Canada |
| Orion A/Orion B summary AOR | field image | Rome/Canada Saclay/Cardiff | field image | Rome Saclay |

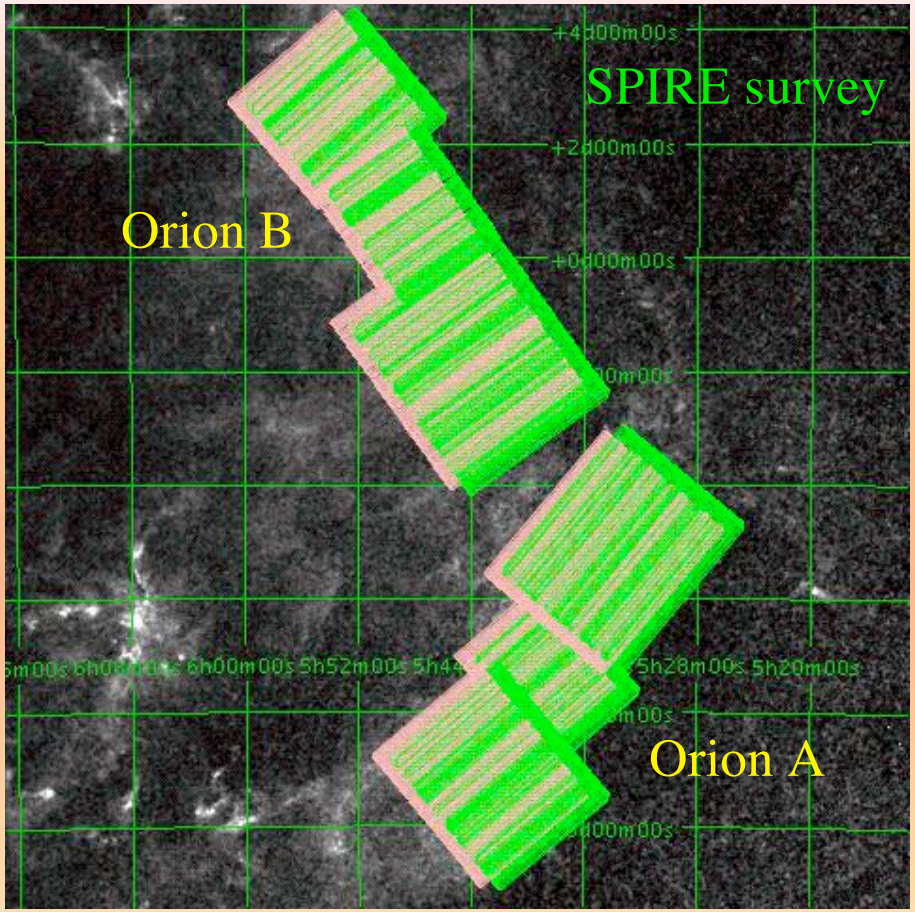
**Links to extinction maps and AOR overlays**

# Careful definition of the target fields using near-IR extinction maps

**(See http://starformation-herschel.iap.fr/gouldbelt/ for all fields)**




Ext. map
S. Bontemps




- ~ 30 = 15+15 deg$^2$ in scan-map mode @ 60''/sec with SPIRE / PACS(75/170μm)
- ~ 15 deg$^2$ @ 20''/sec with PACS (110/170)

http://starformation-heschel.iap.fr/hobys/

# The HOBYS GT Key Programme

**Coordinators**
Frédérique Motte
Sylvain Bontemps
Annie Zavagno

**The project**
Proposal
Constitution & participants
Poster (11 Mb!!)

**Software**
HerschelSPOT

## HOBYS: the Herschel imaging survey of OB Young Stellar objects

With its unprecedented spatial resolution in the critical 75-500 microns wavelength range, Herschel will provide a unique opportunity to determine, for the first time, the fundamental properties of the precursors of OB stars at distances out to a few kpc. The imaging speed of SPIRE and PACS in the parallel mode will enable us to map the entire extent of massive cloud complexes and detect the massive young stellar objects which have been overlooked by IRAS and Spitzer, i.e. the high-mass infrared-quiet protostars and pre-stellar cores. We propose to use SPIRE and PACS to image essentially all of the regions forming OB-type stars at distances 3 kpc from the Sun (total area of 22~deg^2). To complement this imaging survey, we propose to take smaller photometric and spectroscopic maps with PACS toward a handful of isolated regions that display triggered star formation. The 75/110/170 micronsPACS and 250/350/500 microns SPIRE images of this project will provide an unbiased census of both massive pre-stellar cores and massive Class 0-like protostars, and will trace the large-scale emission of the surrounding clouds.This survey will yield for the first time accurate far-infrared photometry, and thus good luminosity and mass estimates, for a comprehensive, homogeneous sample of OB-type young stellar objects at all evolutionary stages. The multi-wavelength imaging will also reveal spatial variations of the cloud temperature close to HII regions and OB associations. These data, along with the detailed photometric and spectroscopic study of a few prototypical regionsof induced star formation, will allow us to determine the importance of external triggers for high-mass star formation in the nearest massive molecular cloud complexes. This Herschel Key Programme is crucially needed to better understand the formation of OB-type stars and will provide the basis for many follow-up studies. In addition, the data will provide templates for galactic studies of star formation, both in our Galaxy and others.

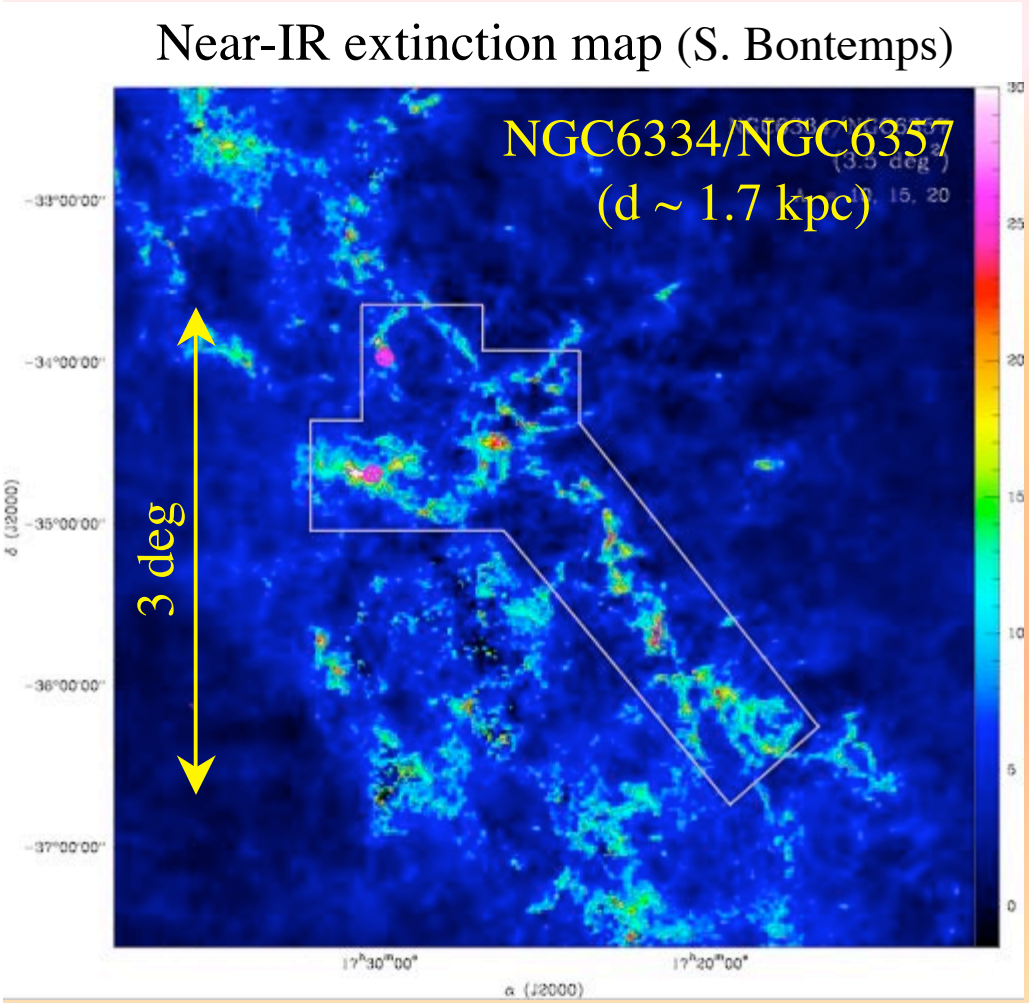
## Targets

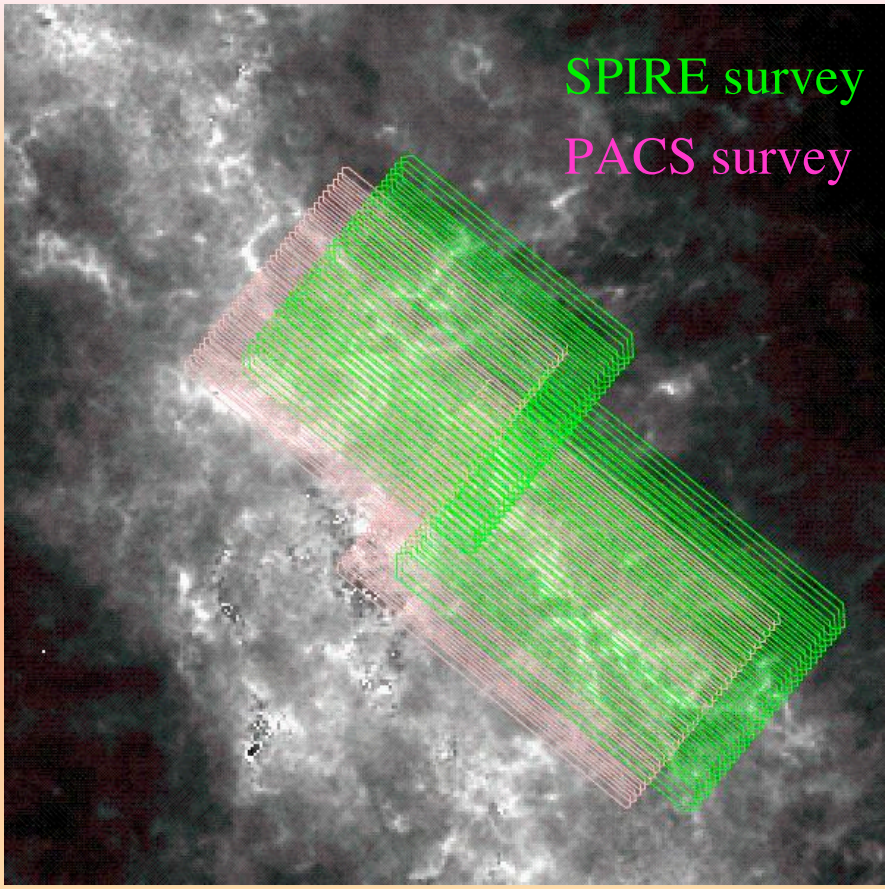
| Molecular complexes | Distance (kpc) | Area ($deg^2$) | Responsability |
|---|---|---|---|
| Vela | 0.7 | 2.75 | Rome/Saclay |
| Mon OB1/NGC2264<br>Mon B2 | 0.8 | 1.65 | Cardiff/Saclay |
| Rosette | 1.5 | 1.15 | Saclay/Canada |
| Cygnus X | 1.7 | 5.90 | Saclay/HSC |
| M 16/M17/Sh40 | 1.7 | 2.15 | HSC/RAL |
| NGC 6334/NGC 6357 | 1.7 | 3.10 | Marseille/Rome<br>RAL/Marseille |
| W3/KR 140 | 2.2 | 1.55 | Canada/Rome |
| NGC 7538 | 2.8 | 0.55 | Canada/Cardiff |
| W48 | 3.0 | 2.75 | Saclay/Rome |
| Sh 104 | 4 | | Marseille |
| RCW 79 | 4 | | Marseille |
| RCW 82 | 2.9 | | Marseille |
| RCW 120 | 1.3 | | Marseille |

For any comment on this Web page, please contact the Web master : Vincent Minier

# Example of « HOBYS » survey field

Near-IR extinction map (S. Bontemps)




→ ~ 3.2 deg$^2$ in parallel-mode @ 20''/sec with SPIRE / PACS (75/170 μm)

See http://starformation-herschel.iap.fr/hobys for all fields

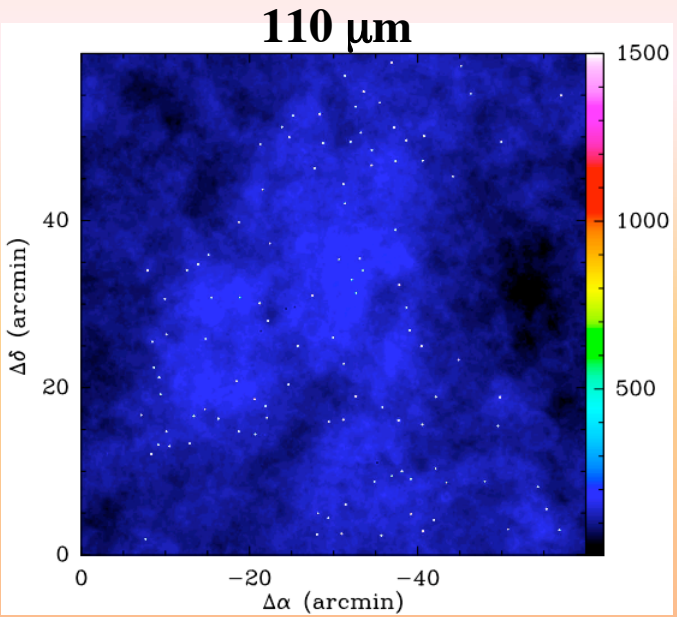
# Preparation for Data Processing and Science: Simulations

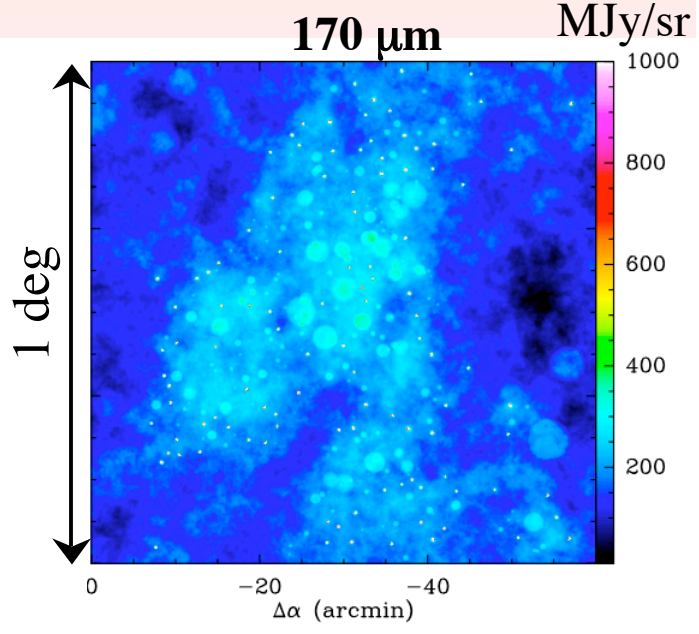
## Synthetic Molecular Cloud Skies

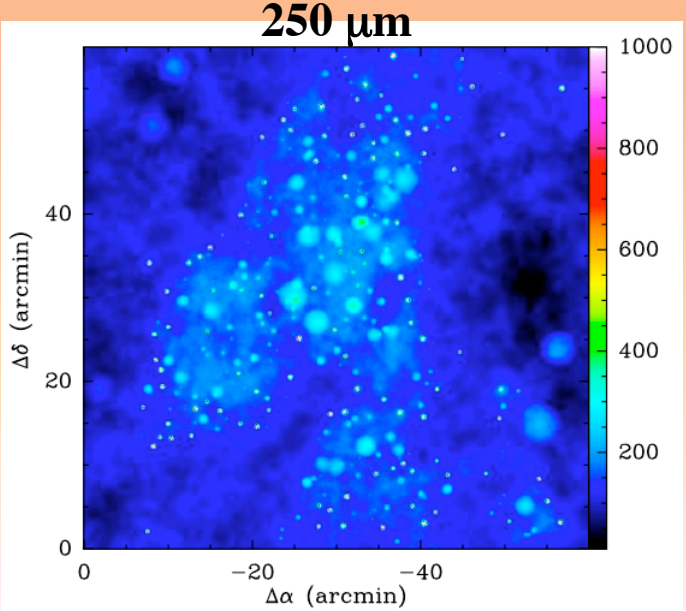
**(A. Menshchikov)**

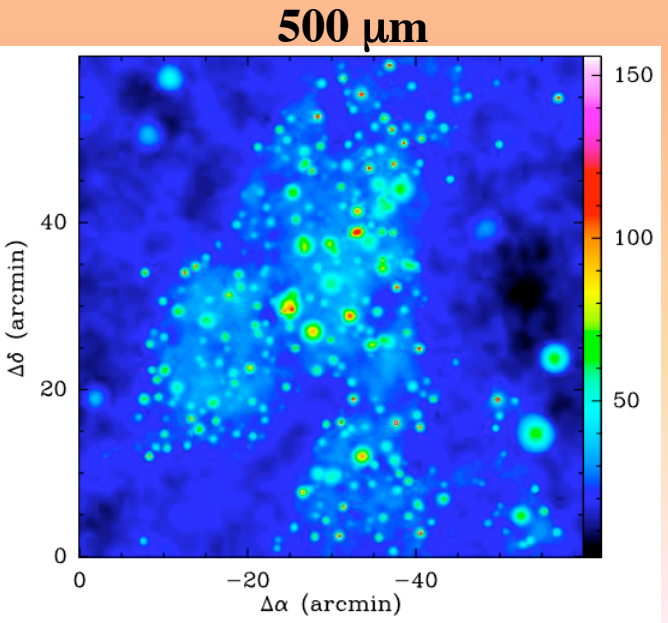
**3 components with different SEDs:**

- **Cirrus-like background**
- **Prestellar cores**
- **Protostars**



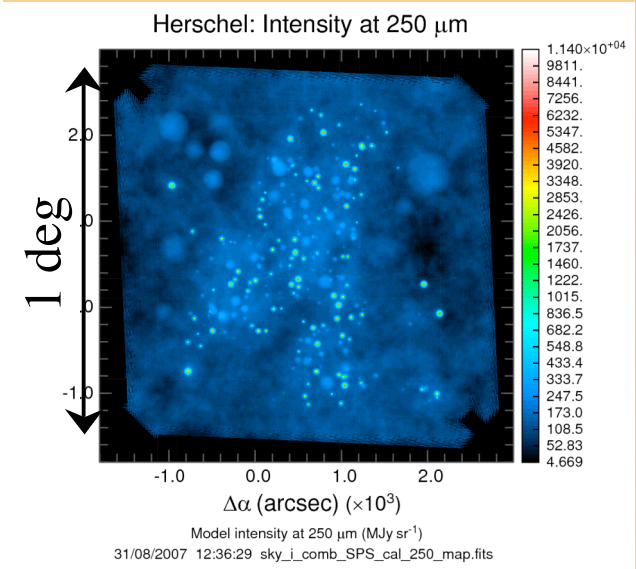



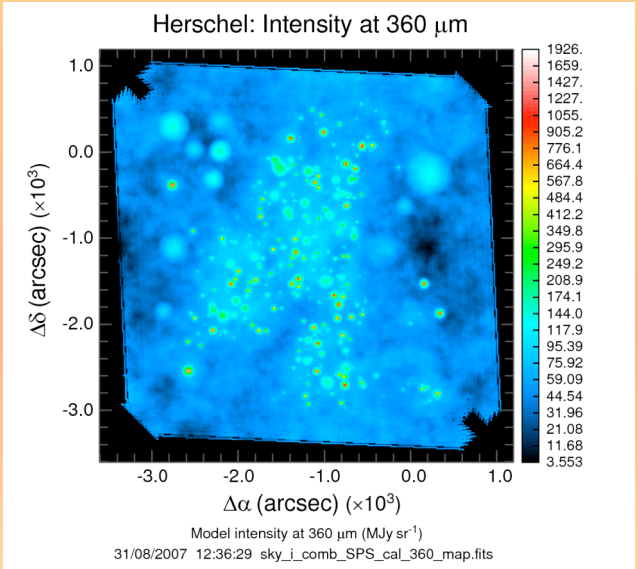



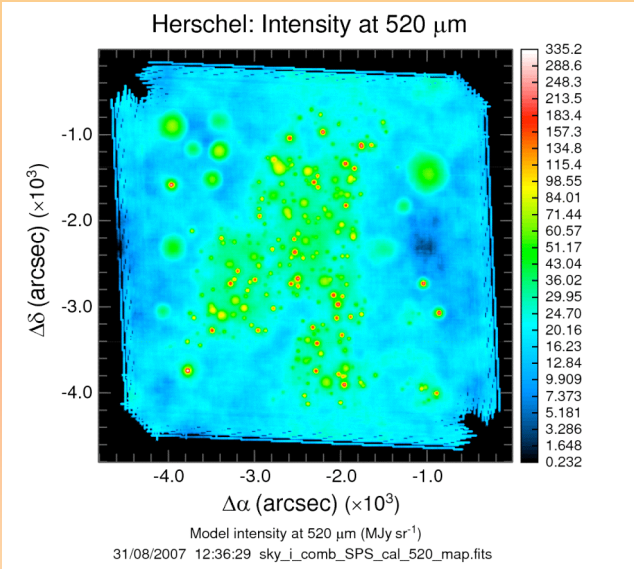
# Simulations of the Herschel SPIRE/PACS mapping

- **Synthetic molecular cloud including ISM structure and populations of prestellar cores & protostars with realistic radiative transfer (A. Menshchikov)**

- **Processing with the SPIRE simulator (B. Sibthorpe, Cardiff) and the PACS simulator (R. Gastaud, Saclay)**



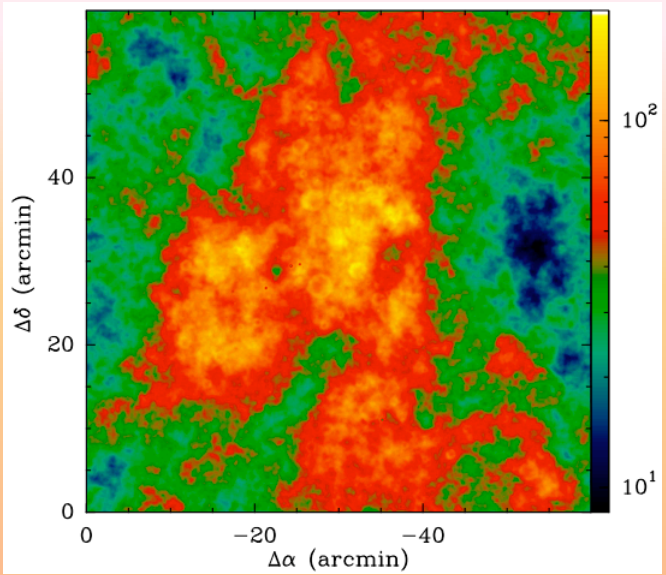

**Tests of various background-subtraction and « clump-finding » algorithms (N. Schneider, P. Didelon)**

# Efficient Background Subtraction Using PACS Data

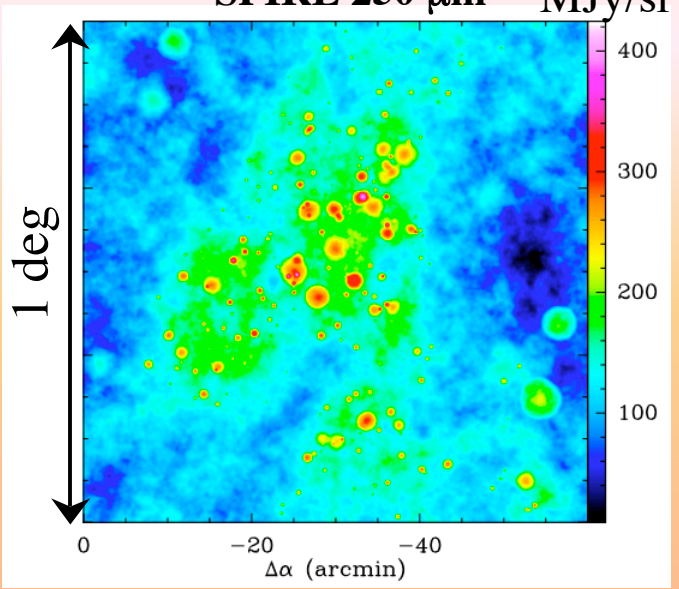
**Prestellar cores are colder than the background and are seen in absorption at $\lambda < 150$ μm**

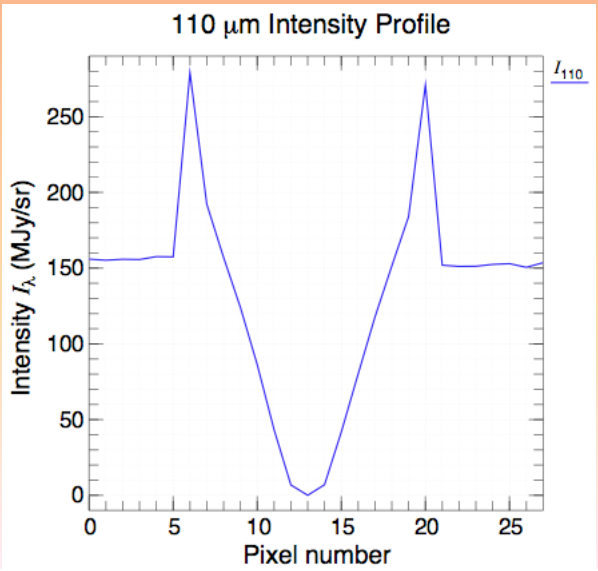
**→ Will greatly facilitate the systematic identification of prestellar cores in SPIRE maps**

**PACS 110 μm at SPIRE resolution**

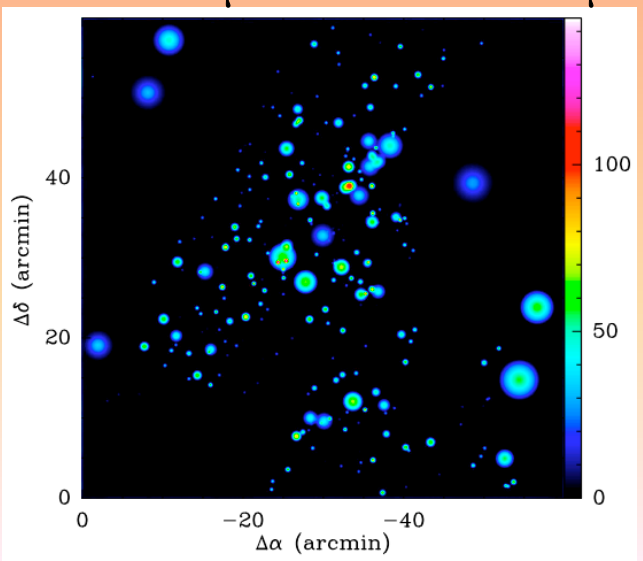



**SPIRE 250 μm** MJy/sr




**SPIRE 250 μm - α x PACS 110 μm**



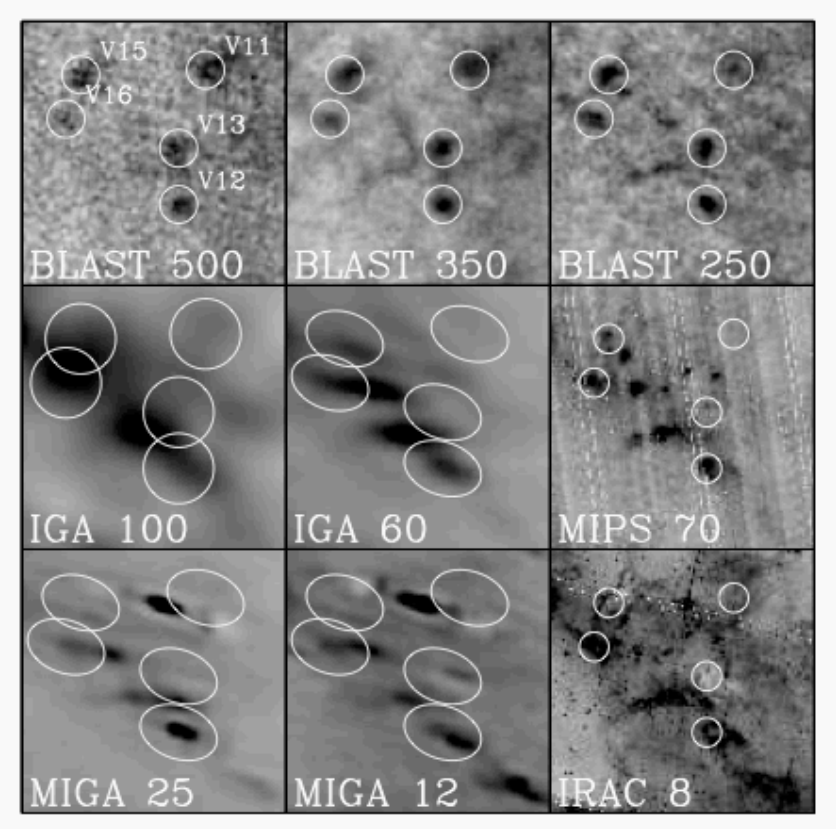
# Complementary Mapping Surveys at 850 μm with SCUBA-2 and LABOCA

- **SCUBA-2 survey of the Northern Gould Belt (Ward-Thompson, Di Francesco, Hatchell, Hogerheijde et al.)**
- **LABOCA survey of the Southern Gould Belt (Hatchell, Belloche et al.)**

# Ancillary Activities

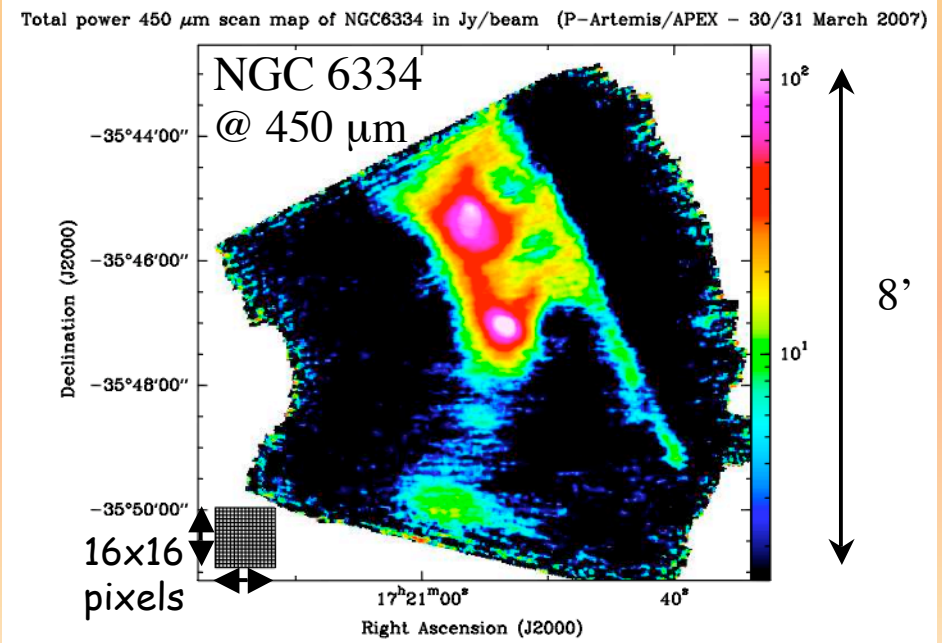
## SAG 3 members involved in:

### BLAST Observations (e.g. P. Martin)




Chapin et al. 2007

### ArTéMiS Observations (e.g. Ph. André, V. Minier)



# Current Assessment of SAG 3 Resources (during exploitation phase)

| Team | Canada | Cardiff | Marseille | RAL | Rome | Saclay |
|---|---|---|---|---|---|---|
| Resources (FTEs) | ~ 1 | 2-4 | 1.5 | 0.5 | ~ 2 | 4.5-6.5 |

Total : ~ 11-15 FTEs