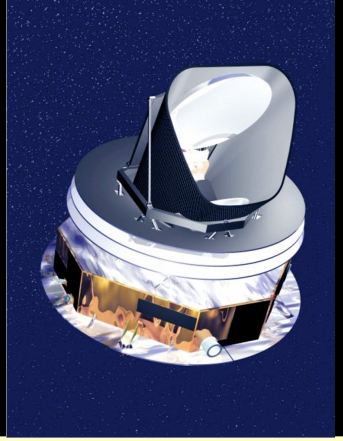
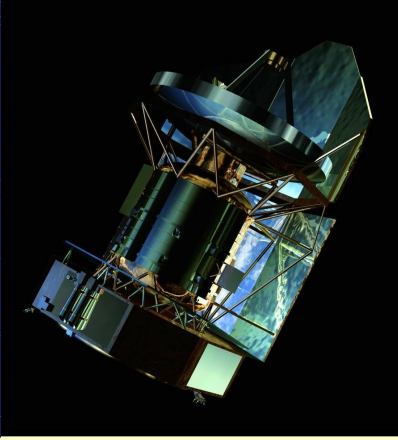
Cold Cores

on Planck[1,2] and Herschel [1]

on behalf of the Planck collaboration





M. Juvela, **I. Ristorcelli** (coord.)

Planck

Desert, Dupac, Giard, Harju, Harrison, Joncas, Jones, Lagache, Lamarre, Laureijs, Lehtinen, Maffei, Martin, **Marshall**, Malinen, Mattila, **McGehee**, **Montier**, Pajot, Paladini, **Pelkonen**, Tauber, Taylor, Valenziano, Verstraete, Ysard

Abergel, Bernard, Boulanger, Cambresy, Davies, Dickinson, Fischera, Macias-Perez, Meny, Miville-Deschenes, Nartallo, Pagani, Puget, Reach

Herschel

Andre, Kiss, Klaas, **Krause**, Molinari, Motte, Schneider, **Toth**, Ward-Thompson, **Zavagno**

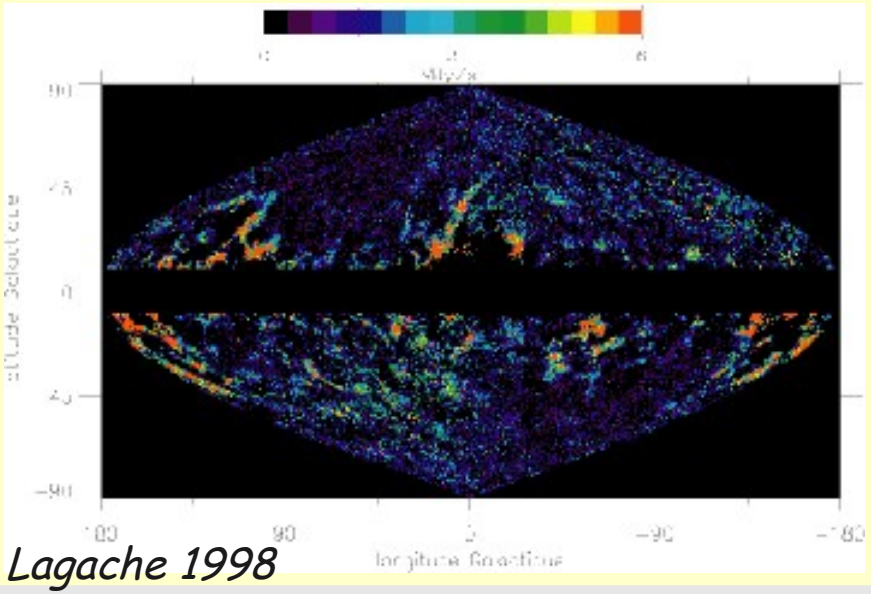
External

Doi, Ueno, Kitamura, Nikeda, Kawamura, Onishi

With acknowledgement to ESA[1] and the Planck HFI & LFI consortia[2]

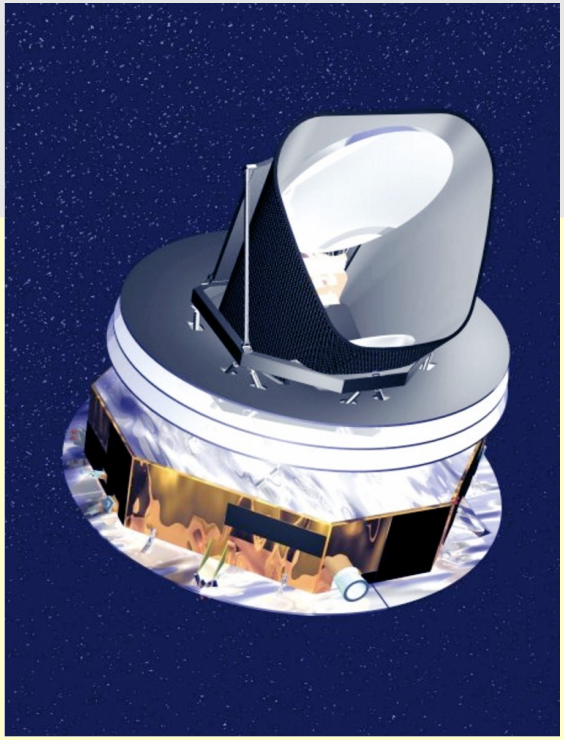
Scientific Justification

- Cold dust: a **tracer** of dense, hidden regions of star-forming clouds
- Access to the **earliest phases of star formation**
  - What generates pre-stellar **cores** and what governs their evolution to protostars and proto-brown dwarfs ?
  - Origin of the global stellar initial mass function (IMF)
- Part of the life **cycle of dust**
  - from diffuse medium dense clouds
- as first step, we need to detect **cold and compact Galactic dust clouds**



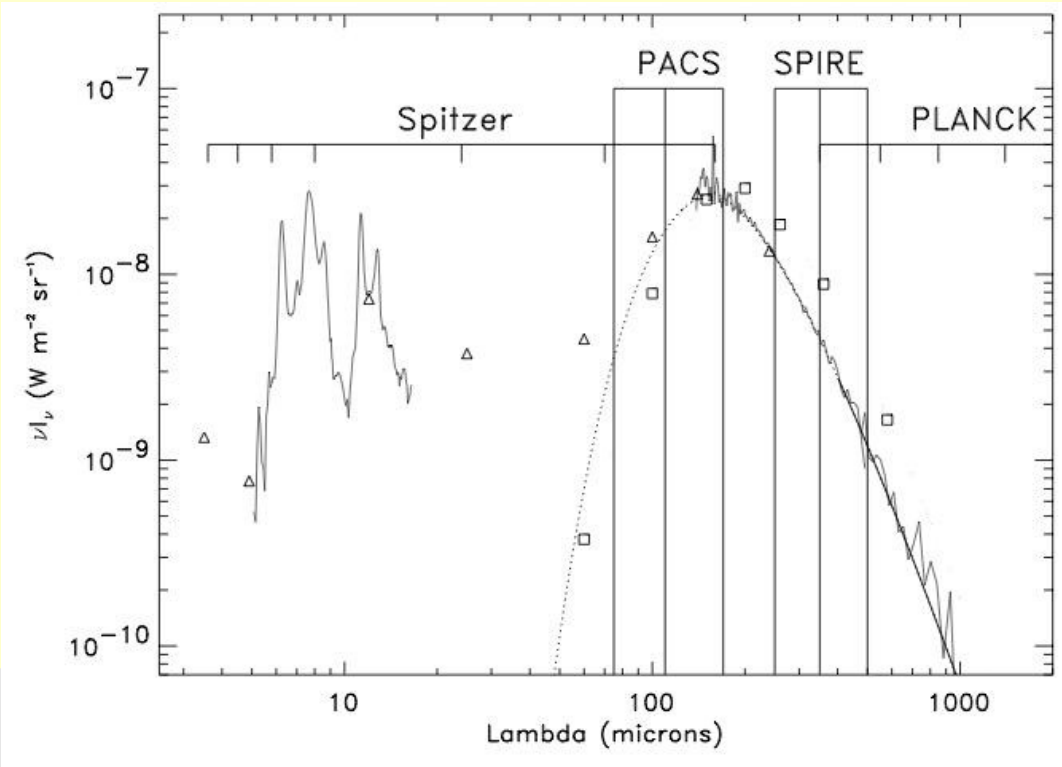
Lagache 1998

Planck



The Planck satellite is mapping the sky at 9 frequencies in the sub-mm/mm range

- main goal is sensitive mapping of CMB fluctuations
- wide wavelength coverage allows good separation of foreground components
  - 350, 550, 850, 1380, 2100, ..., 10000 μm
  - 5.0, 5.0, 5.0, 5., 7.1, ..., 33 arcmin



Cold Cores: The Planck project

PLANCK provides the first **unbiased** cold core catalog

- It will include a large list of 'normal' cloud cores
  - Pre-stellar dust cores in molecular clouds (class –I), isolated globules, dark clouds in the Galactic plane, etc.
  - a large number of new objects at high Galactic latitudes
  - many so far undetected objects (very low T)
  - possibility for the discovery of new classes of objects
    - e.g., Jupiter mass clouds?

We expect **>>1000** detections

Work within **the Planck project**:

- Analysis of Planck frequency maps
- Extract cold cores (paper to be submitted shortly, *Montier et al.*, 2010)
- Cross correlate the findings with ancillary data
- Construct **C3PO** = Cold Core Catalog of Planck Objects

Select targets for the **Herschel follow-up**

- more detailed studies of a representative set of cores
  - higher spatial resolution, inclusion of shorter wavelengths
- the goal: a coherent observational database representing the entire cold core population of the Galaxy, complementing the GT projects that target currently actively star forming regions

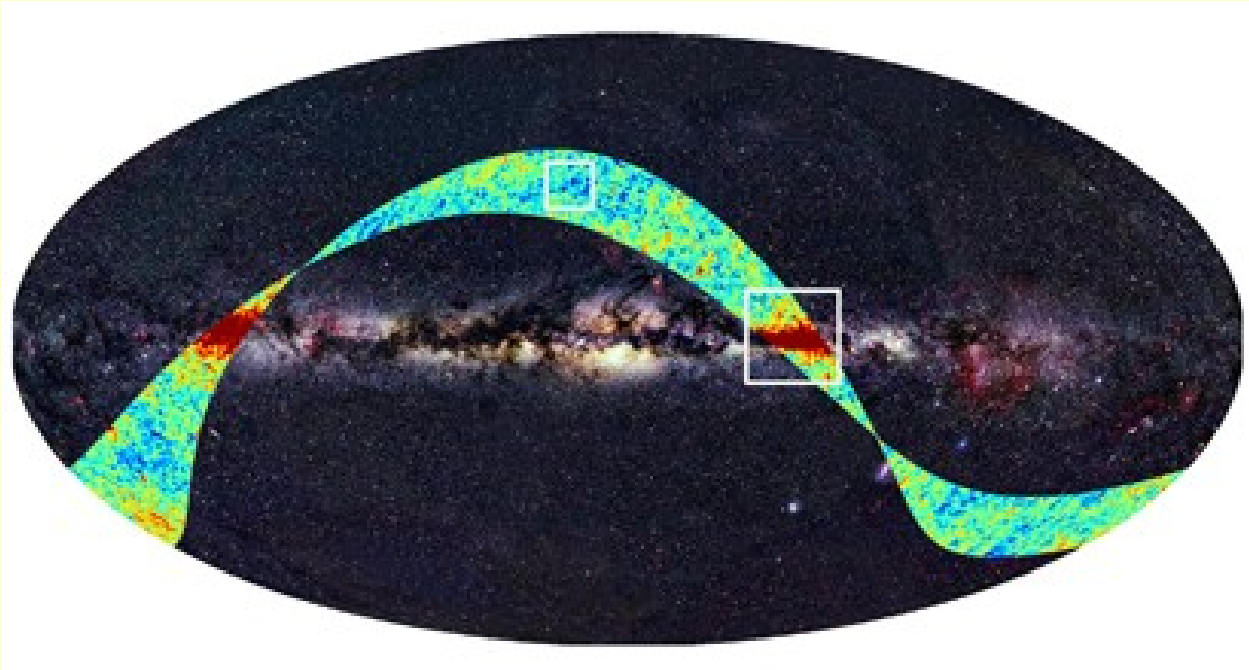
Observations could start in late 2010! ...

Cold Cores: The Herschel project

- OT KP *Galactic Cold Cores* (150.9h)
- observations consist of small (~20 arcmin) PACS and SPIRE maps of carefully pre-selected cores
  - selection using Planck and ancillary data
  - a **cross-section** of Galactic cold cores population
  - selection takes into account **physical properties** of the cores (temperature, mass, density, size), their **location** (high/low latitudes, inner/outer Galaxy), **environment** (clustered vs. isolated sources, magnetic fields), **dust properties** (emissivity index, signs of anomalous microwave emission)
  - special emphasis is put on rare source types (e.g., high latitudes, both ends of the core mass spectrum)
  - 151 hours ~ 100-150 fields

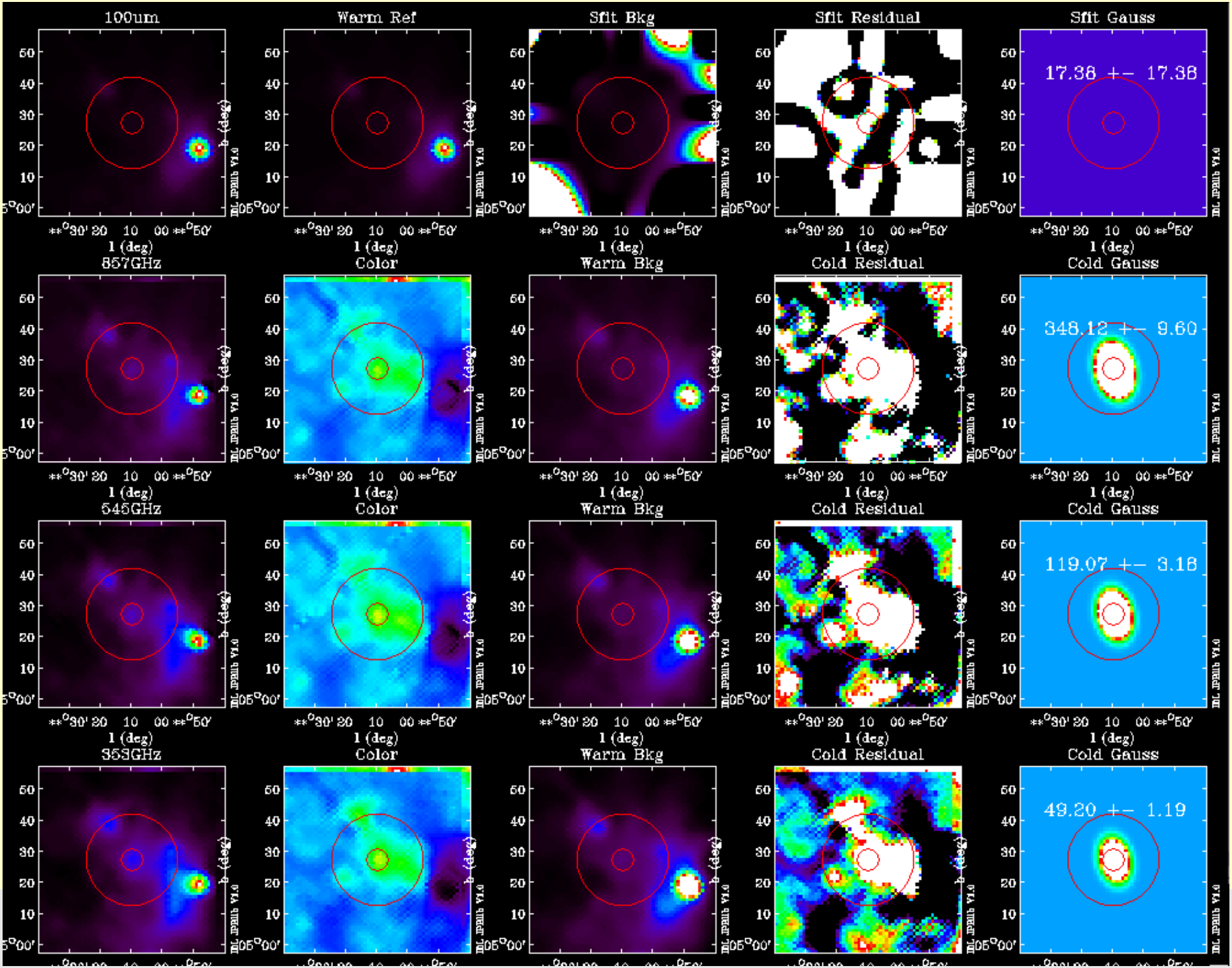
SDP

... analysis of **Planck First Light Survey** resulted in the detection of many new sources!



this gave the possibility to have targets **already in SDP**

PCC249 in Planck



SDP targets

- three secure detections from Planck First Light Survey
- T_d ~13K or below
- visible in SDP and outside GT fields
- test both parallel mode and normal scan mapping with PACS and SPIRE

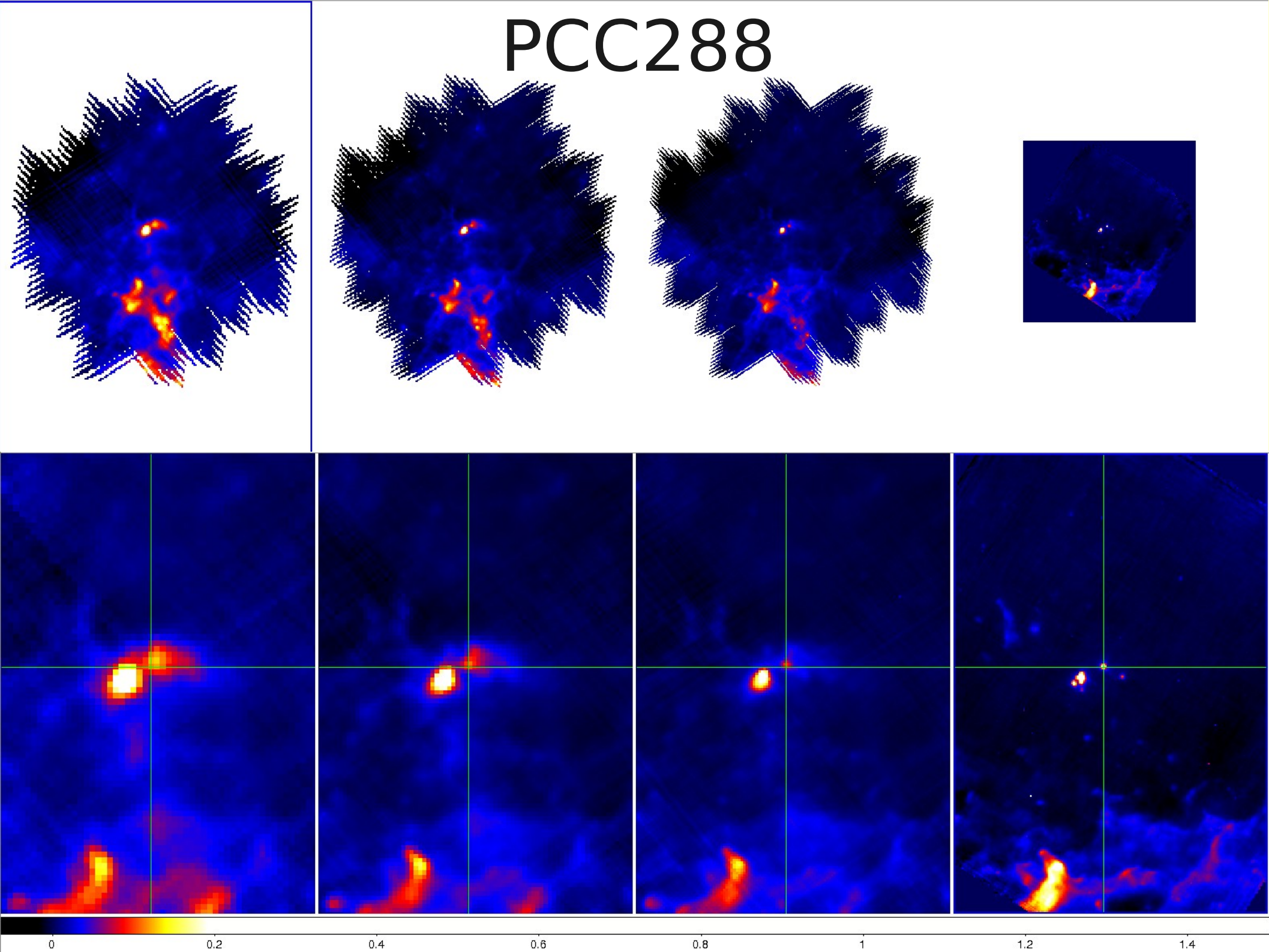
Target ID	Position (Galactic / J2000)	IRAS 100μm[1] (MJy/sr)	T_{dust} (K)
PCC249	107.20+5.52 22 21 17.6 +63 42 25	150	12.2
PCC550	300.86-9.00 12 25 16.5 -71 46 03	25	12.6
PCC288	109.80+2.70 22 53 31.3 +62 31 44	120	11.3

[1]Level of local background (IRAS gives only upper limits of source fluxes)

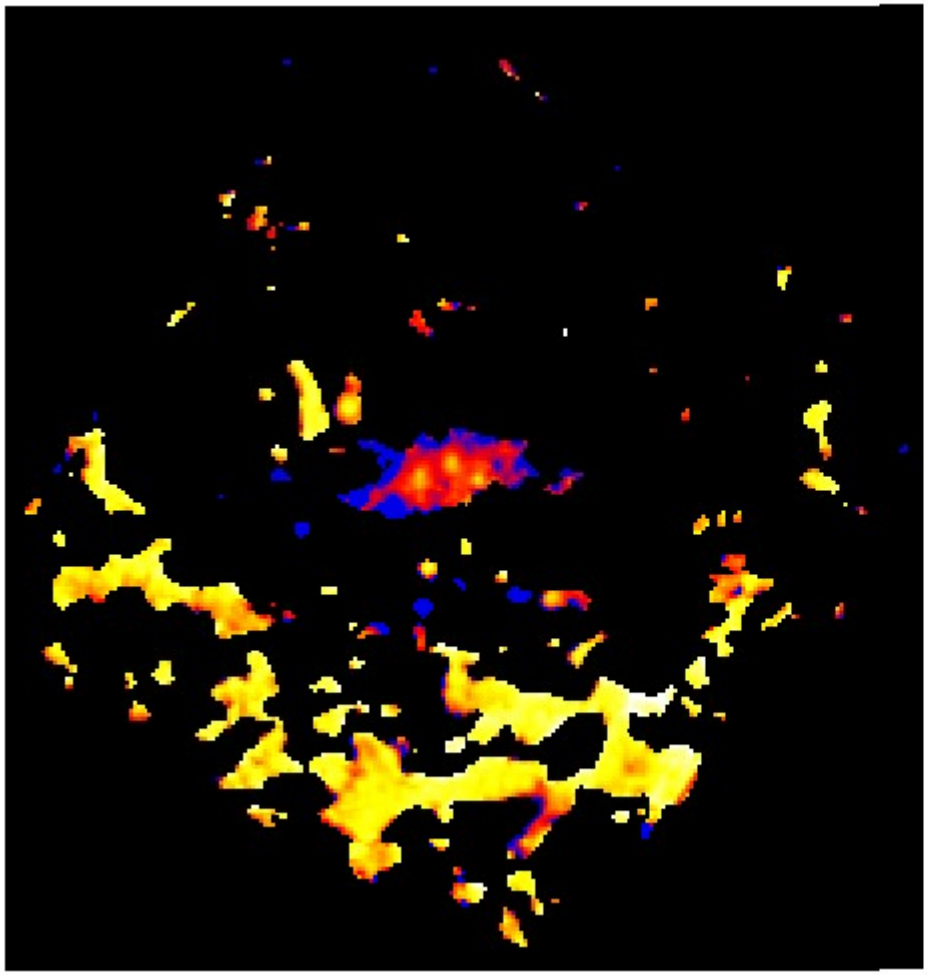
SDP observations

- PCC288
  - PACS: three AORs, total ~0.5 hours; 15 arcmin square, homogeneous coverage
  - SPIRE: 20 arcmin, orthogonal scans
- PCC249
  - parallel mode, orthogonal scans, ~30×30'; ~2 hours
- PCC550
  - PACS: three AORs (0+45+135 deg), 15 arcmin; ~1 hour

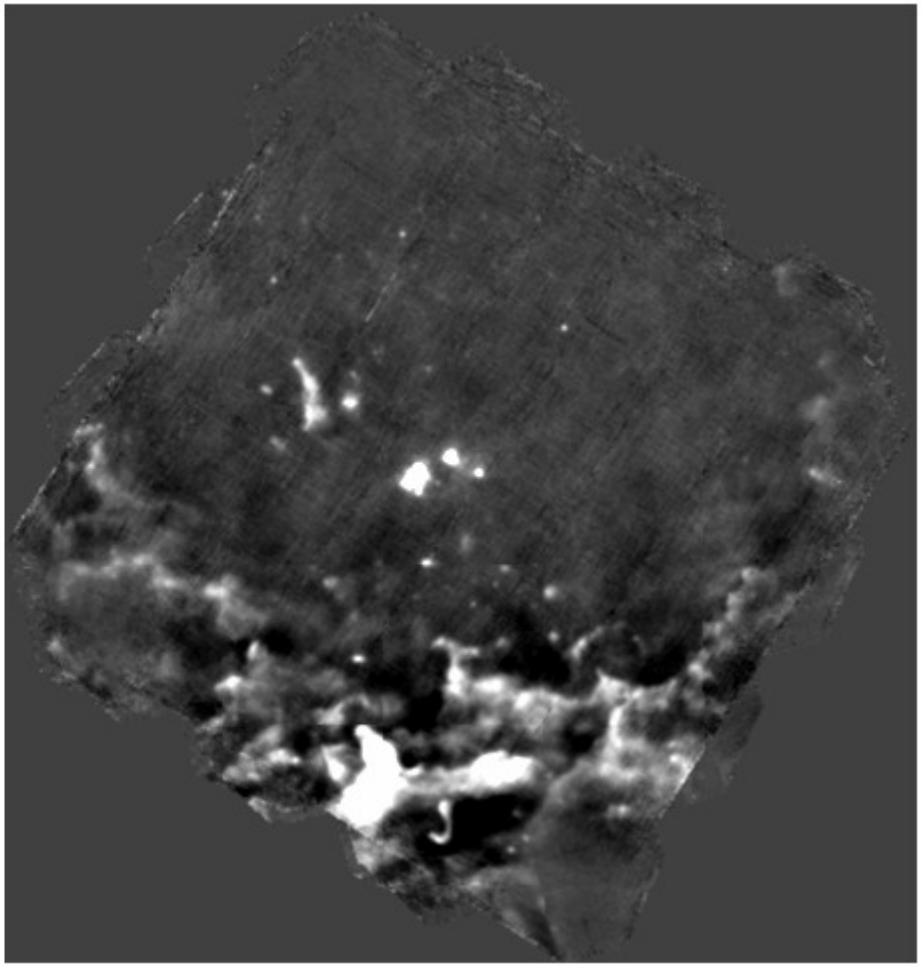
PCC288



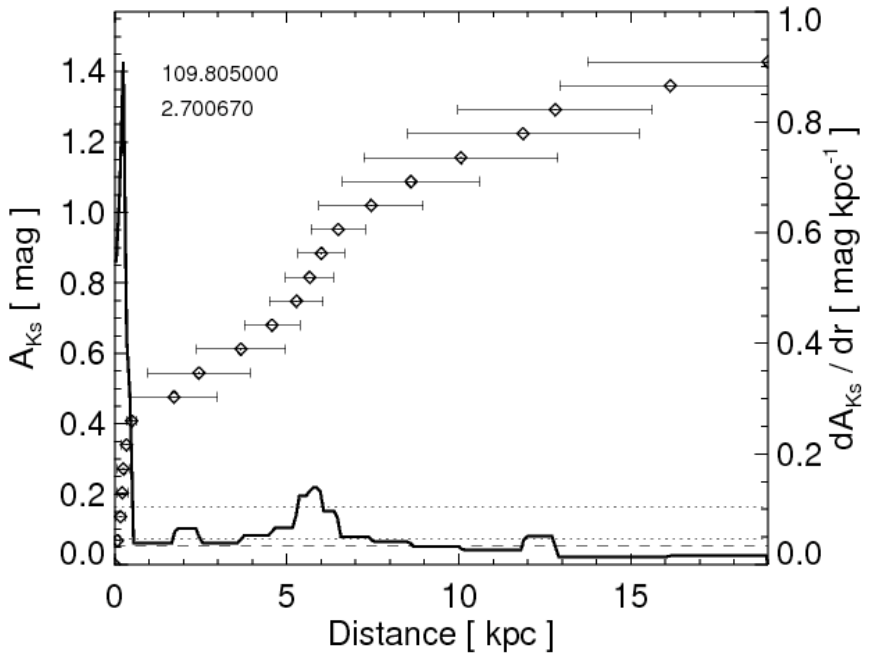
Relative temperature

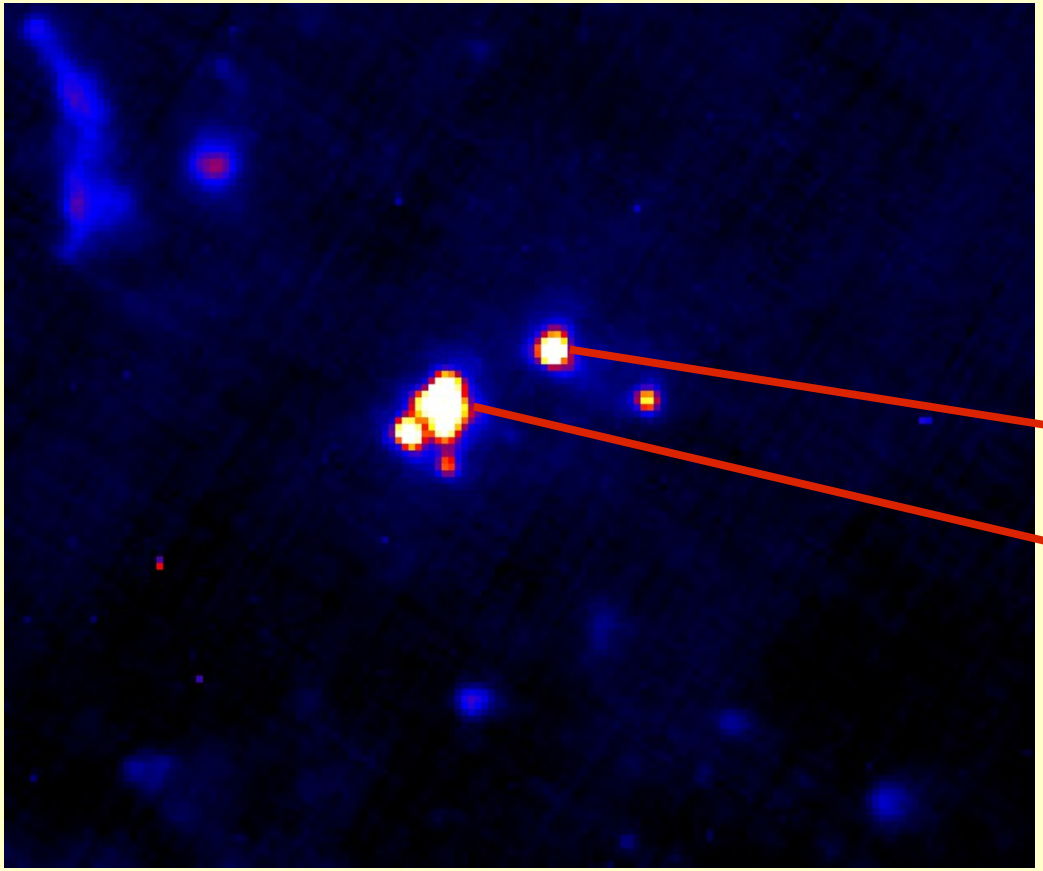


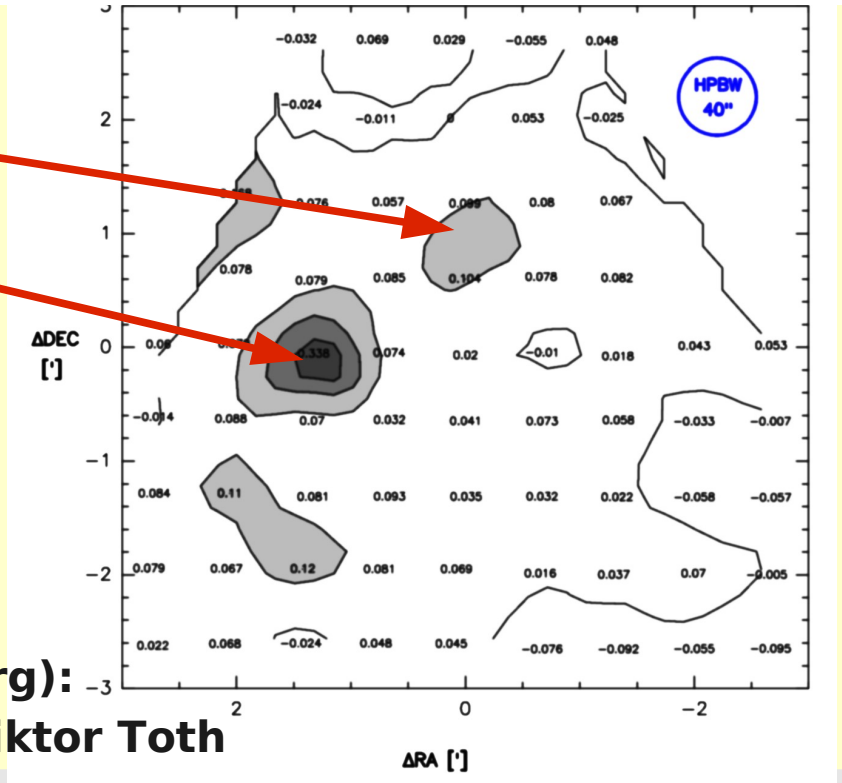
PACS green



3D extinction:
Doug Marshall

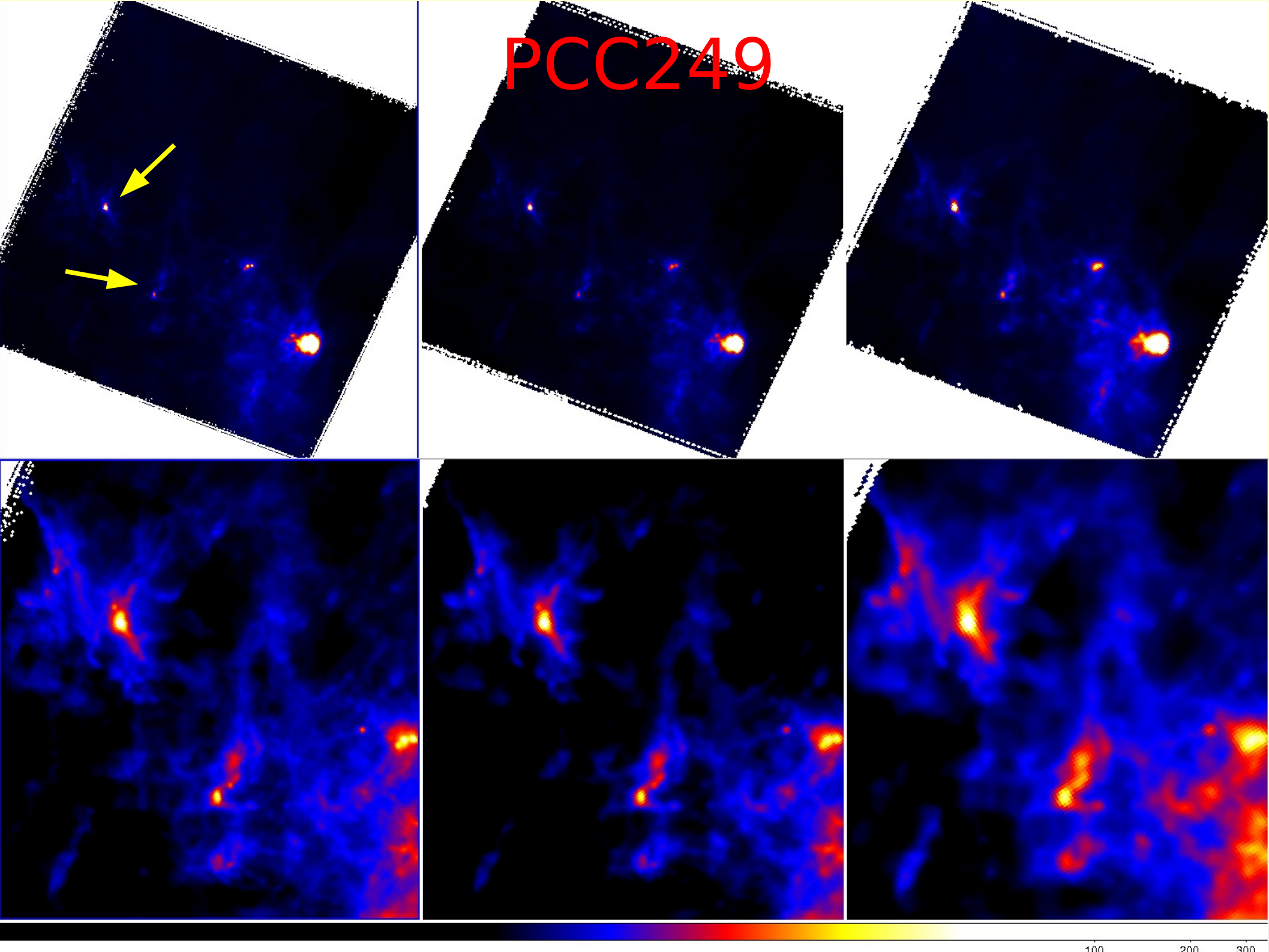


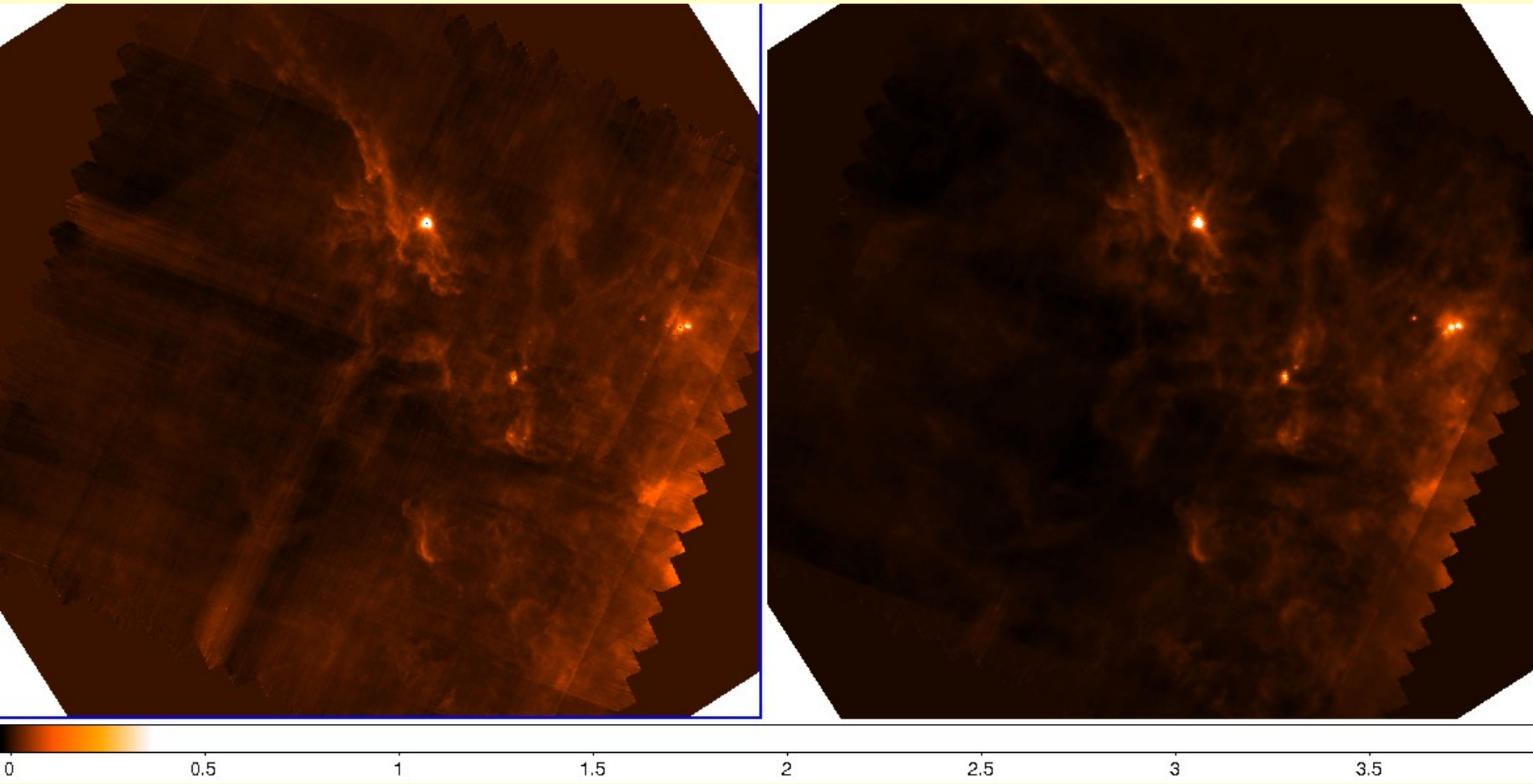




PACS data reduction:
L. Anderson

NH_3 data (Effelsberg):
Erika Werebelyi, Viktor Toth


PCC249
100
200
300


0
0.5
1
1.5
2
2.5
3
3.5

Plan for the future

- follow-up observations and analysis of SDP sources
- publication of a paper in the Herschel special issue
- 2010: analysis of first Planck sky survey
- end of 2010: target list for the actual Herschel survey of Cold Cores