Star formation triggered by expanding HII regions

Herschel first results

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Motte, Zavagno, Bontemps et al. HOBYS Saclay, France
Molinari and the Hi-GAL team IFSI-INAF, Italy
Abergel, Zavagno & SAG4 IAS, France

Outline

- Context: star formation triggered by expanding Galactic HII regions
- New Herschel results
  - A population of highly embedded YSOs
  - A massive Class 0 at the border of RCW120
  - Temperature maps
  - The (β, T) relation
  - First SPIRE FTS results
  - More to come…..
  - Towards a global study on the Galactic scale with Hi-GAL

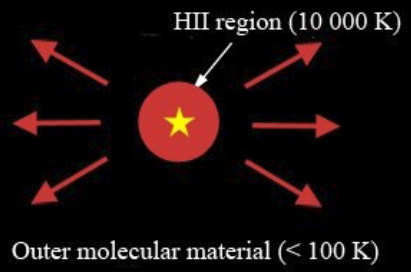
Star formation triggered by expanding HII regions

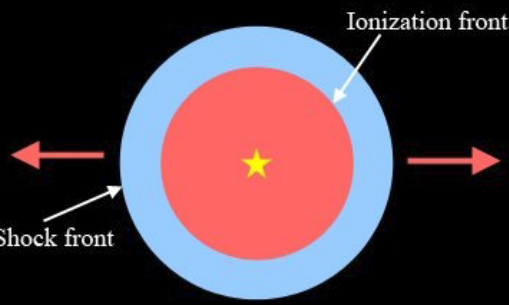
- Bright IR sources are observed on the borders of HII regions
- Star formation can be triggered by means of expanding HII regions (with different physical mechanims)
- HII regions are a good place to study the earliest phases of star formation

→ Select HII regions with a simple morphology (bubbles)

The collect and collapse process (Elmegreen & Lada 1977)

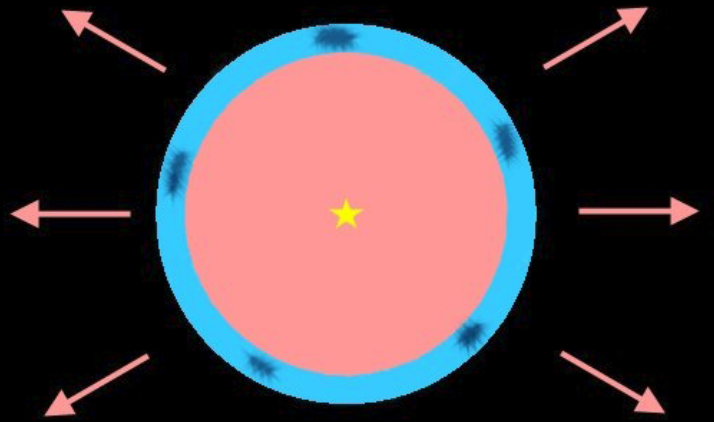
1. Expansion of the HII region

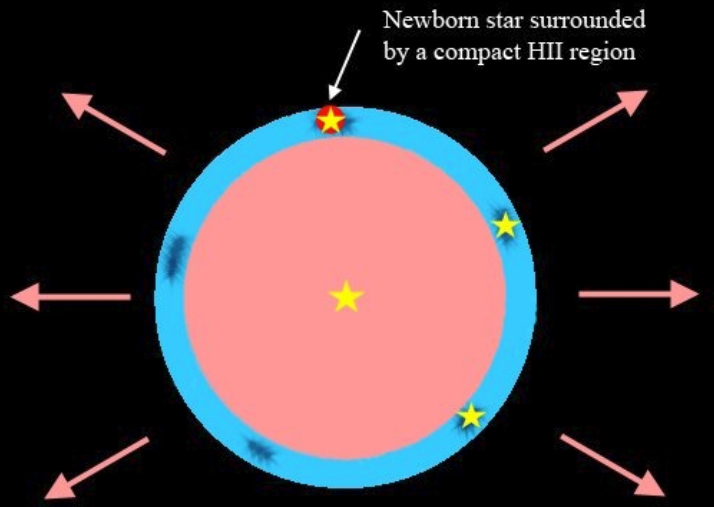




2. Formation of a dense layer surrounding the HII region

3. Gravitational collapse of the layer into dense fragments

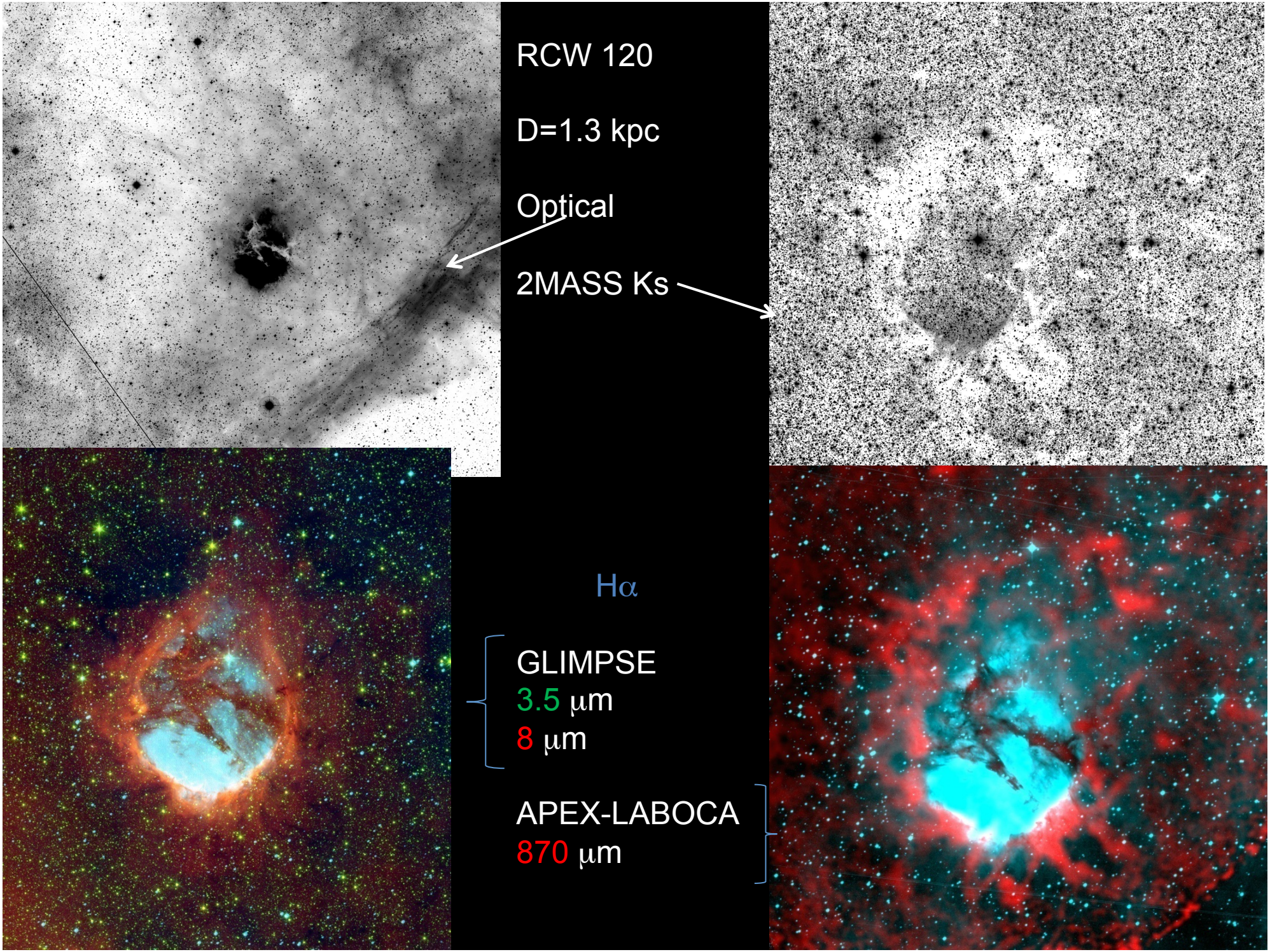


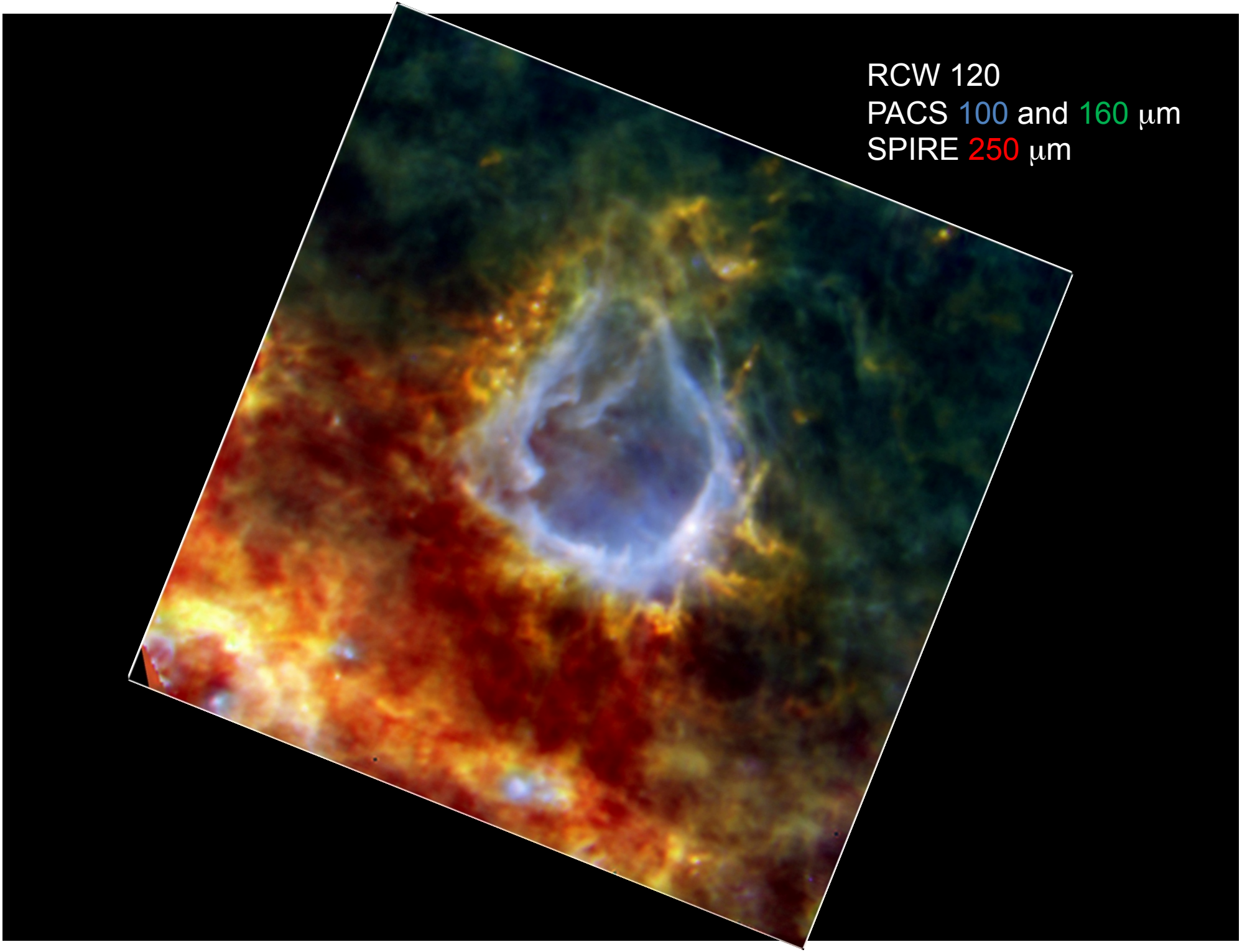


4. New stars forming in the fragments

Herschel programs

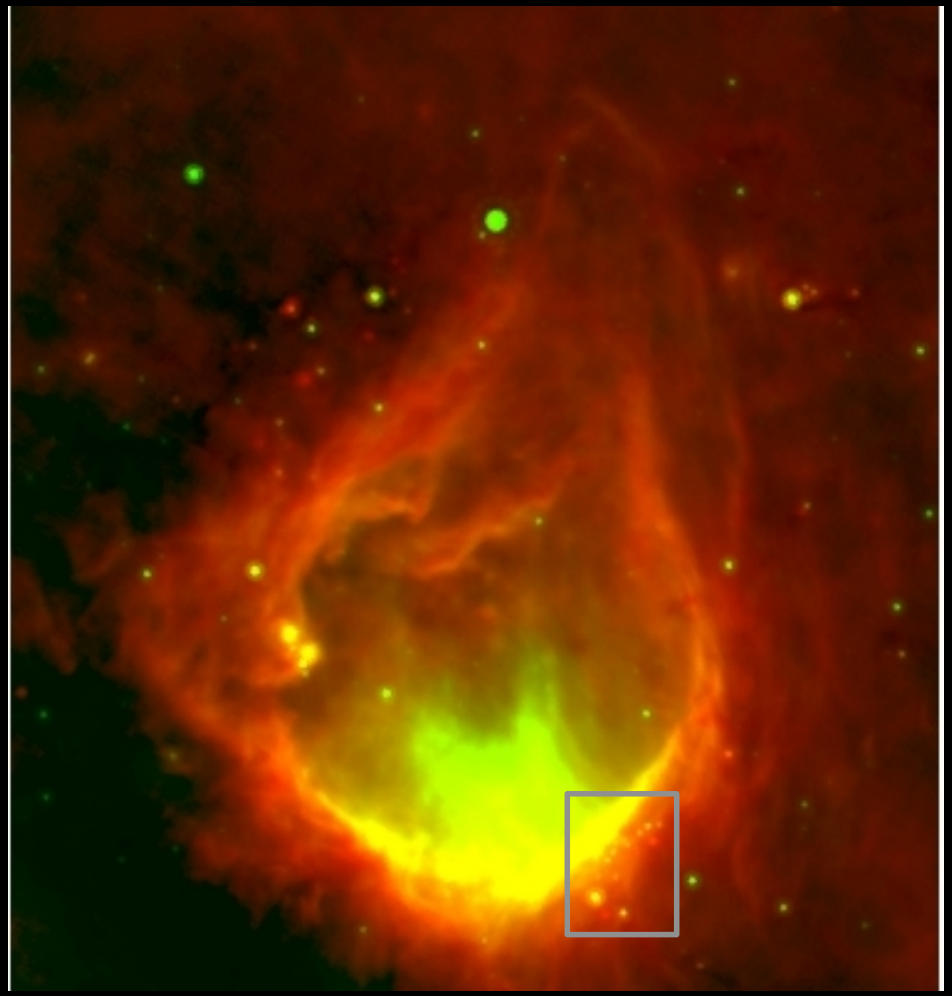
- Guaranteed time key-programs: HOBYS (Motte et al.) and Evolution of interstellar dust (Abergel et al.)
- SPIRE and PACS imaging and spectroscopy of Galactic HII regions with bubble morphology where triggered star formation is at work
- Open time key-program Hi-GAL (Molinari et al.): survey of the Galactic Plane with PACS and SPIRE


RCW 120
D=1.3 kpc
Optical
2MASS Ks
Hα
GLIMPSE
3.5 μm
8 μm
APEX-LABOCA
870 μm

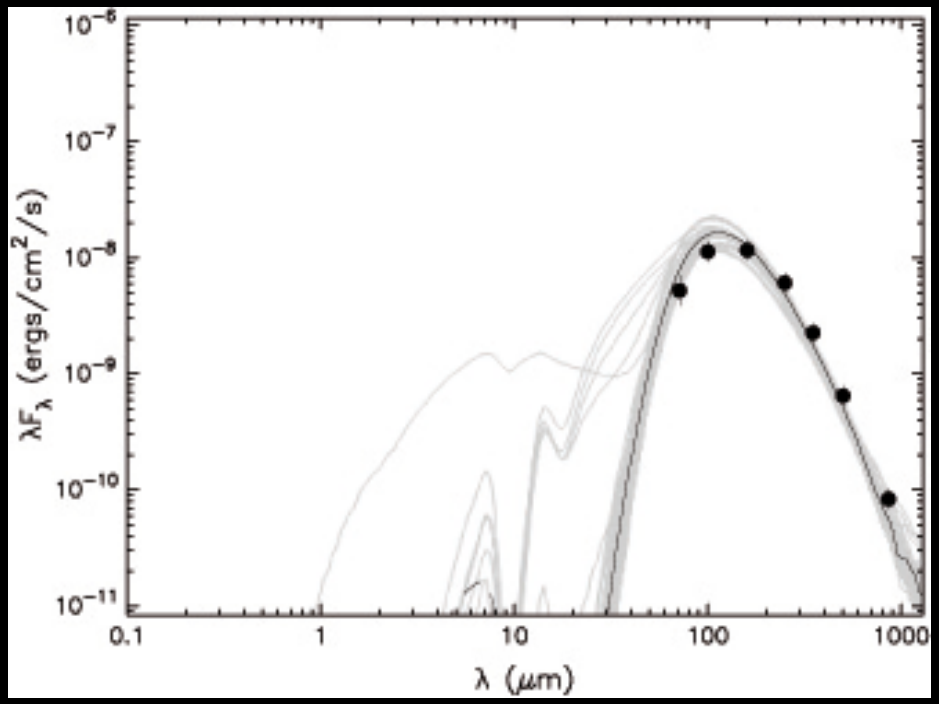

RCW 120
PACS 100 and 160 μm
SPIRE 250 μm

A population of highly embedded young stars towards RCW 120

Spitzer-MIPSGAL 24 μm
PACS 100 μm

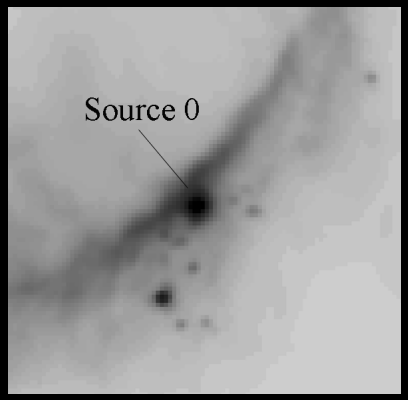


A massive Class 0 on the border of RCW 120



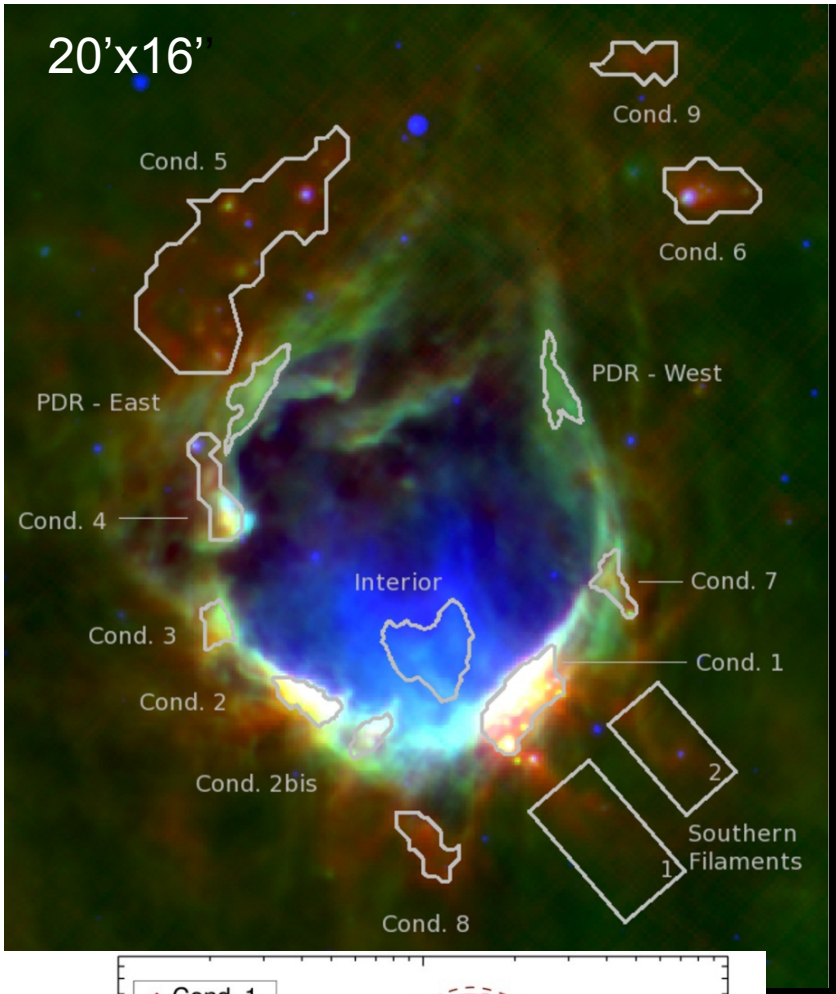
A massive Class 0 (8-10 M_{sun})

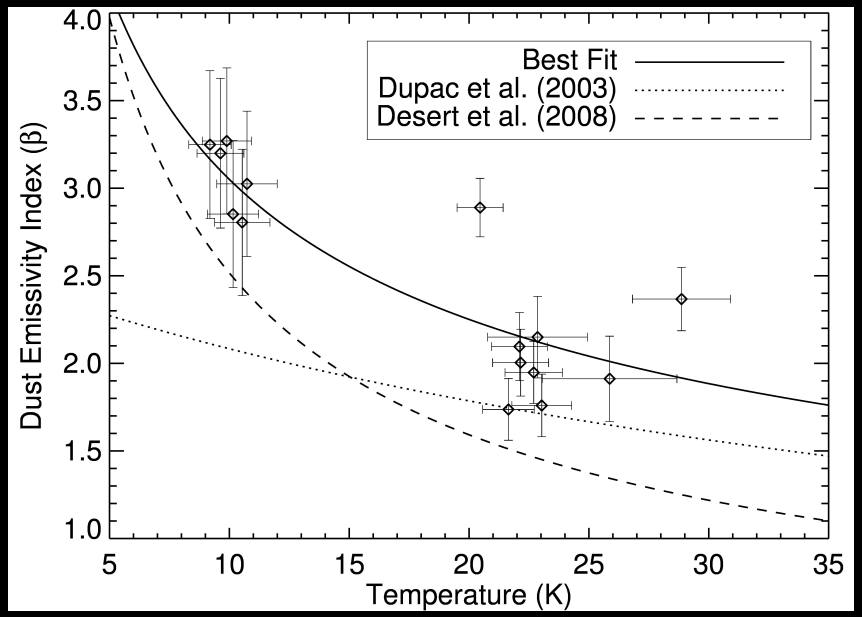
SED using Robitaille et al. (2007) model

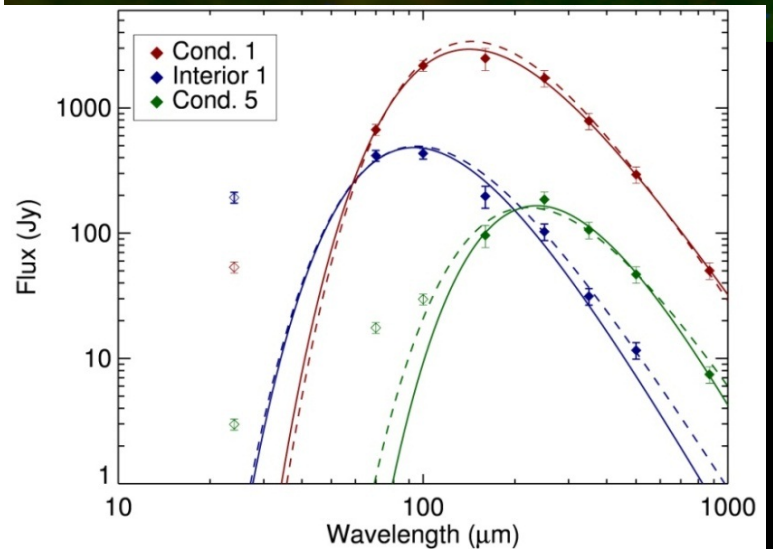


PACS 100 μm

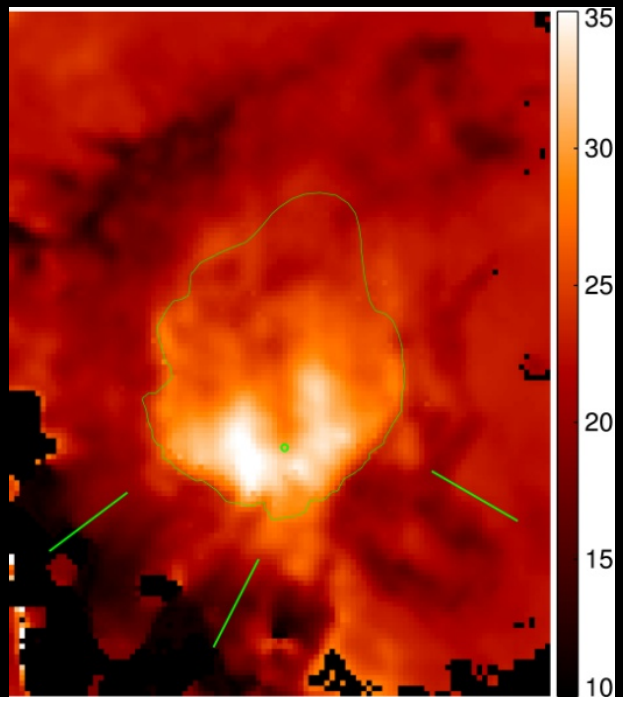
Temperature maps - The β - T relation
Anderson et al. (2010)



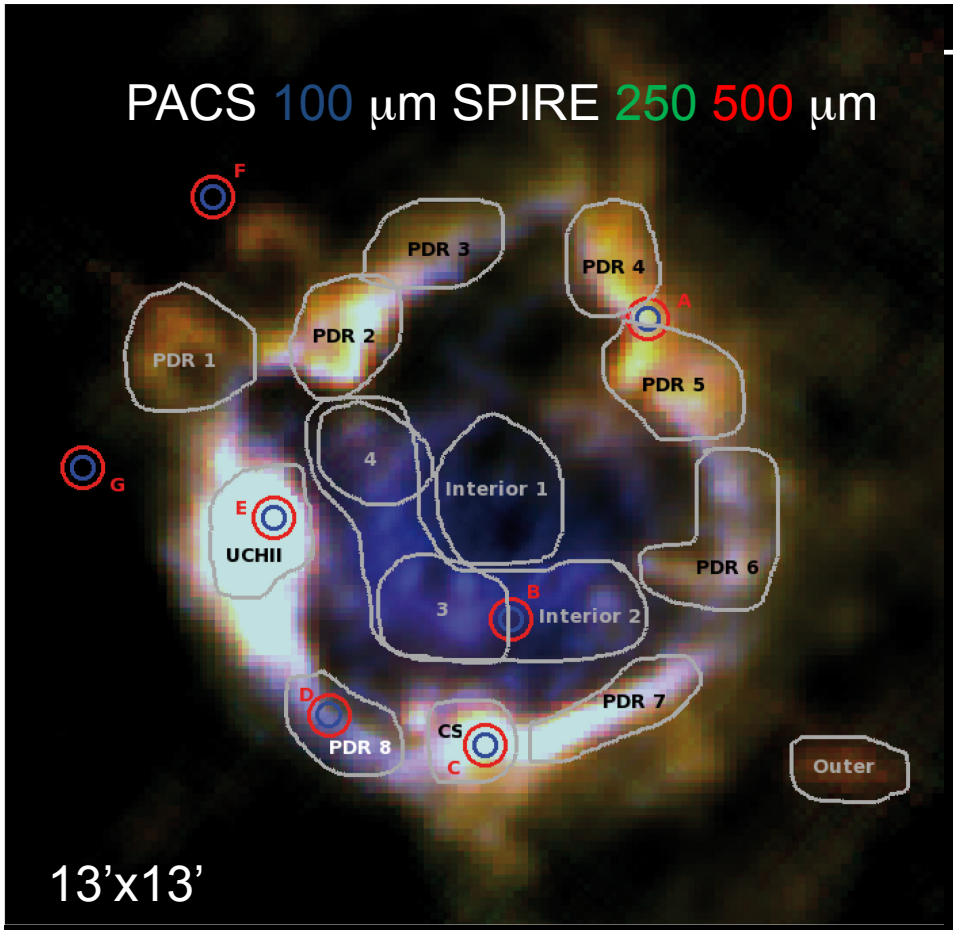




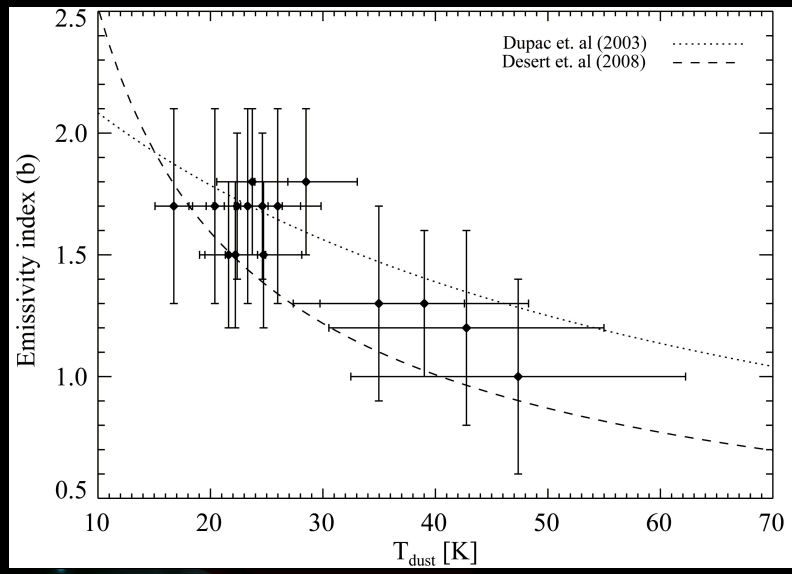
RCW 120
D=1.3 kpc

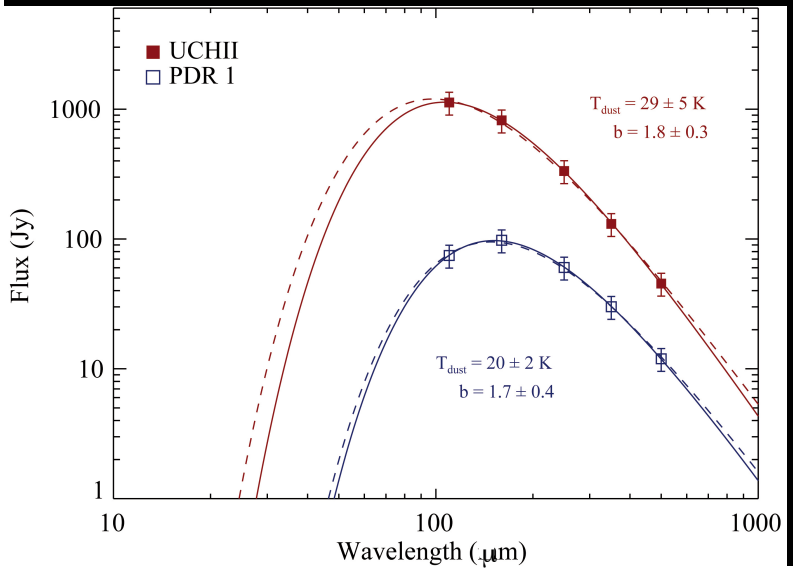


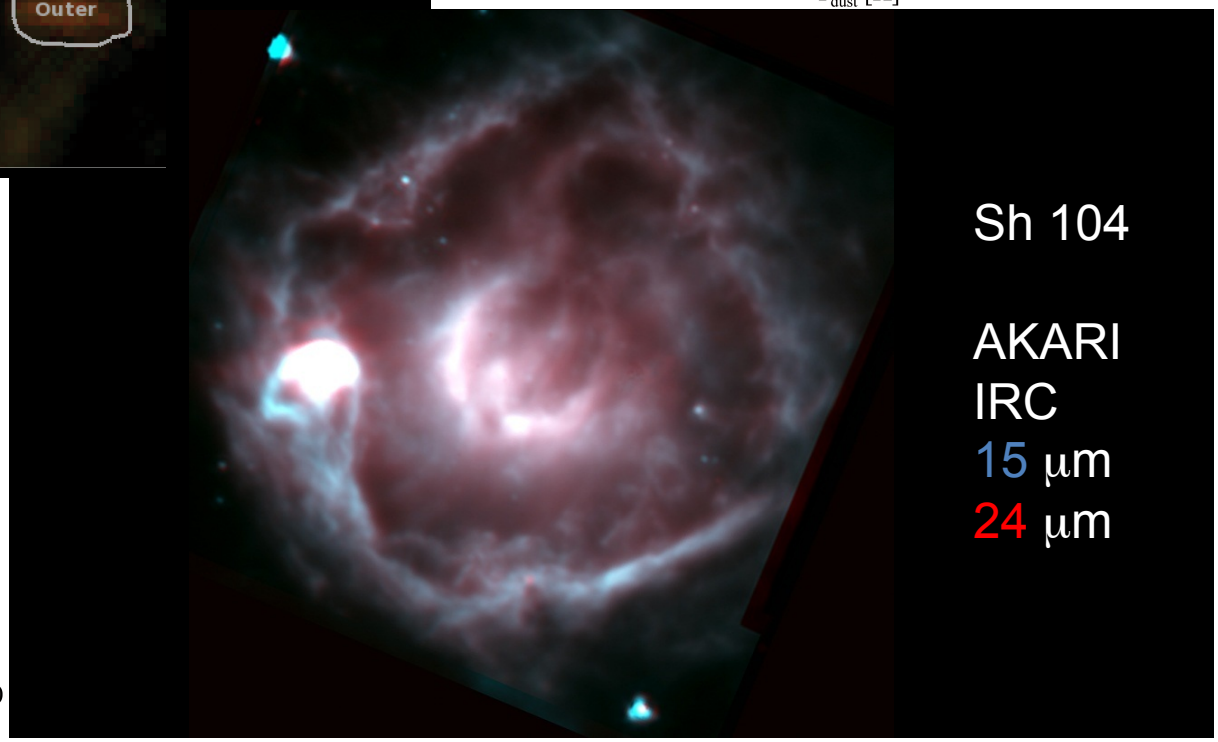
Temperature maps - The β - T relation
Rodón et al. (2010)



Sh104
D=4 kpc



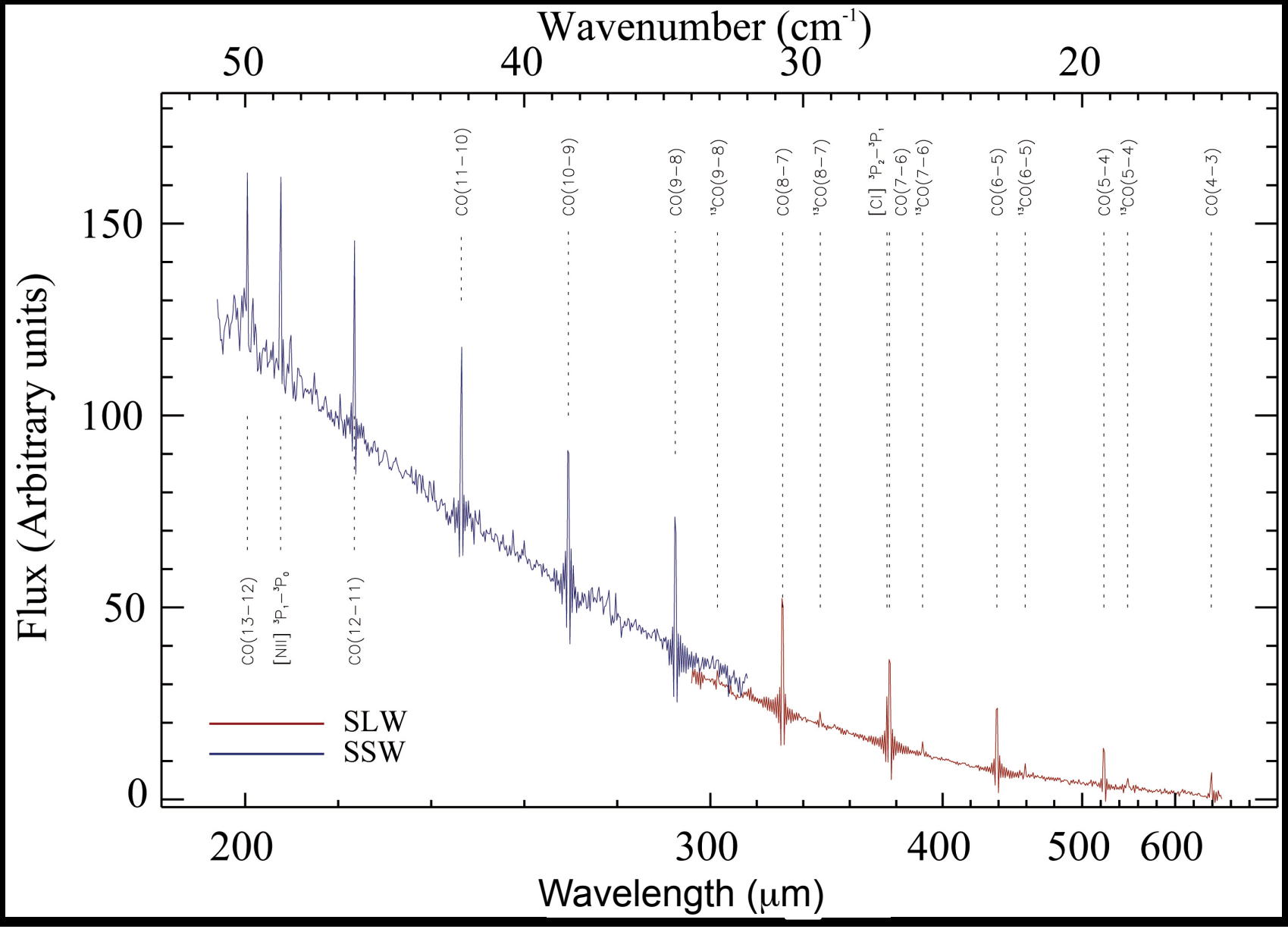




Sh 104

AKARI
IRC
15 μm
24 μm

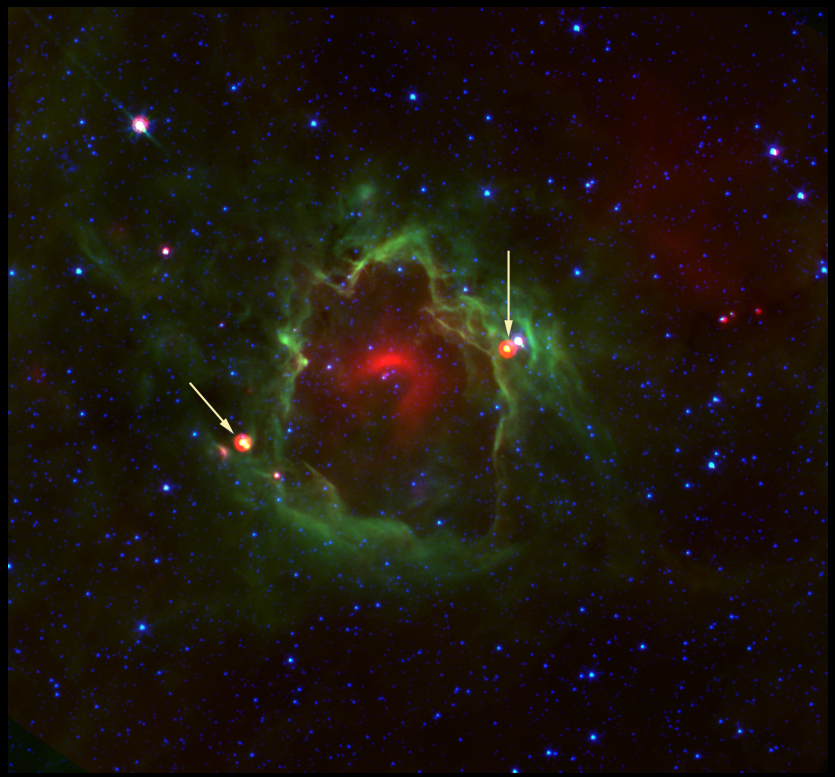
SPIRE-FTS first results: the UC HII region Rodón et al. (2010)



More to come….

SPIRE and PACS imaging
SPIRE-FTS and PACS spectroscopy

RCW 82

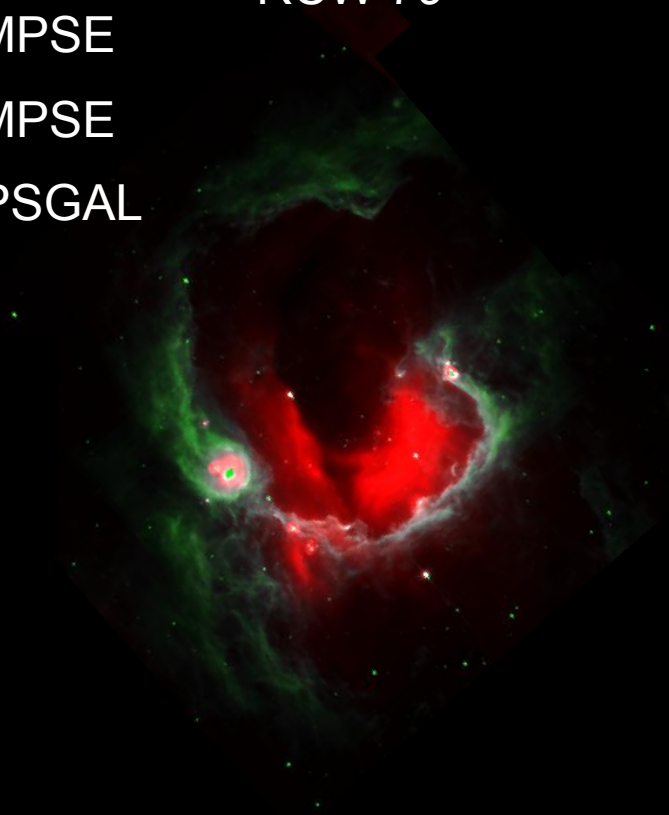


3 μm GLIMPSE

8 μm GLIMPSE

24 μm MIPSGAL

RCW 79



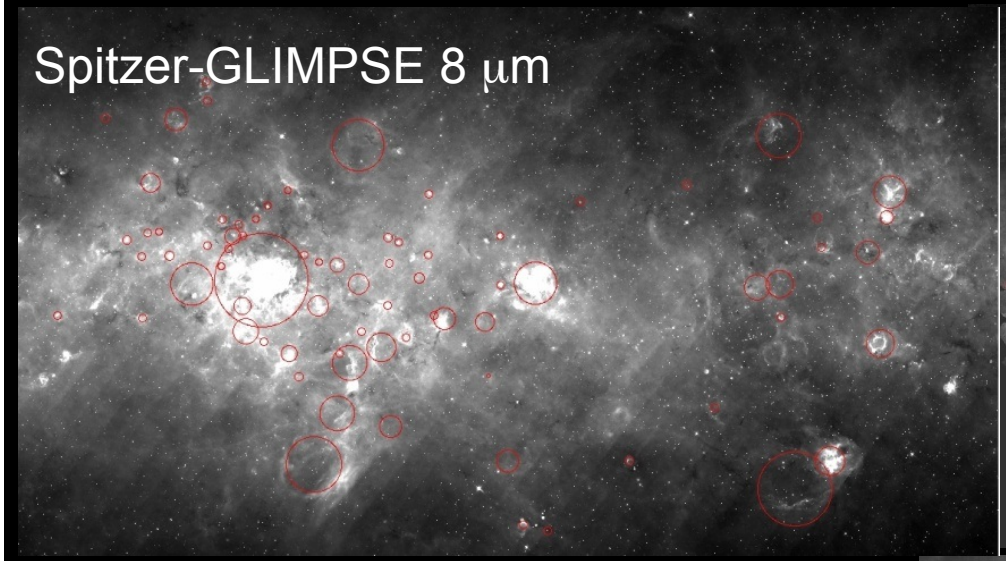
Towards a global study using Hi-GAL

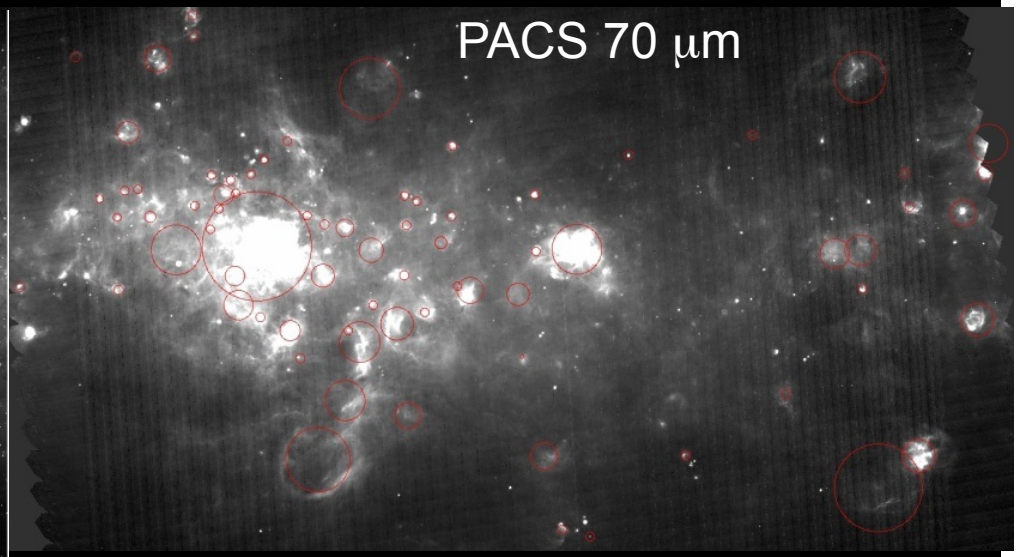
More than 600 bubbles in the Galaxy (Churchwell et al. 2006)

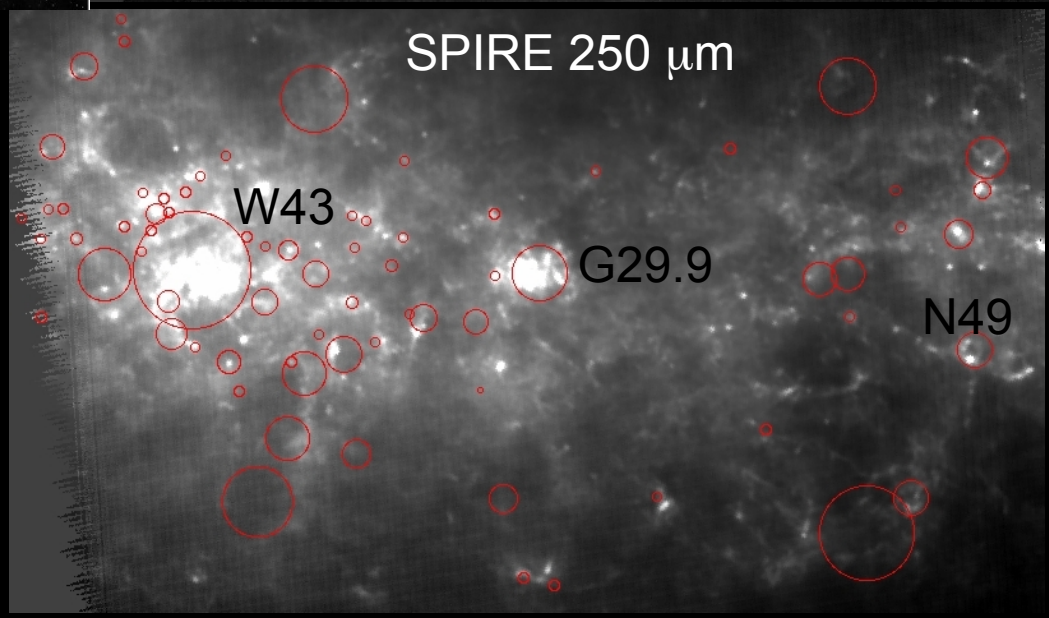
Use multiwavelength surveys to study the star formation triggered by expanding HII regions

Statistics and efficiency (see N. Billot's talk)
Census of massive star formation in our Galaxy (trace the mass and evolutionary stage)

A multiwavelength view of our Galaxy

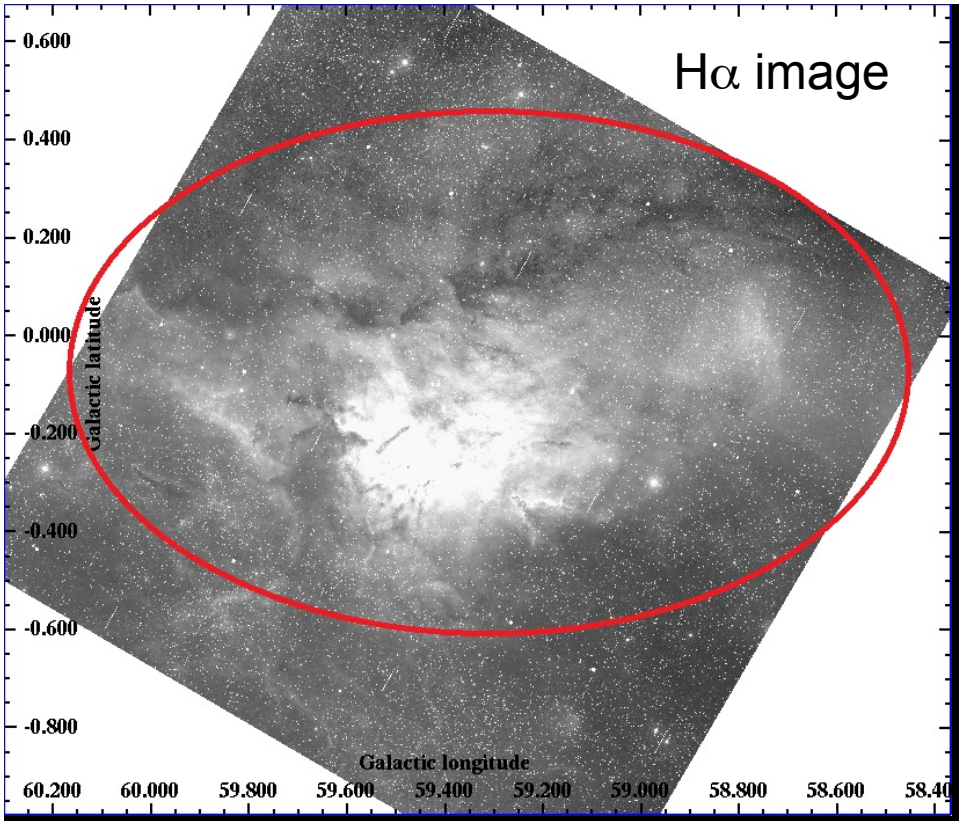


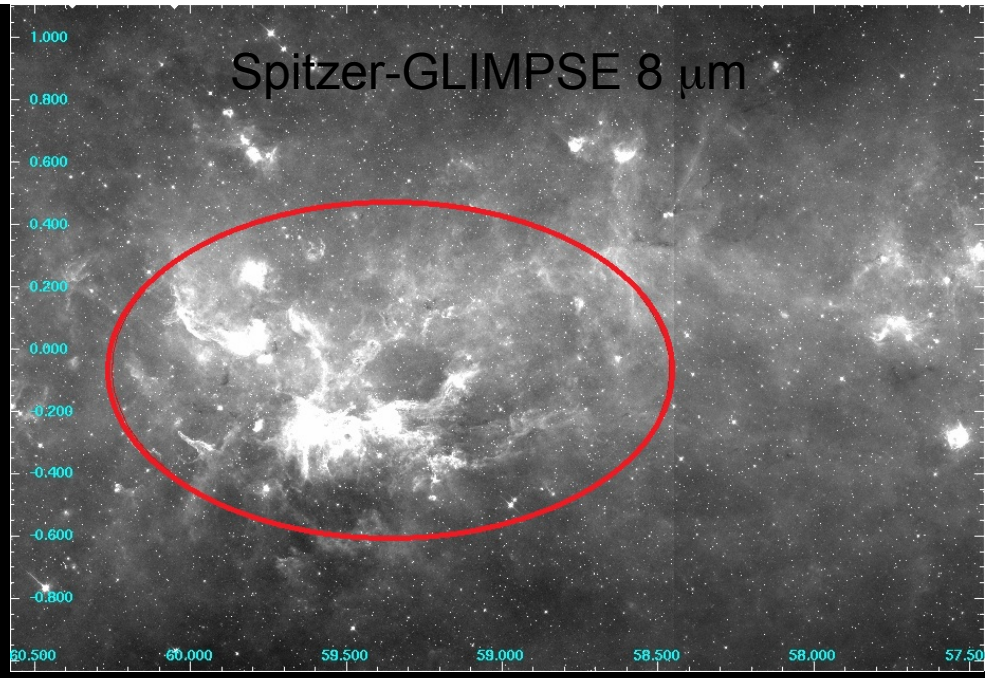


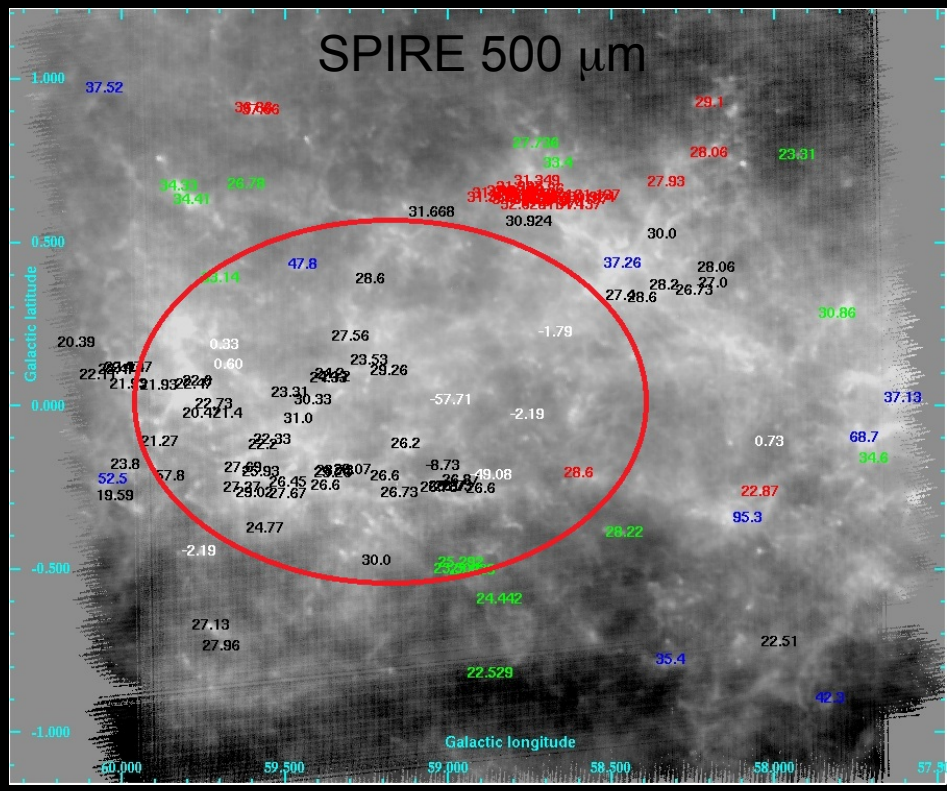


76 HII regions in the l=30° field

Distance determination is essential to discuss the TSF





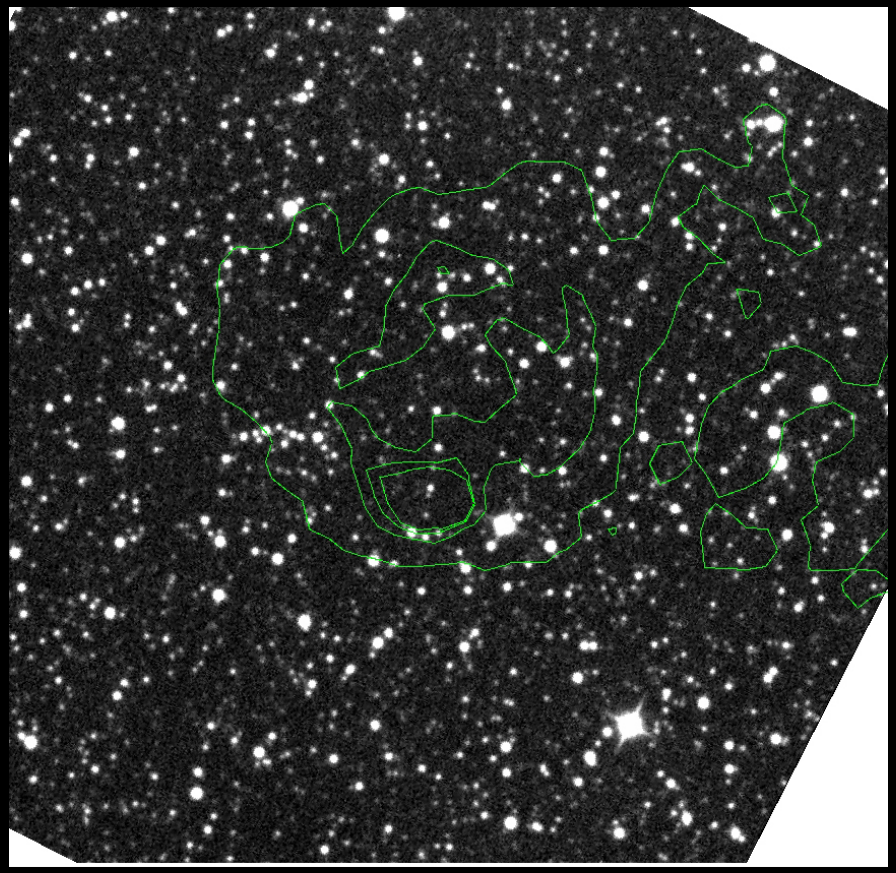


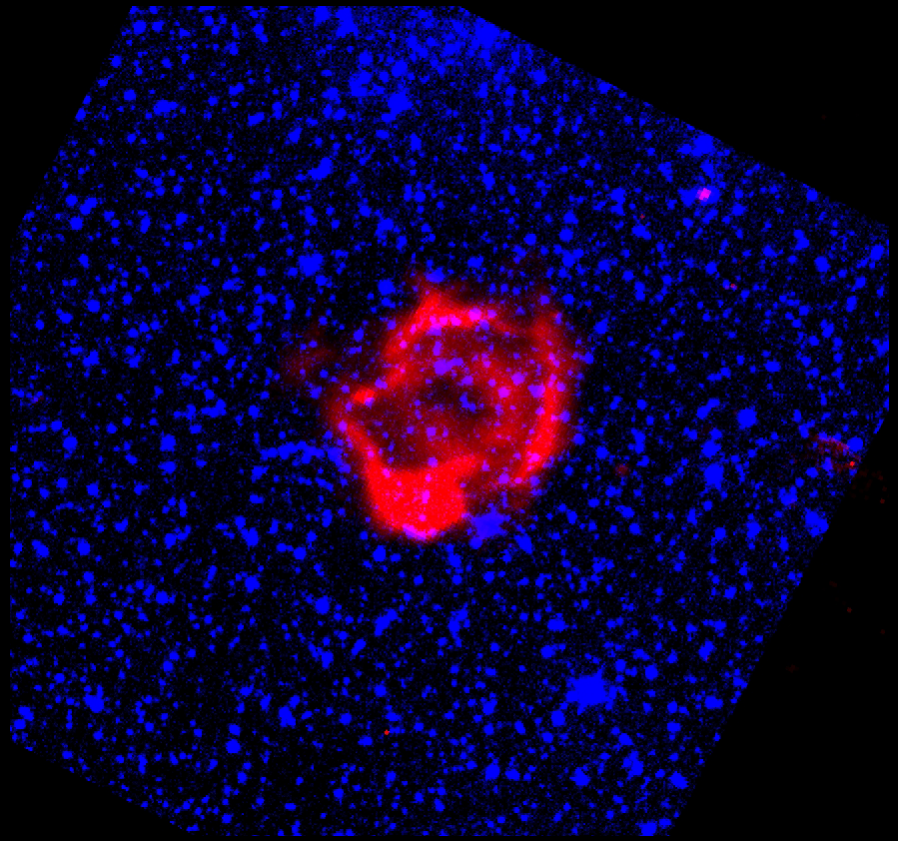
The case of Sh2-86

(Hi-GAL SDP field l=59°)

Russeil et al. (2010) + poster

First results on N49 (Zavagno et al.)

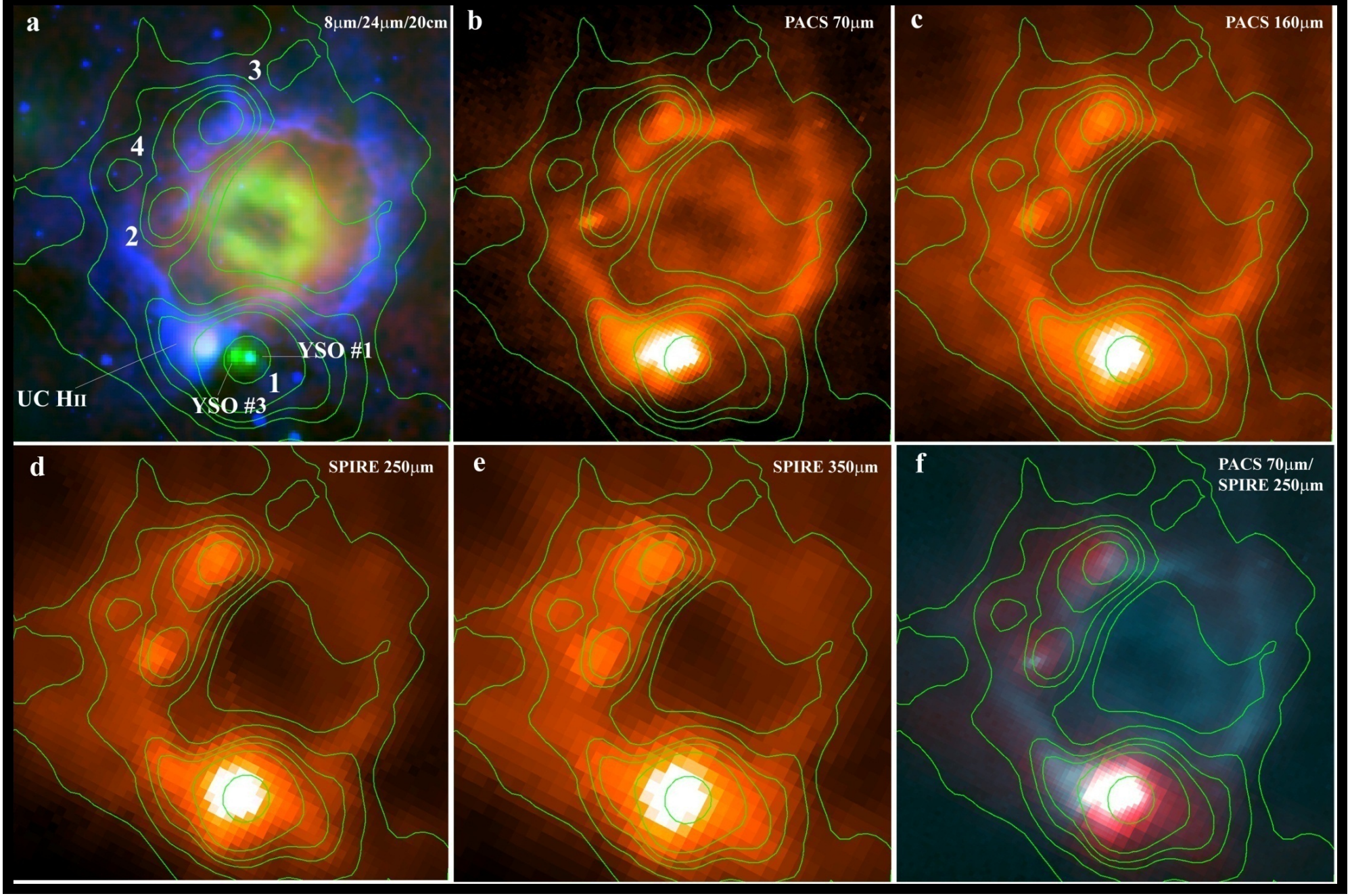




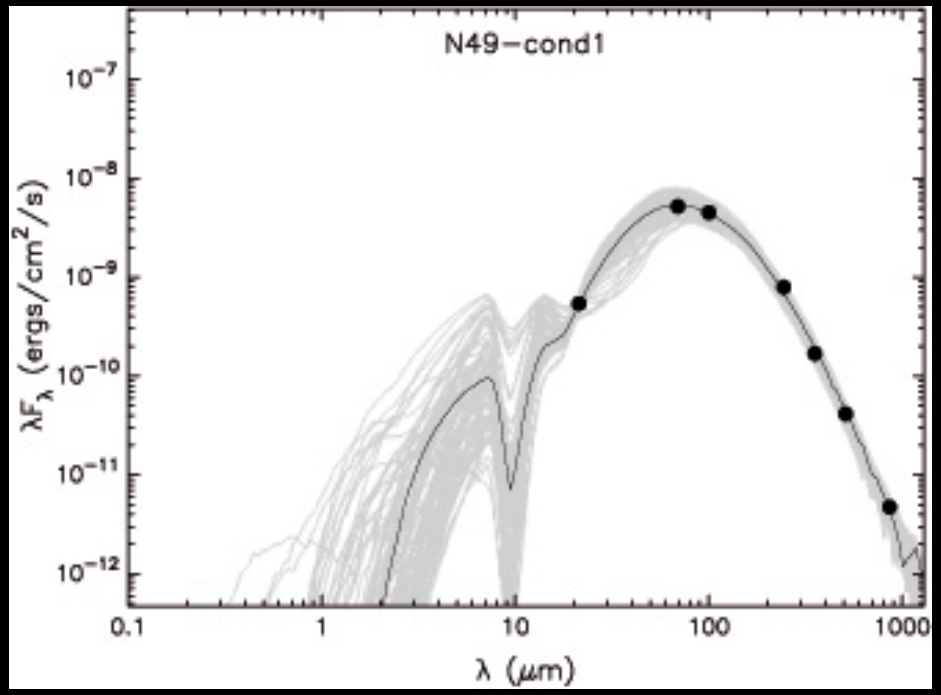
Optical (I-band) + ATLASGAL 870 μm (contours and red)

N49: Galactic HII region d=4.5 kpc

First results on N49 (Zavagno et al. 2010) (5'x5' field)

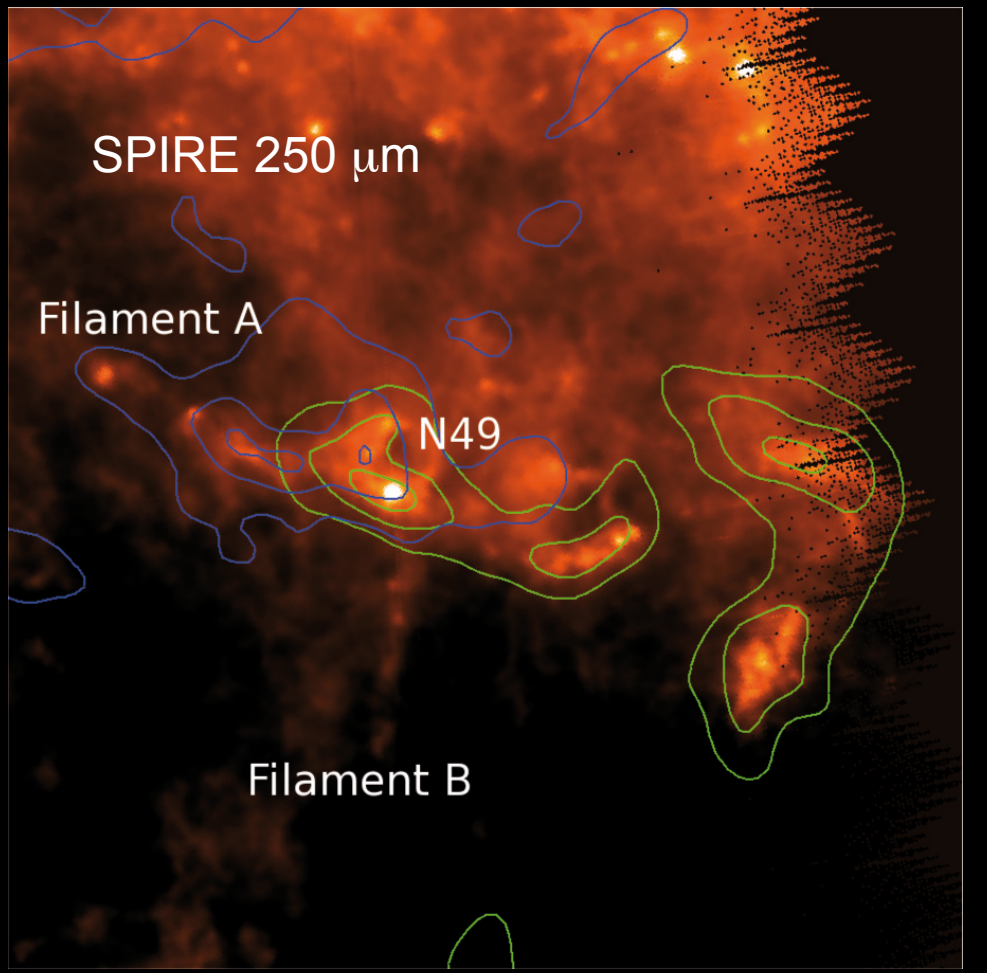


First results on N49 (Zavagno et al.)



A massive young star (8-10 M_{sun})

Four sites of massive star formation around N49→ importance of the winds from the first generation massive star?



Large scale study (1°x1°): Importance of distance determination when discussing the TSF (Russeil et al. 2010)

Thank you

Many thanks to the PACS and SPIRE instrument and ICC teams

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