



# Distribution of gas in our Galaxy

D. Russeil

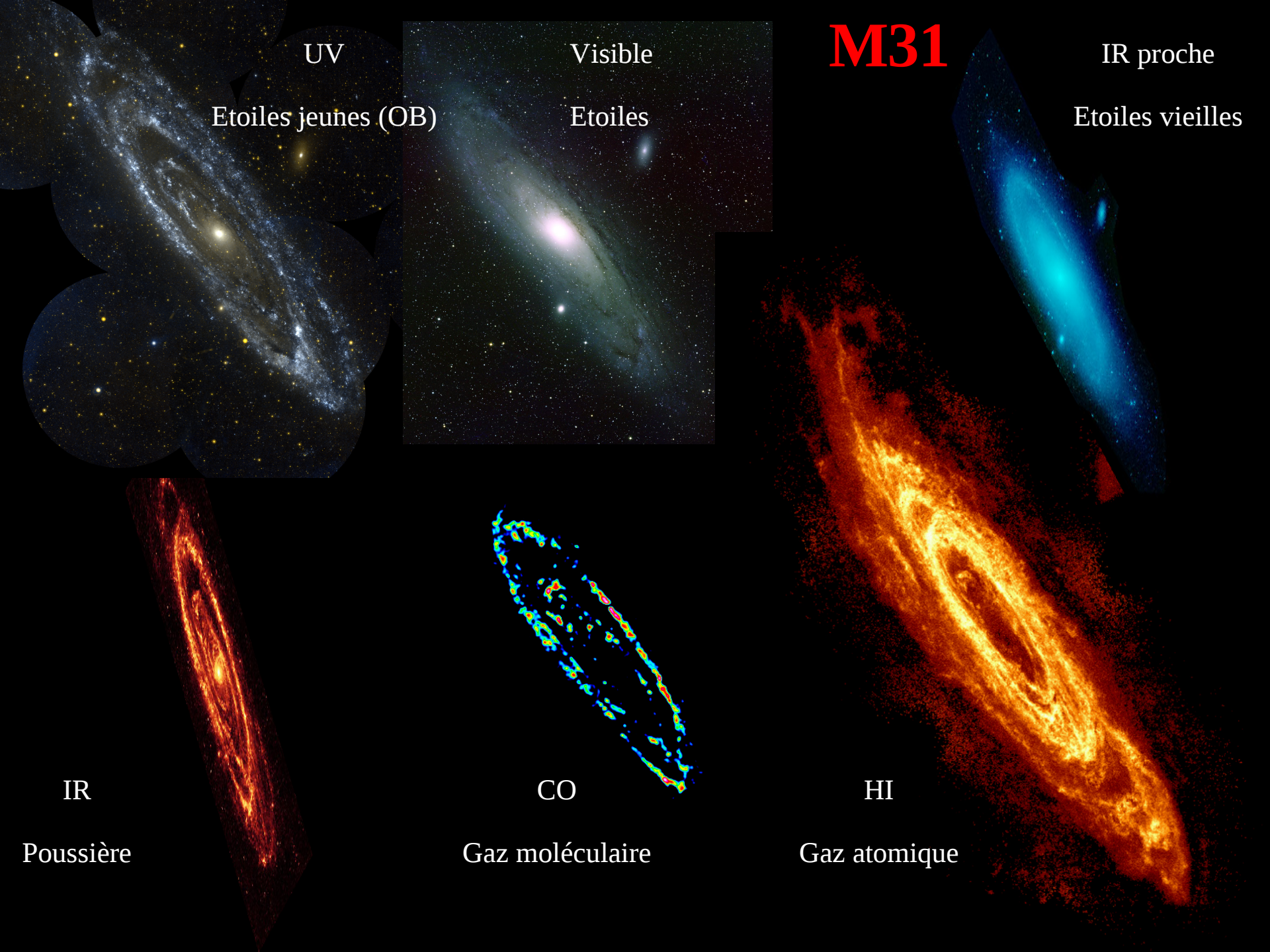
OAMP/LAM, Marseille, France

MdC Université de Provence

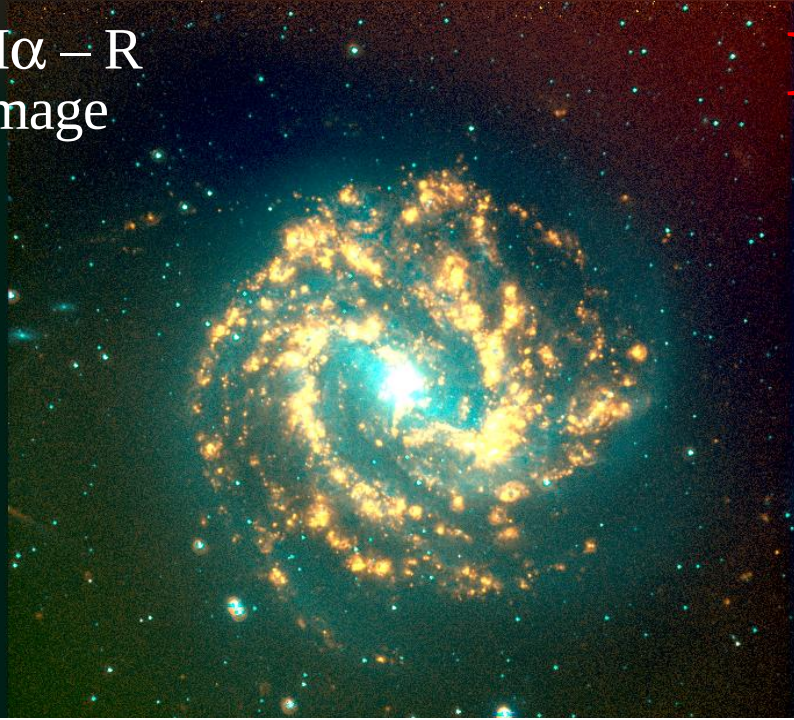
# The gas distribution in galaxies

**Examples: M31 et M83**



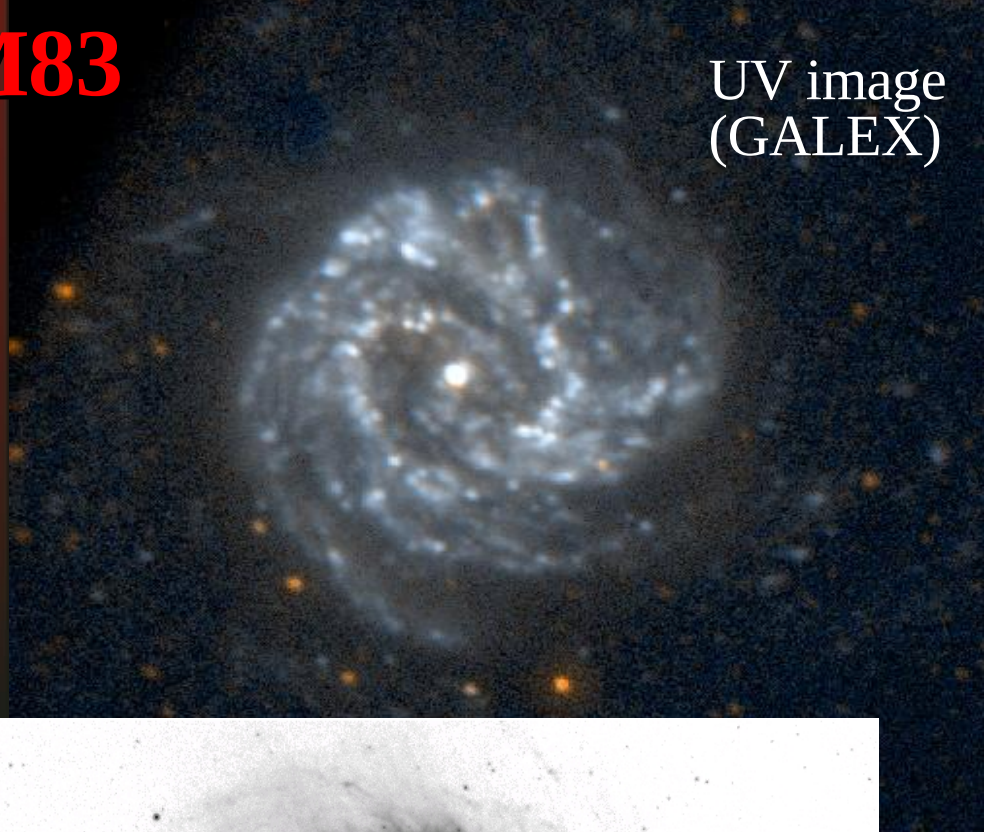


H $\alpha$  - R  
image

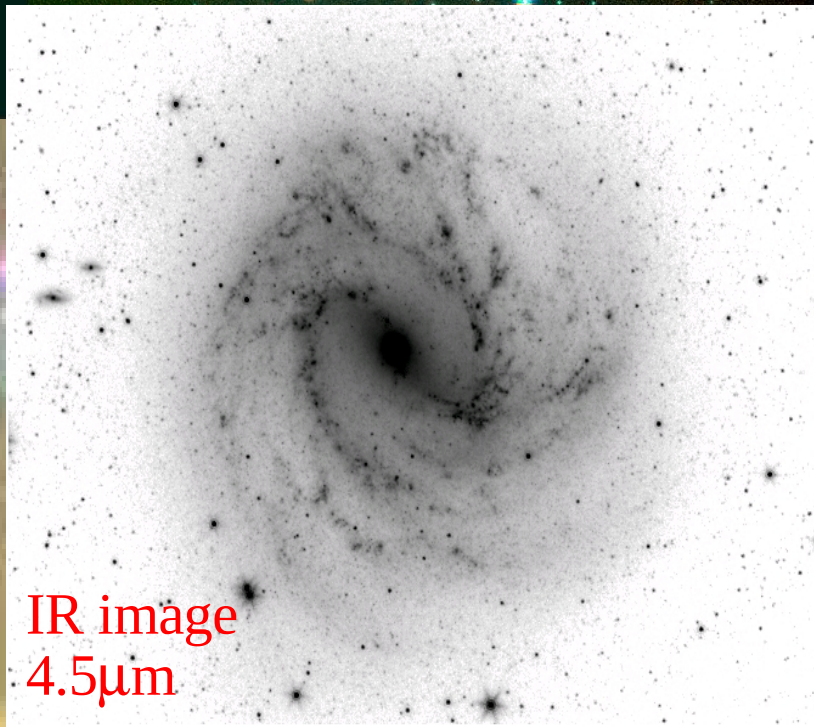


**M83**

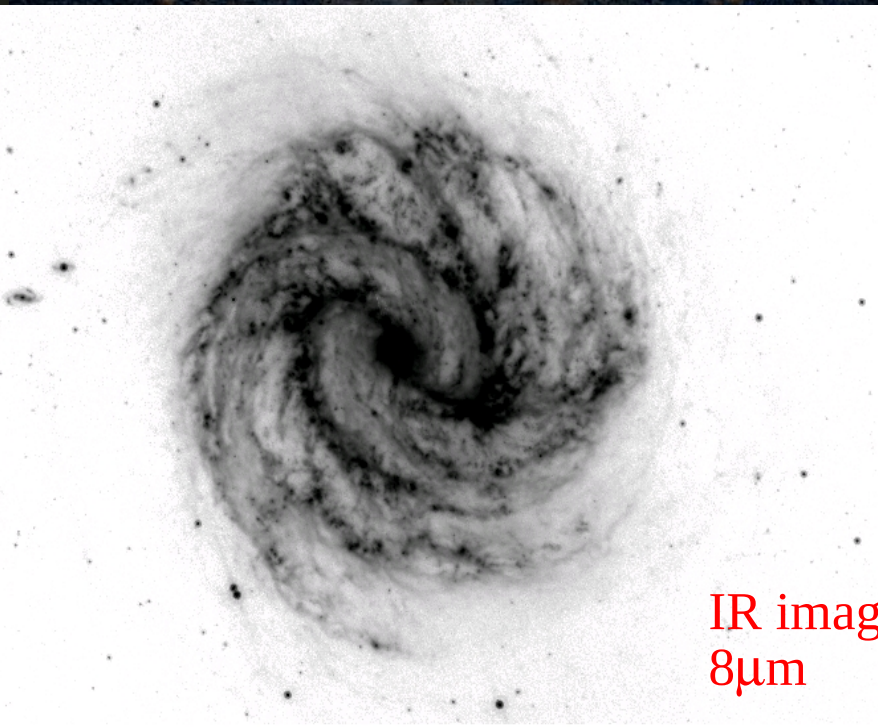
UV image  
(GALEX)



IR image  
4.5 $\mu$ m



IR image  
8 $\mu$ m



H $\alpha$  – R  
image

**M83**

UV image  
(GALEX)

Spiral arms = overdensity of gas  
(ionised + molecular), stars  
(especially OB stars) and dust

IR image  
4.5 $\mu$ m

IR image  
8 $\mu$ m

# Interstellar medium

## global view in our Galaxy

Ionised gas: HII regions + WIM

HII regions: around OB stars,  $20 - 1000 \text{ cm}^{-3}$ ,  $< 30 \text{ pc}$

WIM: widespread ( $h \sim 1 \text{ kpc}$ ), 20% of the disk volume,  $0.08 \text{ cm}^{-3}$

Molecular gas: GMC, clumps, cores ...

contrast arm-interarm  $\sim 28:1$

GMC:  $10^5 - 10^6 M_{\text{sun}}$ ,  $50 - 100 \text{ pc}$ ,  $10^2 - 10^3 \text{ cm}^{-3}$

Clumps and cores:  $< 1 \text{ pc}$ ,  $10^4 - 10^6 \text{ cm}^{-3}$

Atomic gas:

contrast arm-interarm  $\sim 3:1$

“Widespread” ( $h \sim 200 - 600 \text{ pc}$ ), High latitude high velocity clouds, Warp,  $1 - 500 \text{ cm}^{-3}$

# The structure of our Galaxy

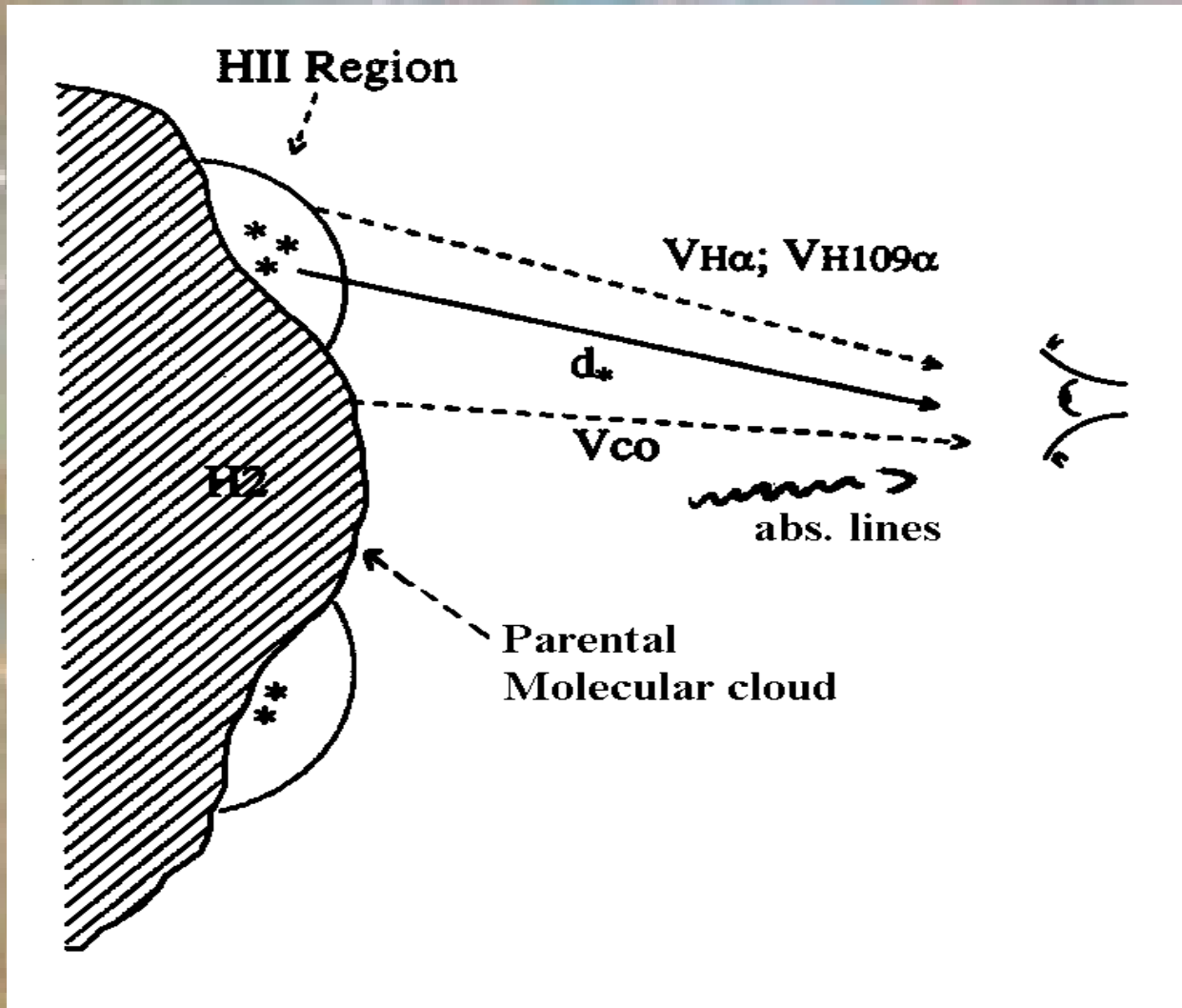
- > same tracers as external galaxies
- > identification and distribution of star-forming complexes

Problem: we are inside the Galaxy !!!!

- Information along the line of sight is superimposed
- Distance ambiguity problem (inner Galaxy)

# The star-forming complexes

- Why? => reduce spatial and kinematic spread of objects belonging to the same complex.





## Identification of a Complex

Multiwavelength lines: H $\alpha$ , radio recomb., Molecular, Absorption

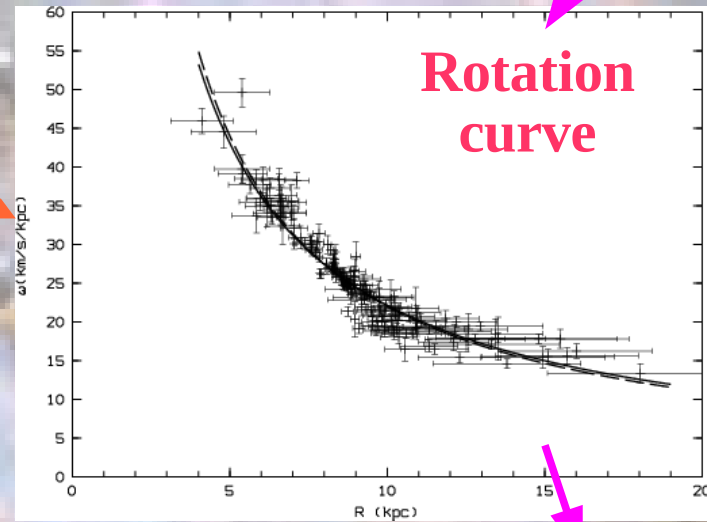
Stellar distance  
(up to ~6 kpc)

Identification of the  
exciting star: UVB  
photometry + spectro.

Systemic velocity  
*Internal motion*

Spatial Distribution of the  
complexes

Physical properties of HII  
regions: Size, ionising photon  
flux, Masse/ density of ionised  
gas ....

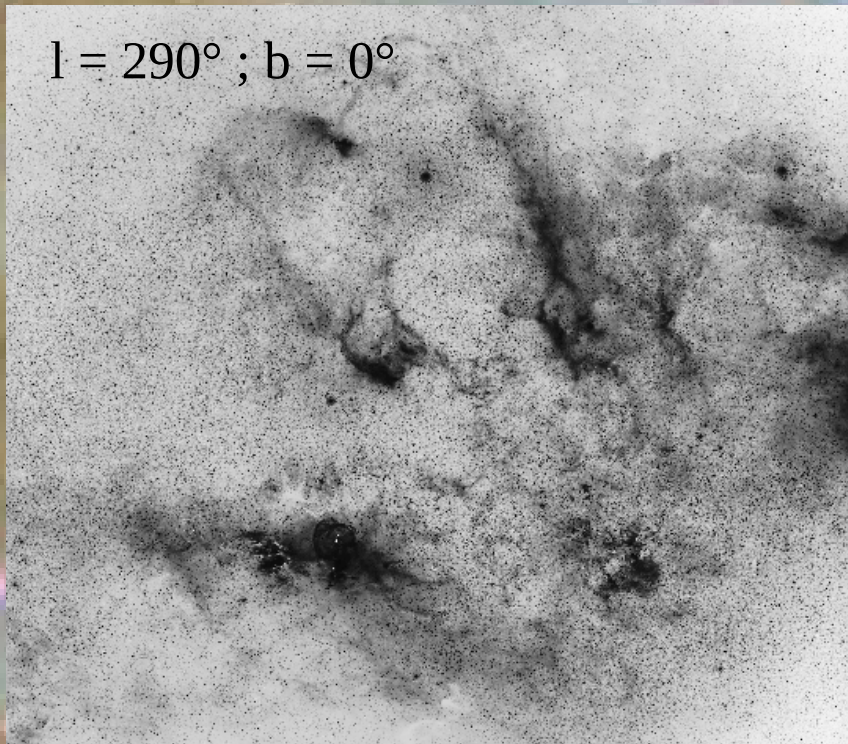
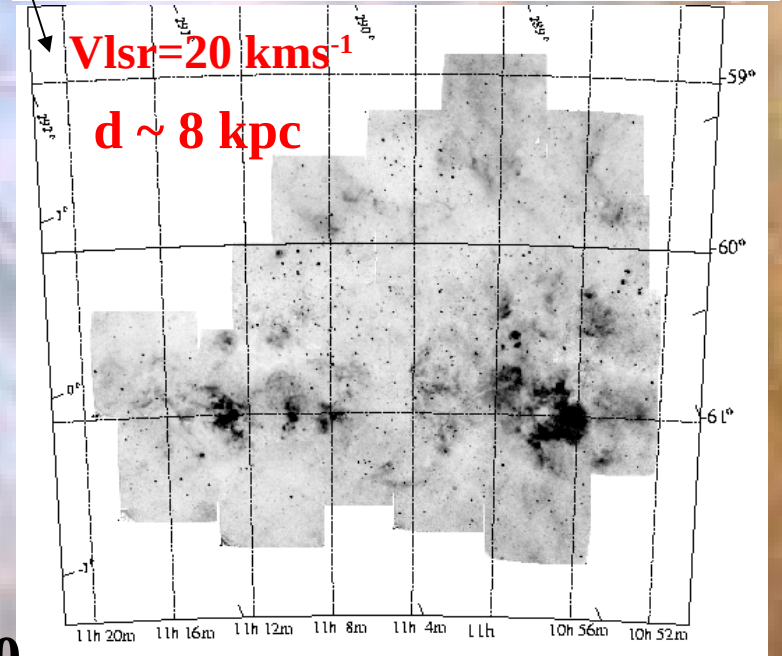
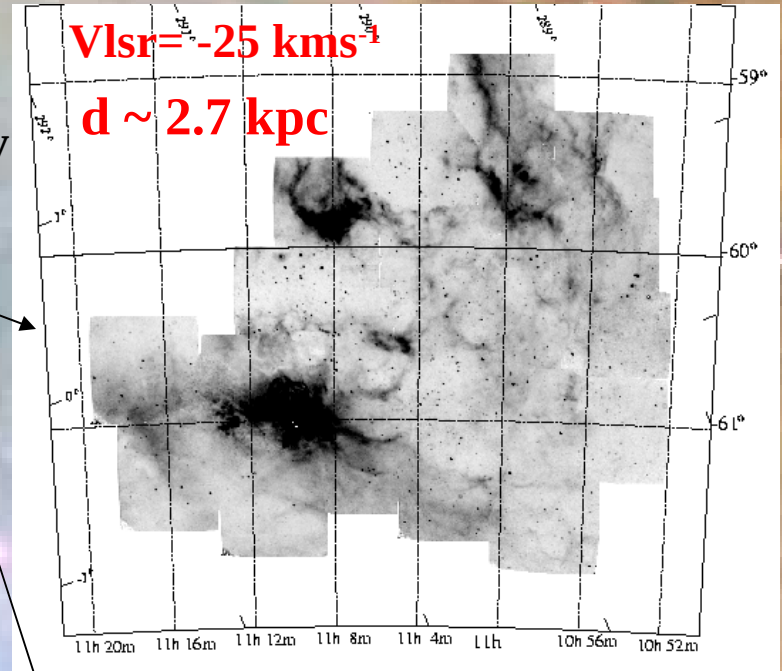


Kinematic distance

Circular Velocity departures  
Resolve near/far ambiguity

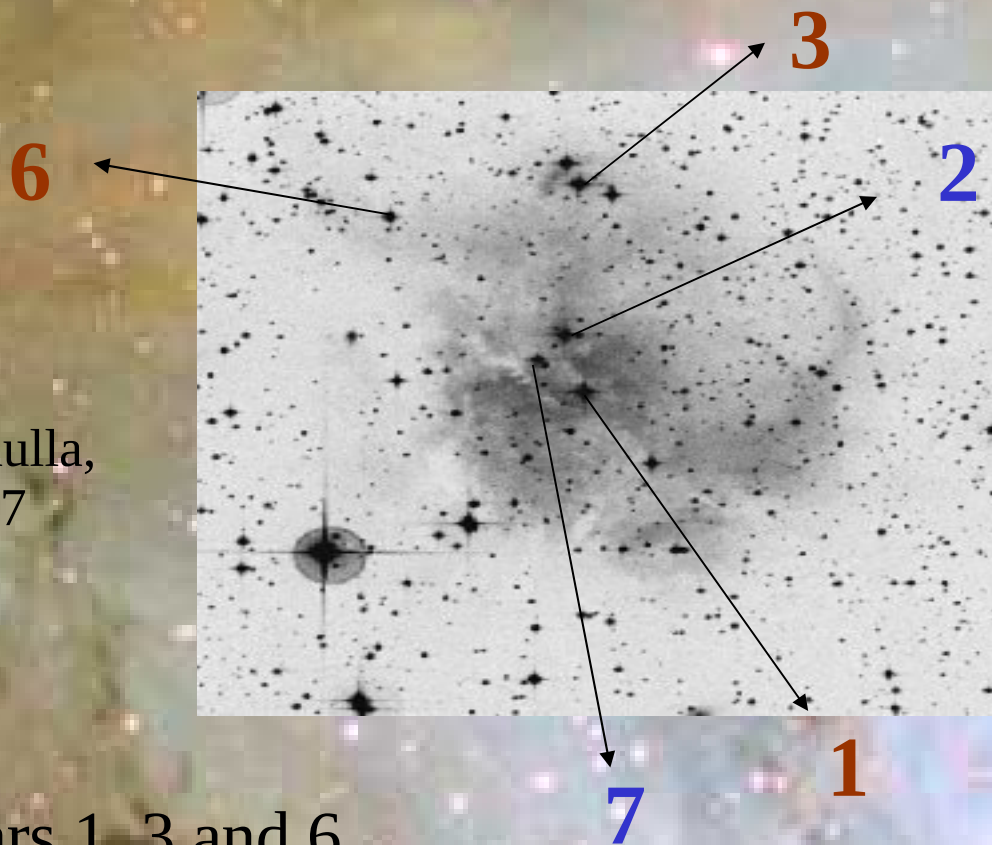
The velocity to disentangle the information superimposed along the line of sight

Marseille H $\alpha$  Survey  
(Scanning PF interferometer)



AAO/UKST H $\alpha$  Survey  
Parker et al., 1999

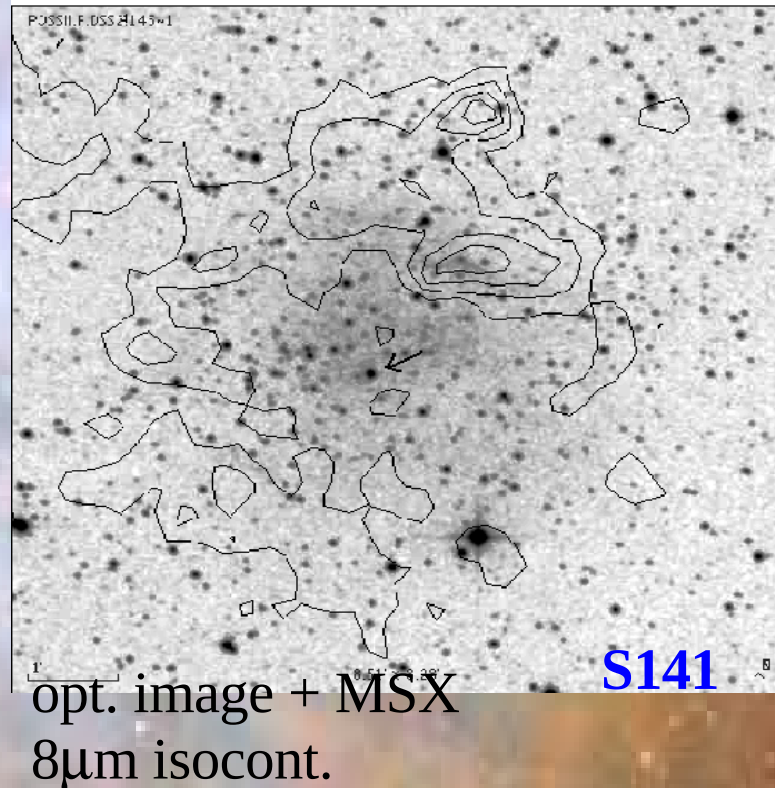
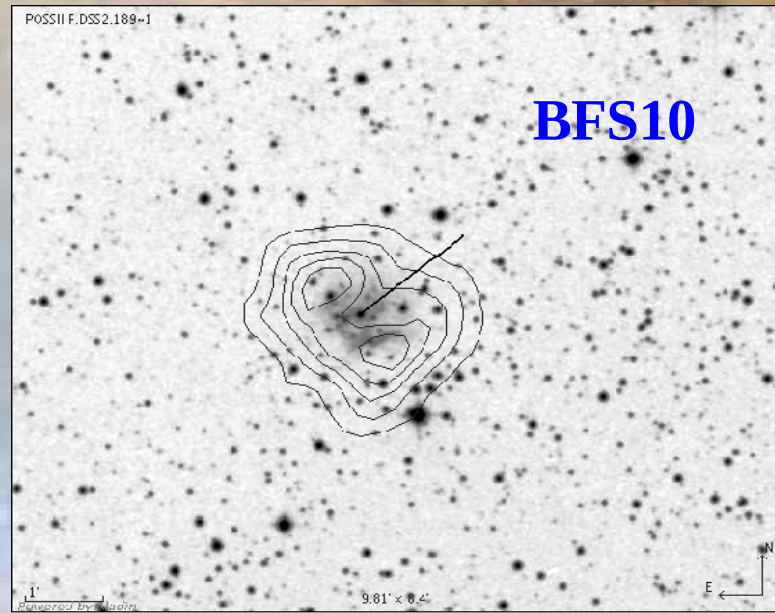
Georgelin et al., 2000



Lahulla,  
1987

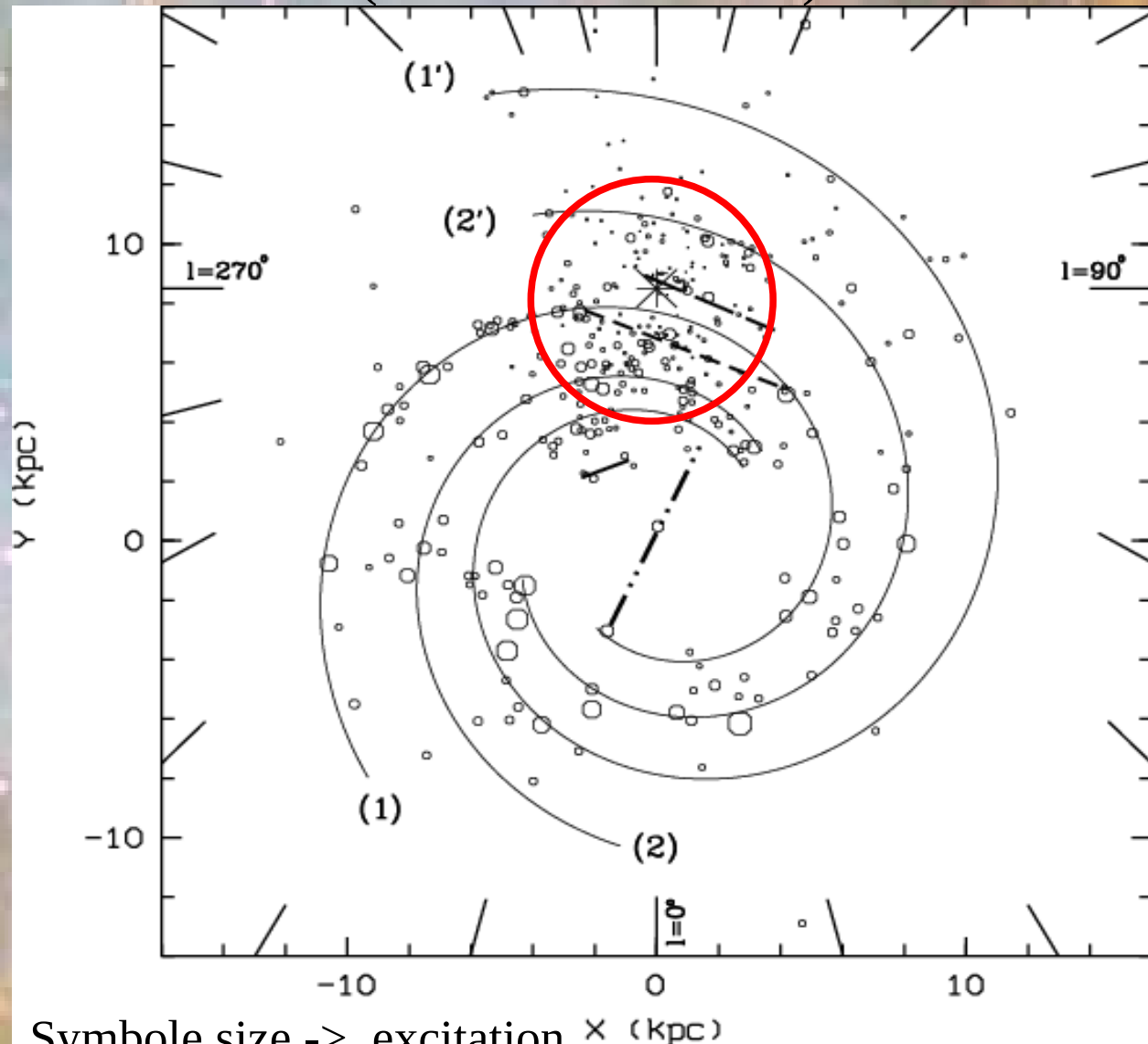
Stars 1, 3 and 6  
associated

Stellar distance



# The spiral structure

(Russeil et al. 2007)



1': Norma-Cygnus arm  
(or external arm)

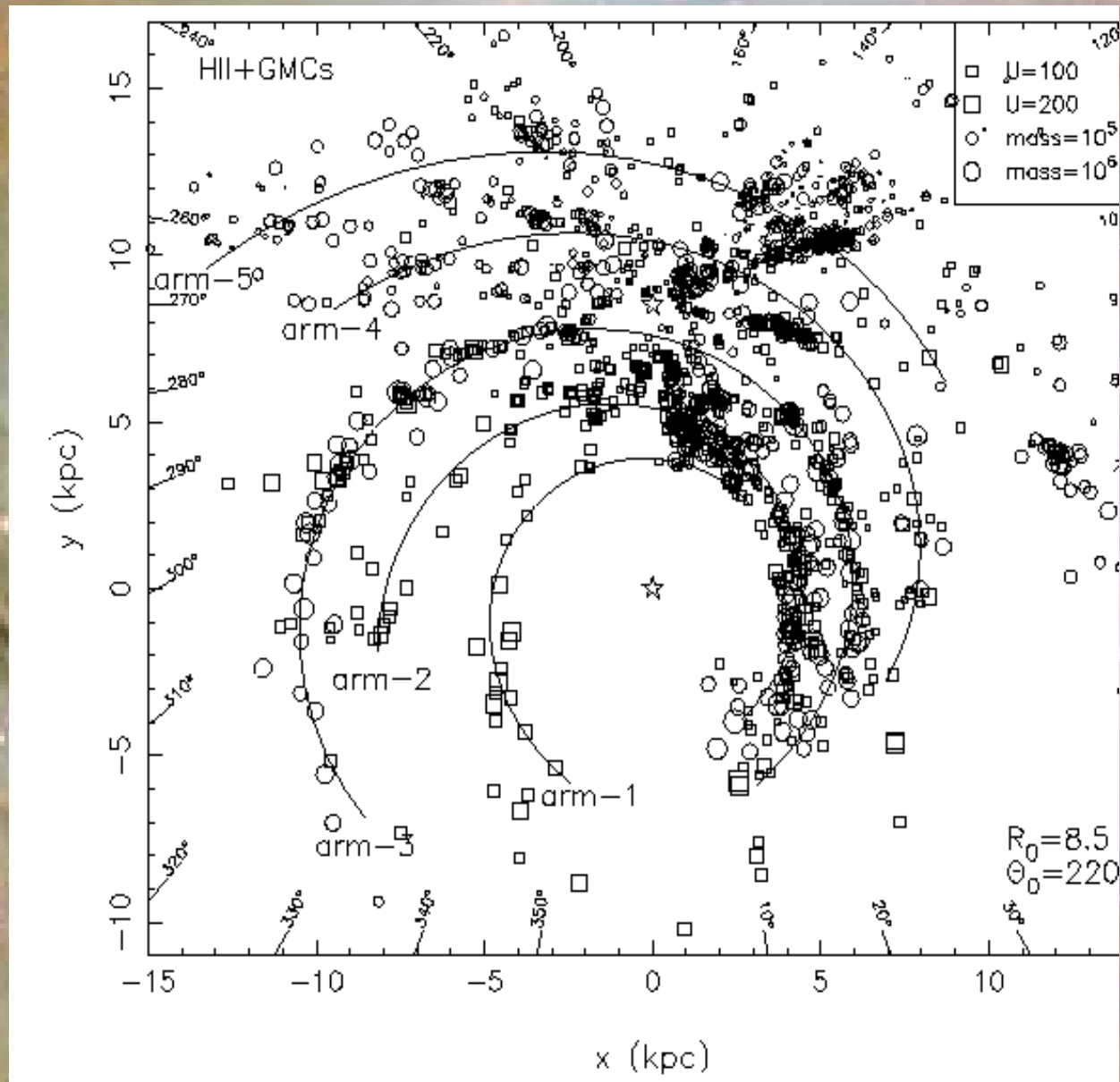
2': Perseus arm

1: Sagittarius-Carina  
arm

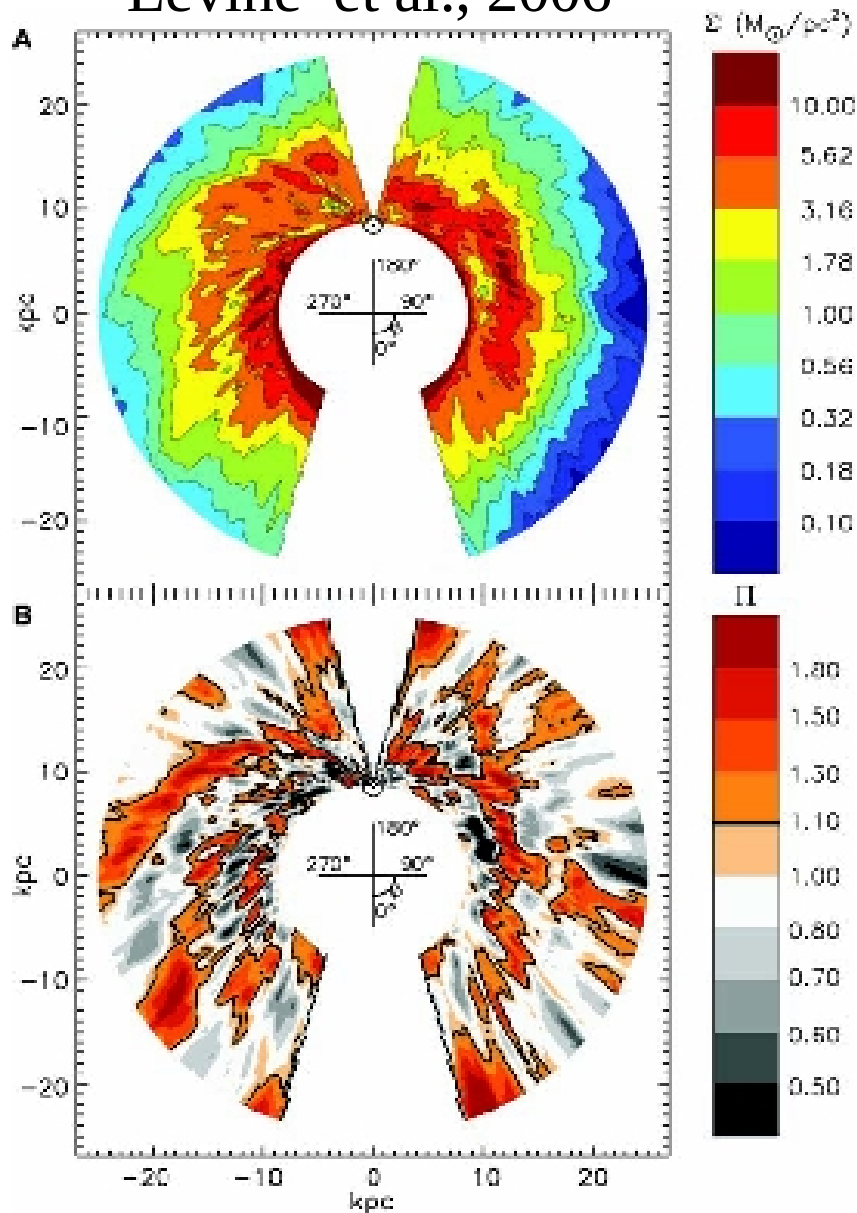
2: Scutum- crux arm

Symbol size -> excitation  
parameter

# Hou et al., 2009

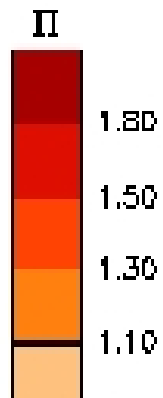
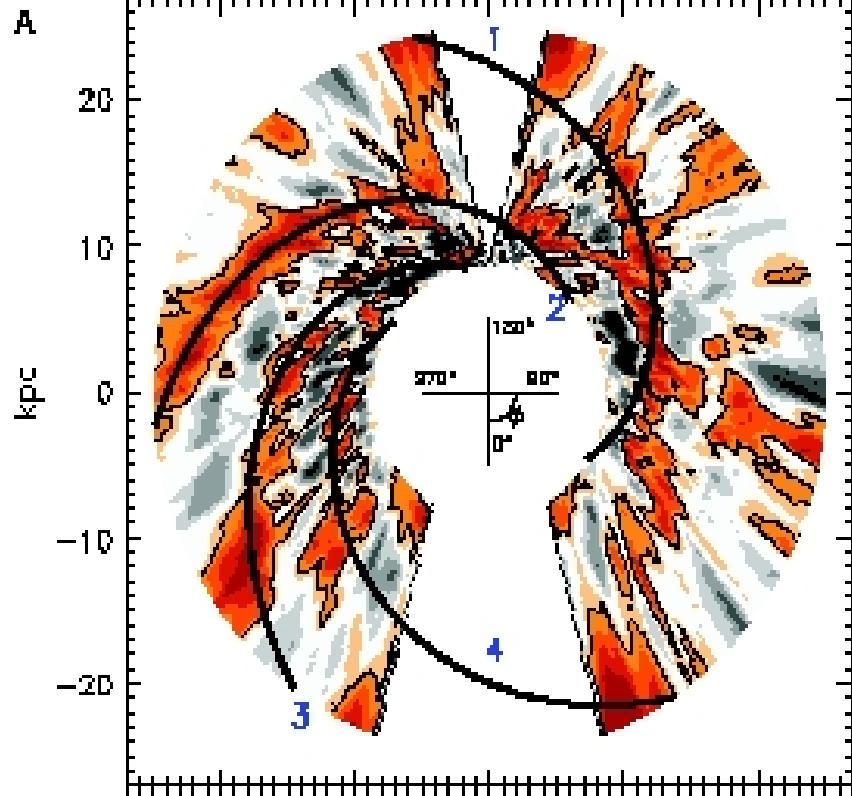
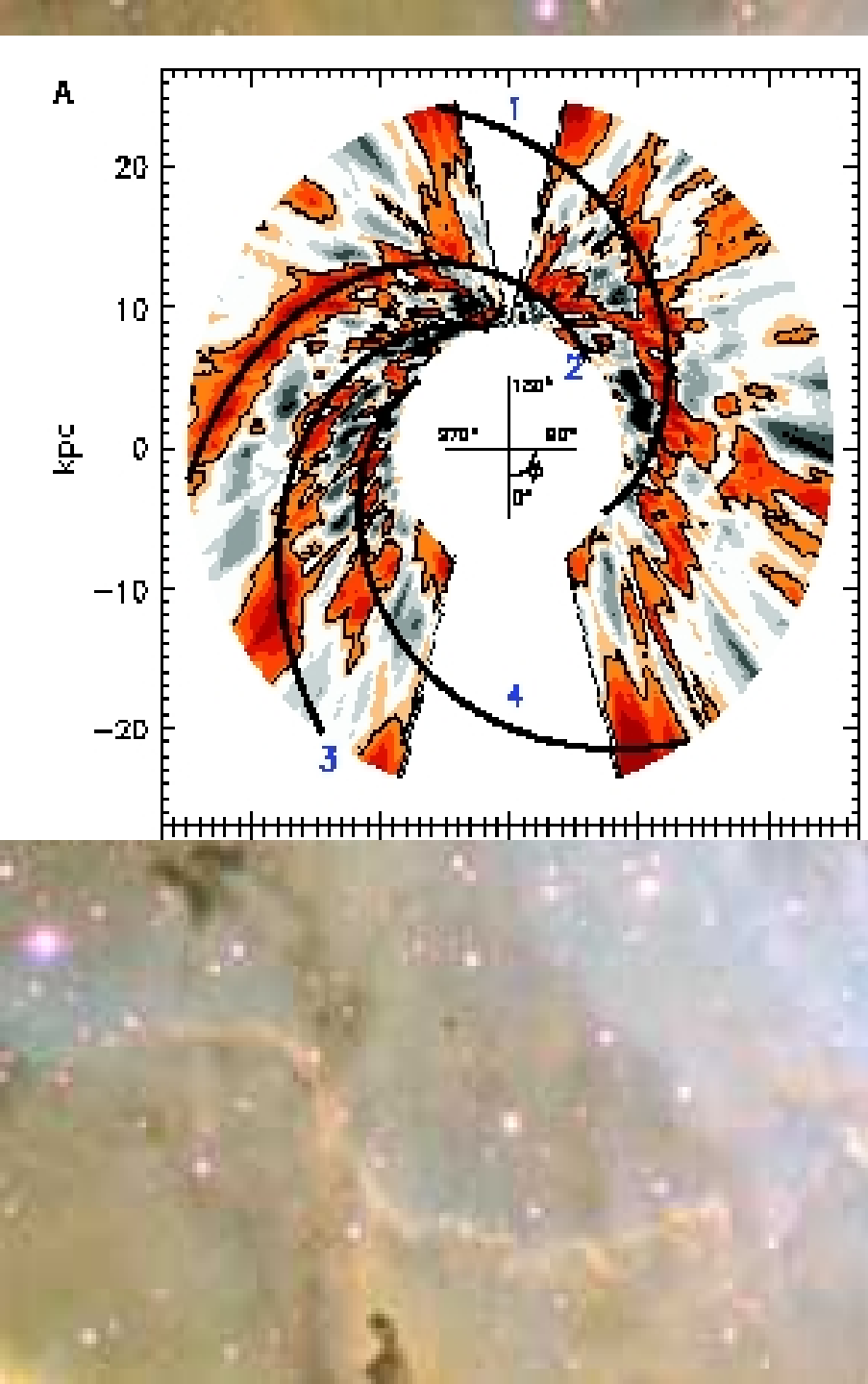


Levine et al., 2006

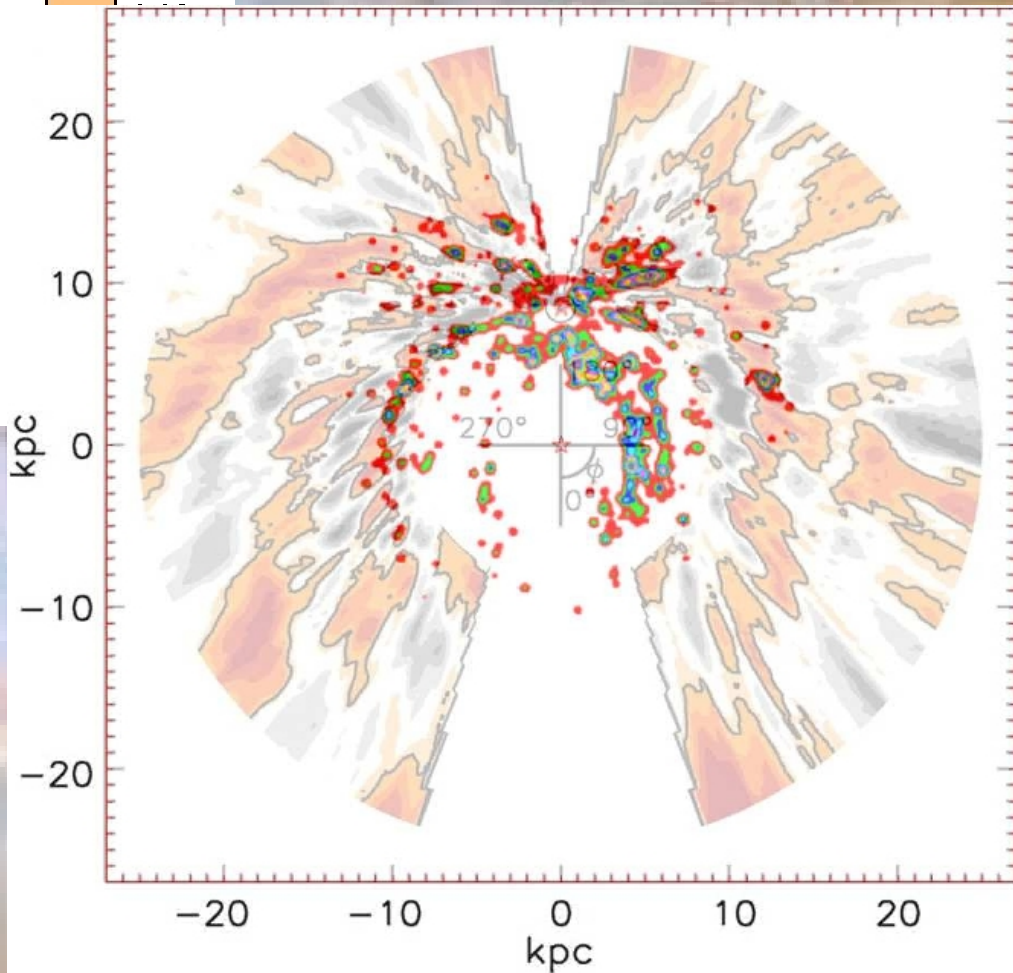


The HI gas to  
trace our  
Galaxy's outer  
structure

Poor contrast: arm  
to inter-arm  
density ratio  $\sim 3$



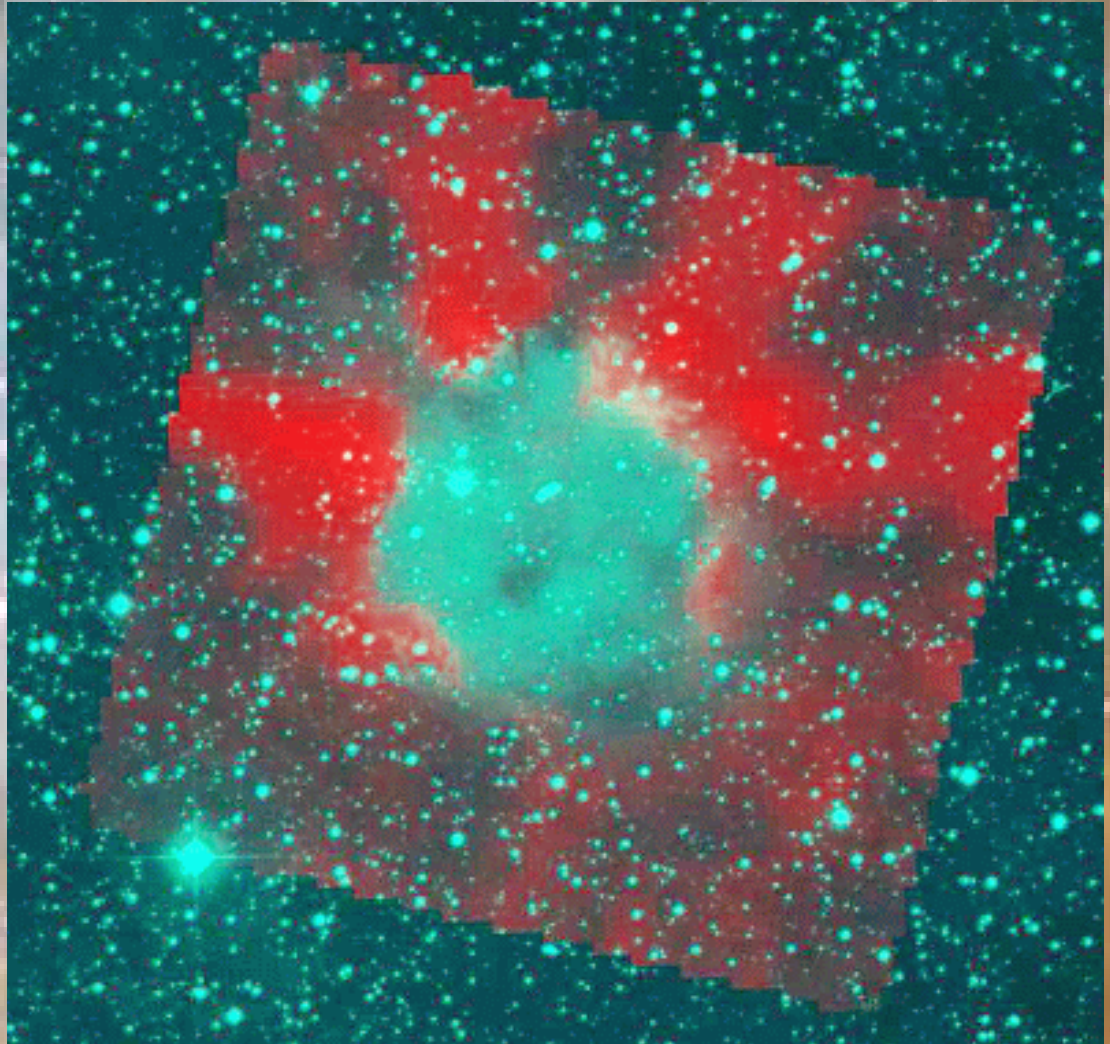
Connection Outer-  
inner structures



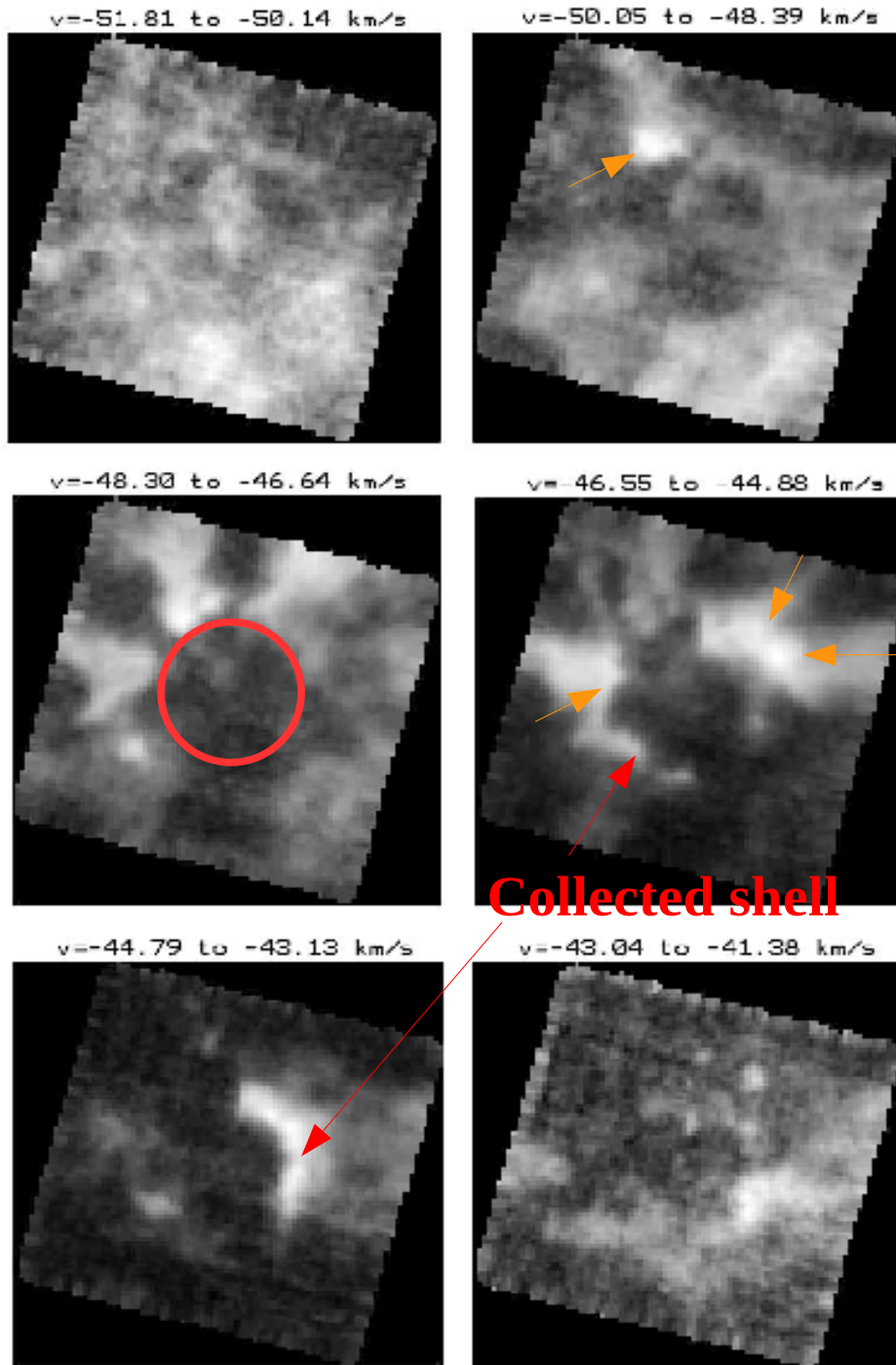
# Smaller-scale Structures

## RCW82 (Pomares et al., 2009)

H $\alpha$  image (green)  
superimposed on CO  
column density map  
(red).  
CO data from MOPRA.



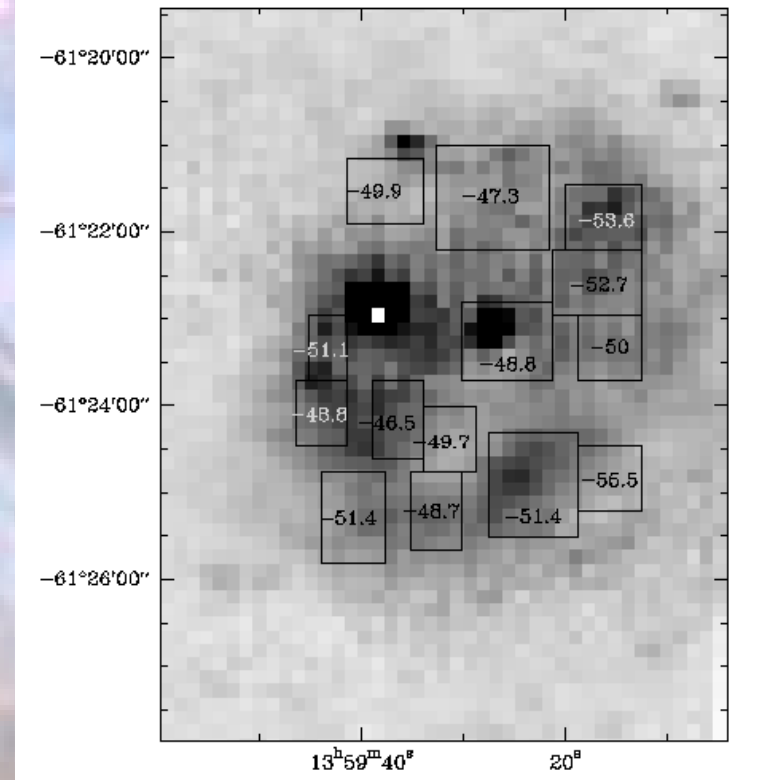




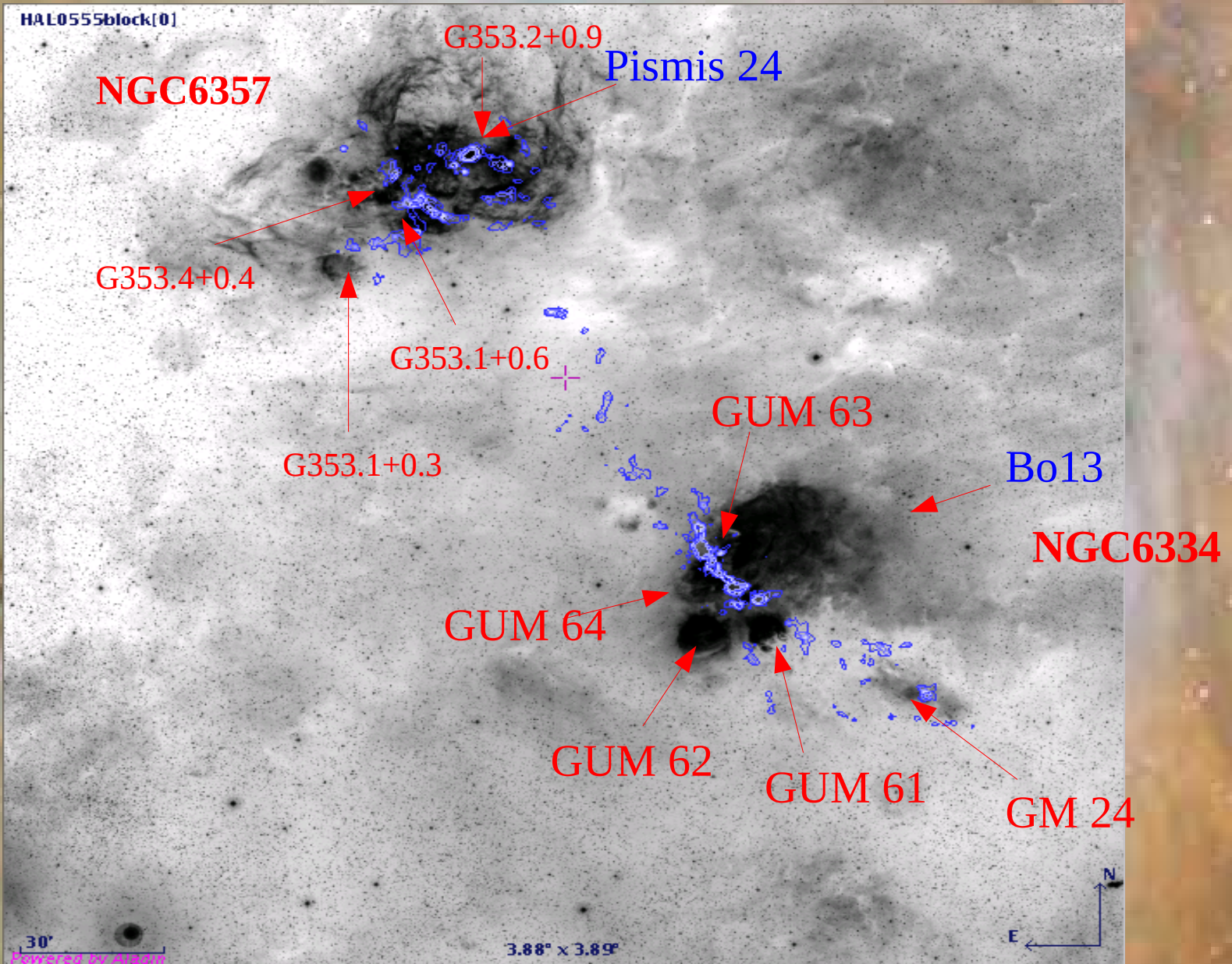
Integrated 12CO emission in the direction of RCW 82.

Identified condensations: arrows.  
 Circle: extension of the HII region.

### H $\alpha$ velocity information

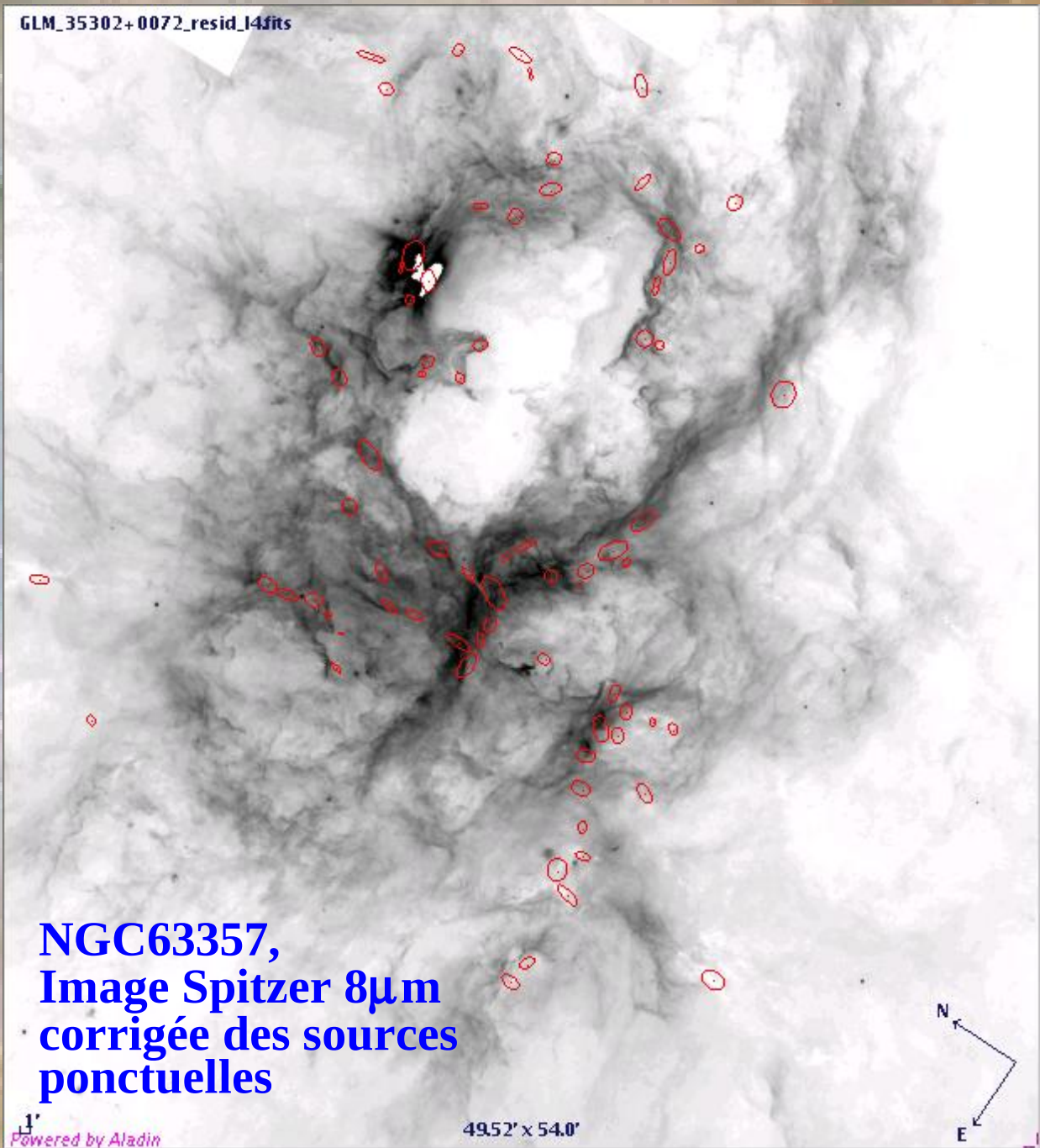


# The complex NGC6334-6357



H $\alpha$  image (UKST)+ SIMBA 1.2mm isocontours (Munoz et al. 2007)

GLM\_35302+0072\_resid\_14.fits



**NGC63357,  
Image Spitzer 8μm  
corrigée des sources  
ponctuelles**

Powered by Aladin

49.52' x 54.0'



Extraction des coeurs  
denses:

-> image 1.2mm de  
Munoz et al. (2007)

-> Méthode d'extraction:  
Motte et al. (2007)

-> Masse, densité

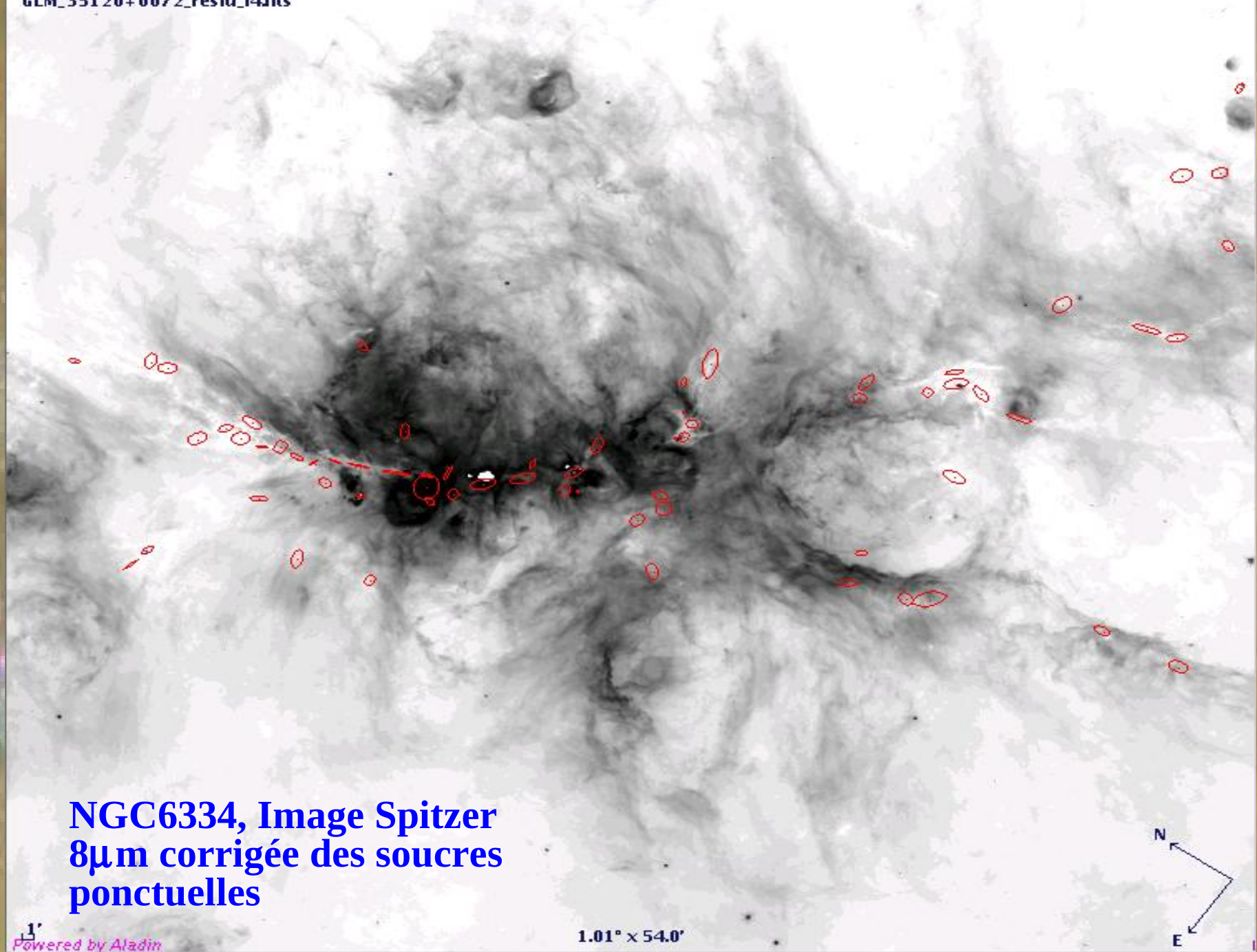
total: 163 coeurs



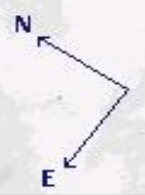
42 coeurs massifs  
(>100 Msol)



15 starless cores



**NGC6334, Image Spitzer  
8 $\mu$ m corrigée des sources  
ponctuelles**



# Perspectives

## New/recent and incoming Large surveys of the galactic plane :

Molecular: GRS, IGPS

HI:southern and northern surveys

Ionised gas: radio (MAGPIS, CORNISH) , H $\alpha$  ( IPHAS, WHAM) ...

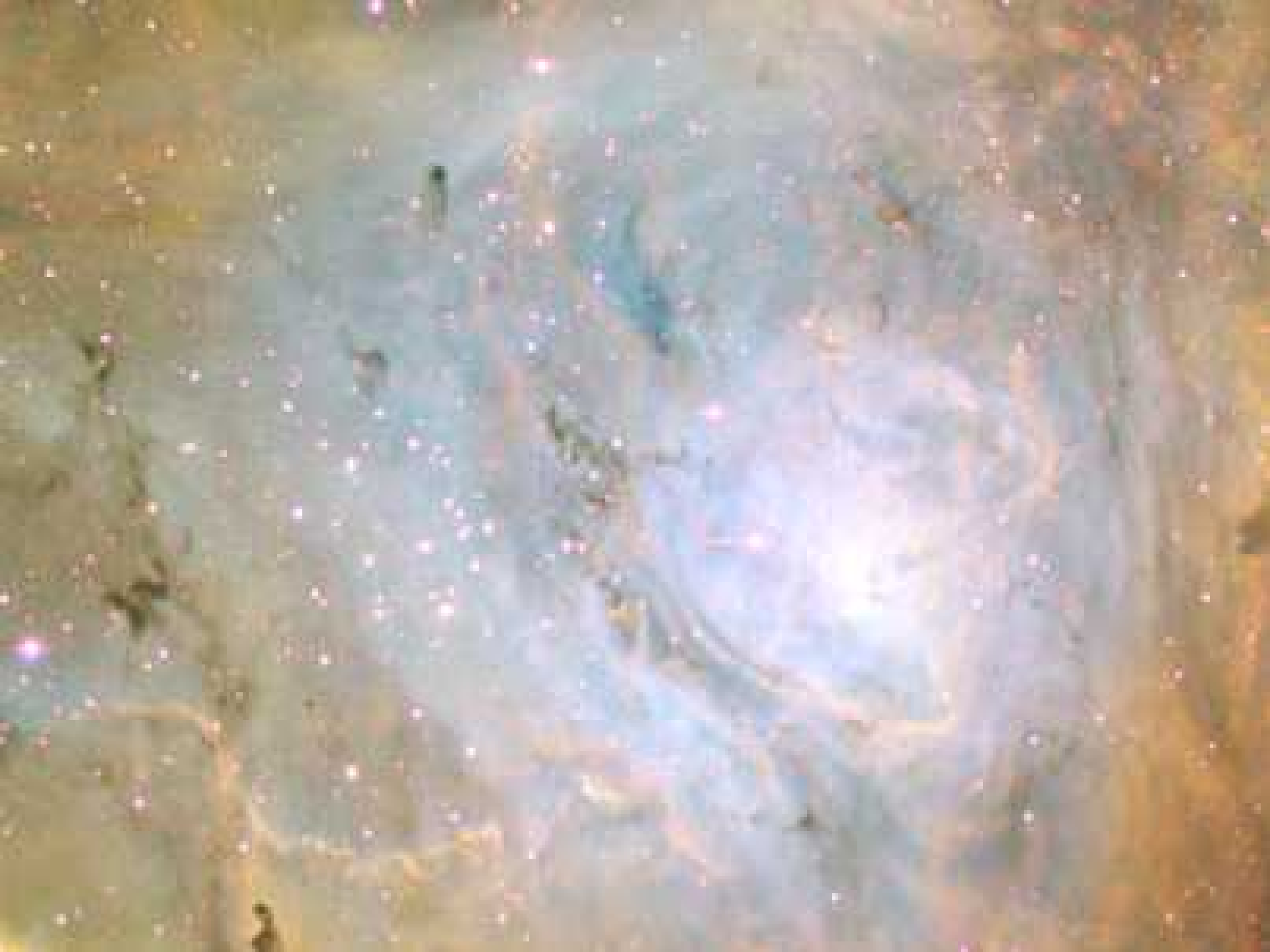
Dust/PAH: MSX, Spitzer-GLIMPSE, Spitzer-MIPSGAL

Cold dust: ATLASGAL and SCUBA2 (sub-mm continuum),

**Herschel-HIGAL (FIR)**

Incoming new distance determination : GAIA, maser Parallaxes

Comparison with energetic wavelengths: X, Gamma ...



## Caractérisation des 42 coeurs massifs:

Recherche d'activité stellaire  
associée:

Spitzer/Glimpse class I/II  
sources

Spitzer/MIPSGAL 24 $\mu$ m  
counterparts:  
«High Luminous » or « IR-  
quiet »

Radio sources / maser  
counterparts

Outflows, infall, turbulence ...  
(raies moléculaires: SiO,  
HNC, HCO<sup>+</sup>...)

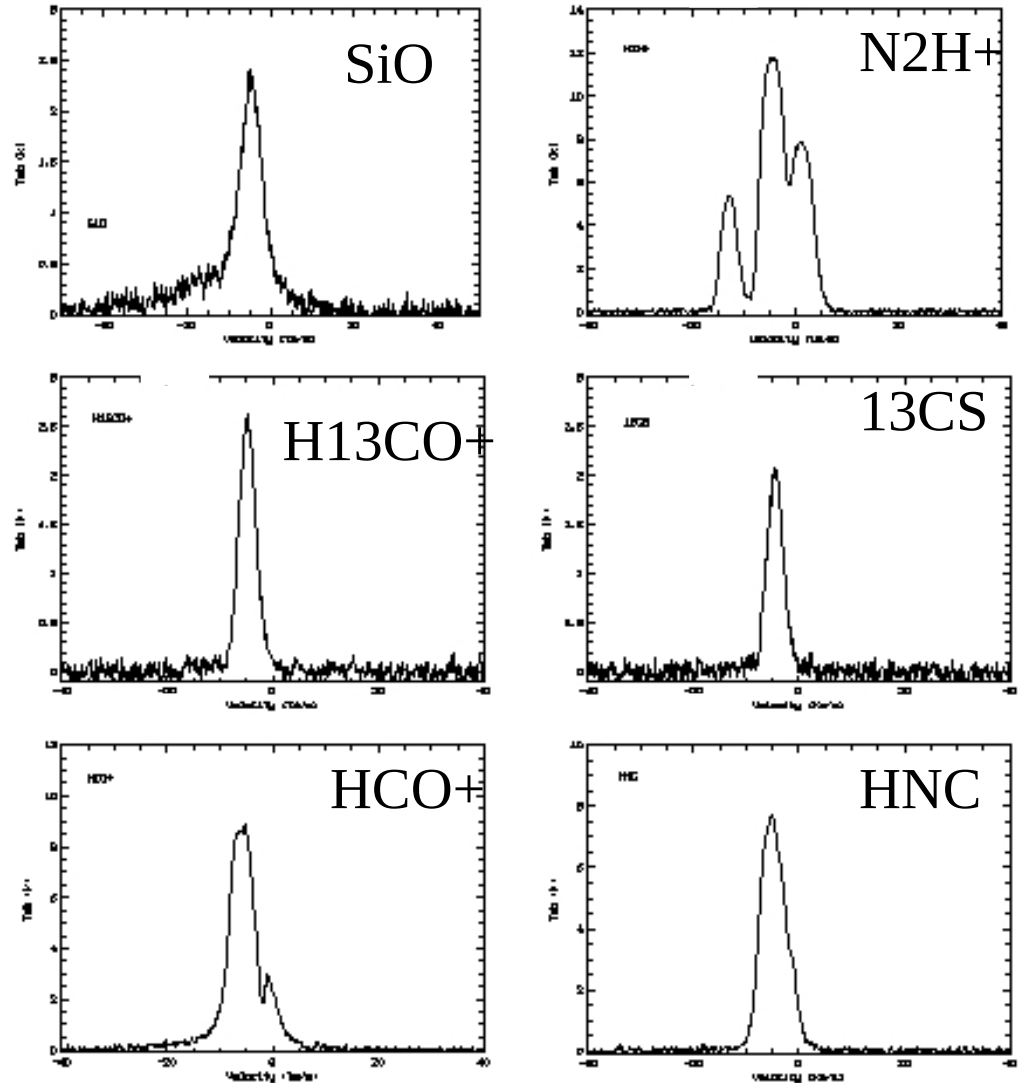


Fig. A.6. Profiles core 63