A Detailed Investigation of the HII Region RCW175: from radio to mid-IR wavelengths

Christopher Tibbs

IPAC/Caltech

In collaboration with:
Roberta Paladini, Clive Dickinson, Mathieu Compiègne, Nicolas Flagey, Alberto Noriega-Crespo, Sean Carey, Sachindev Shenoy, Kieran Cleary, Simon Casassus, Yacine Ali-Haïmoud, Chris Hirata

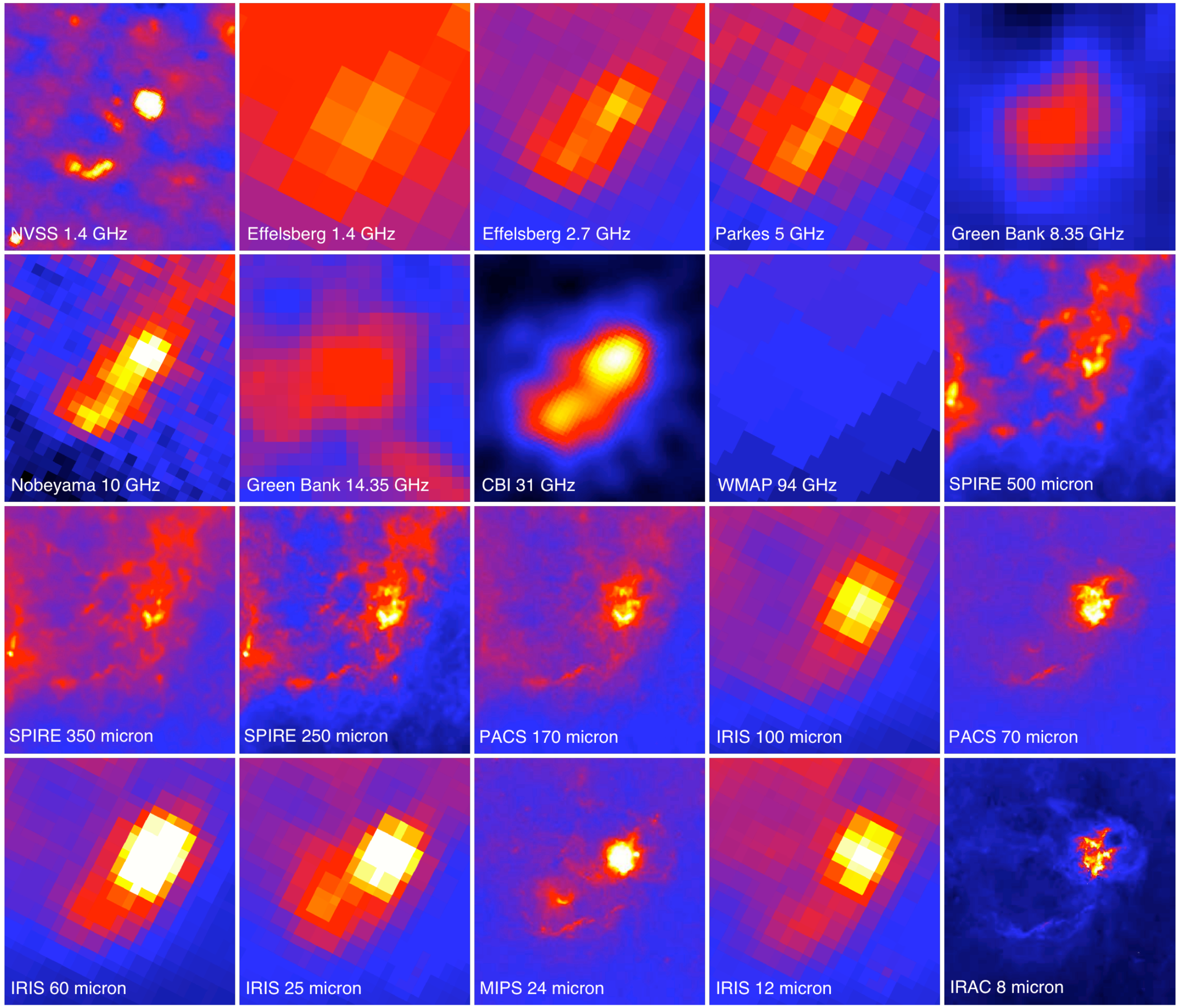
Tibbs et al. to be submitted

RCW175 Observations

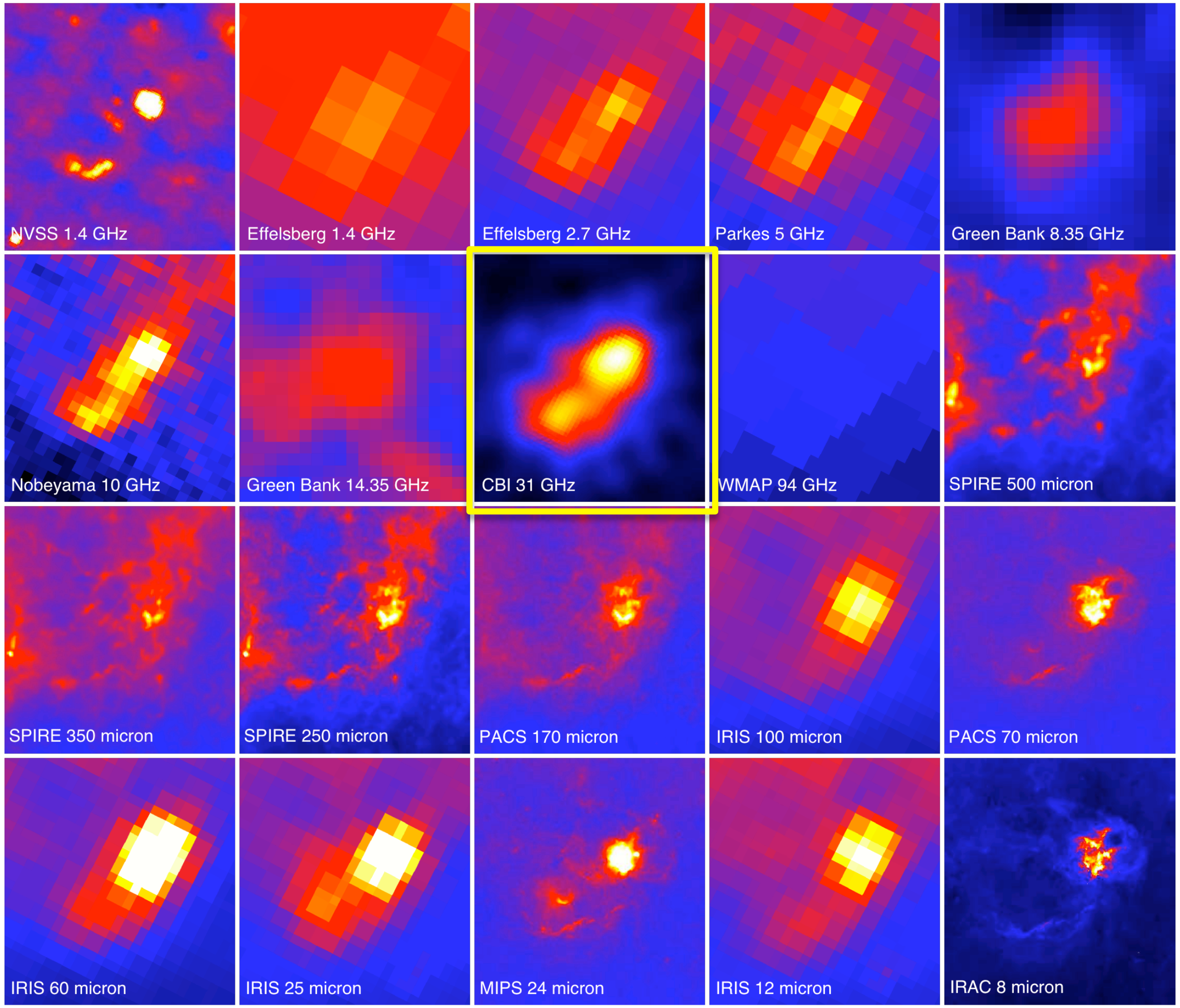
- RCW175 has been observed extensively all the way from radio to mid-IR wavelengths.

Frequency (GHz)	Telescope/ Survey	Reference for Data	Angular Resolution (arcmin)
1.4	Effelsberg 100 m	Reich et al. (1990a)	9.4
2.7	Effelsberg 100 m	Reich et al. (1990b)	4.3
5	Parkes 64 m	Haynes et al. (1978)	4.1
8.35	Green Bank 13.7 m	Langston et al. (2000)	9.7
10	Nobeyama 45 m	Handa et al. (1987)	3.0
14.35	Green Bank 13.7 m	Langston et al. (2000)	6.6
31	CBI	Dickinson et al. (2009)	4.3
94	WMAP	Jarosik et al. (2011)	13.2
599.6 (500 μm)	*Herschel*/SPIRE	Molinari et al. (2010)	0.6
856.5 (350 μm)	*Herschel*/SPIRE	Molinari et al. (2010)	0.4
1199.2 (250 μm)	*Herschel*/SPIRE	Molinari et al. (2010)	0.3
1873.7 (160 μm)	*Herschel*/PACS	Molinari et al. (2010)	0.2
2997.9 (100 μm)	IRIS	Miville-Deschênes & Lagache (2005)	4.3
4282.7 (70 μm)	*Herschel*/PACS	Molinari et al. (2010)	0.1
4996.5 (60 μm)	IRIS	Miville-Deschênes & Lagache (2005)	4.0
11991.7 (25 μm)	IRIS	Miville-Deschênes & Lagache (2005)	3.8
12491.4 (24 μm)	*Spitzer*/MIPS	Carey et al. (2009)	0.1
24982.7 (12 μm)	IRIS	Miville-Deschênes & Lagache (2005)	3.8
37474.1 (8 μm)	*Spitzer*/IRAC	Churchwell et al. (2009)	0.03

RCW175 Observations

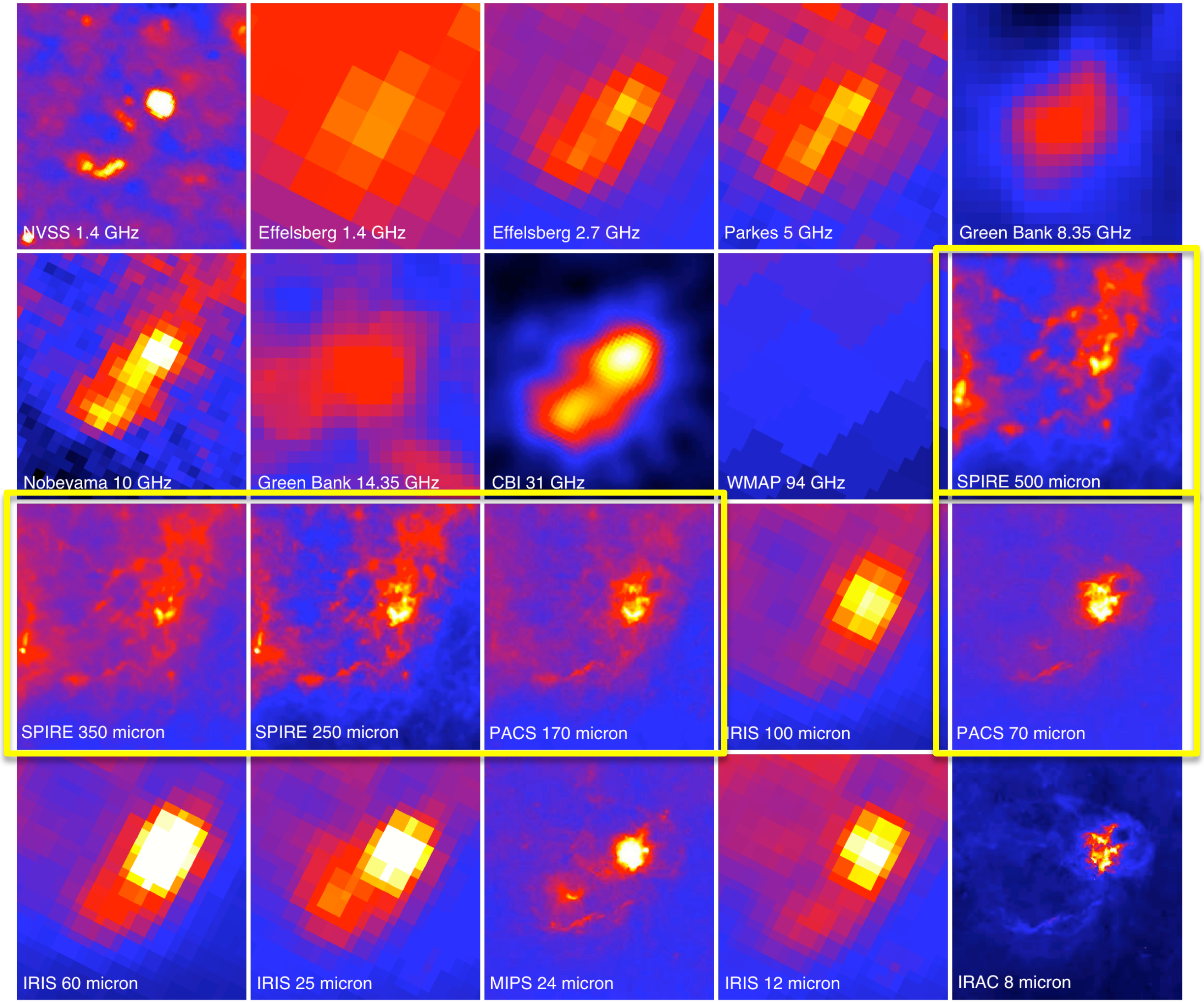


RCW175 Observations



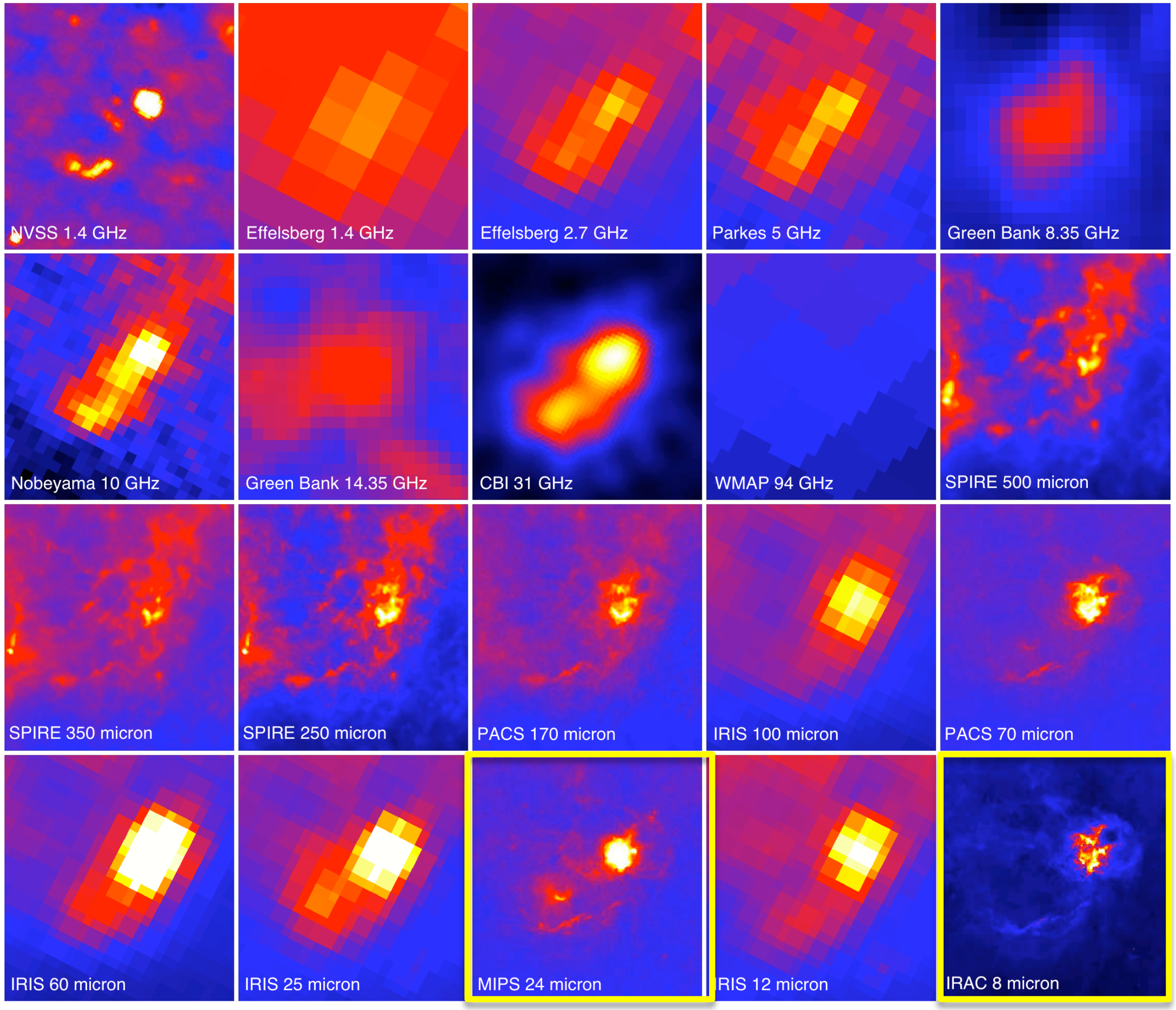
Cosmic Background Imager (CBI) data at 31GHz
(Dickinson et al. 2009)

RCW175 Observations



Herschel HiGAL 70, 160, 250, 350 and 500μm data

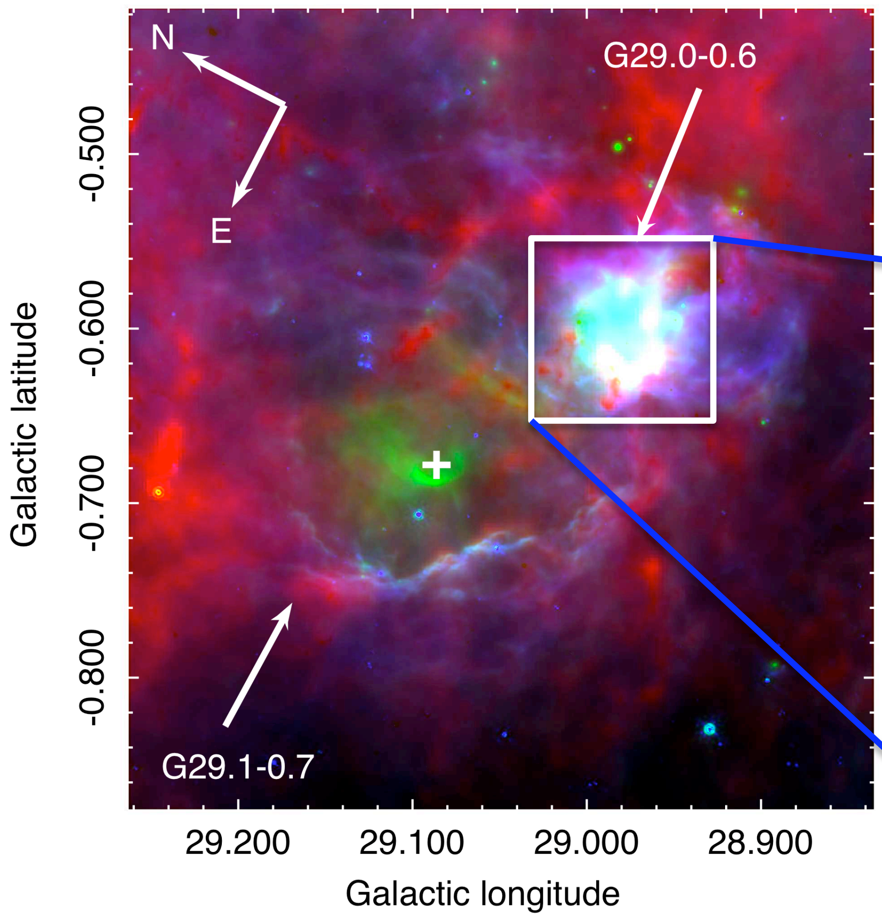
RCW175 Observations

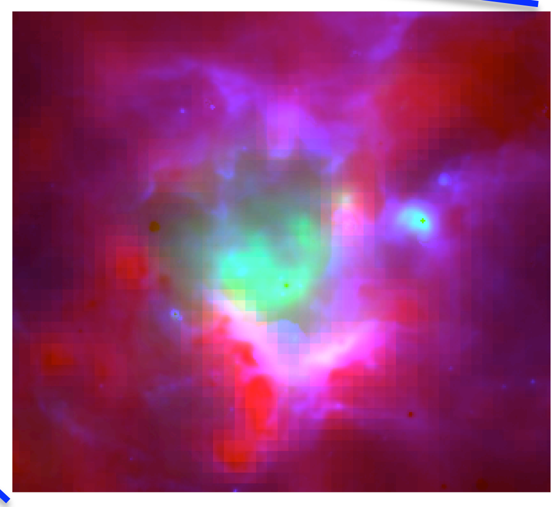


Spitzer MIPS 24μm and IRAC 8μm data

Morphology of RCW175

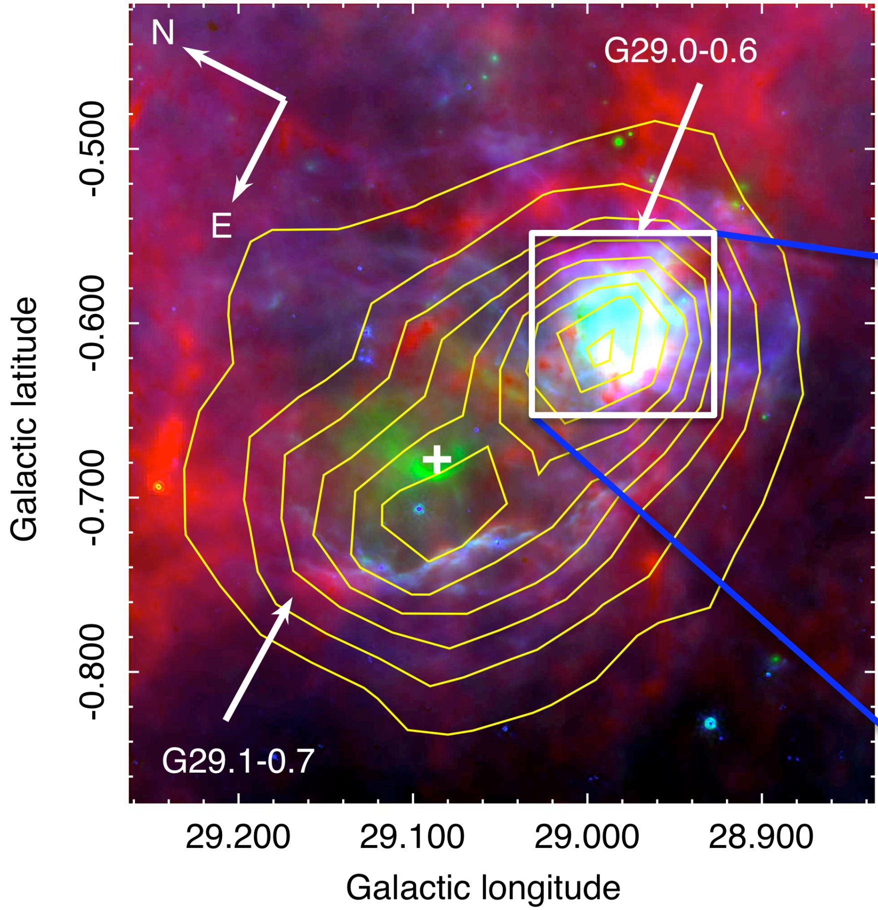
- Galactic HII region originally identified by Sharpless (1959)
- Consists of 2 separate components, G29.1-0.7 and G29.0-0.6

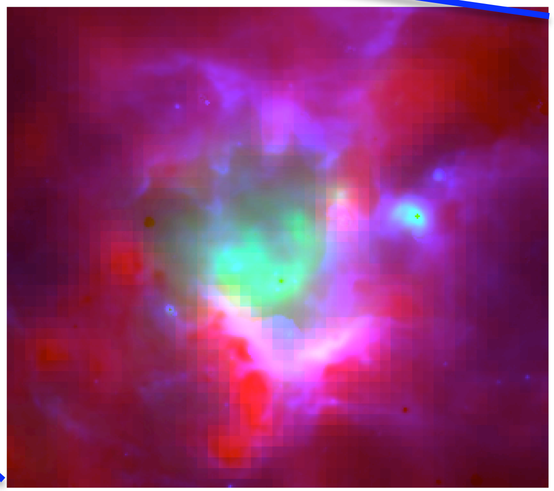




Blue = 8μm, green = 24μm, red = 350μm

Morphology of RCW175



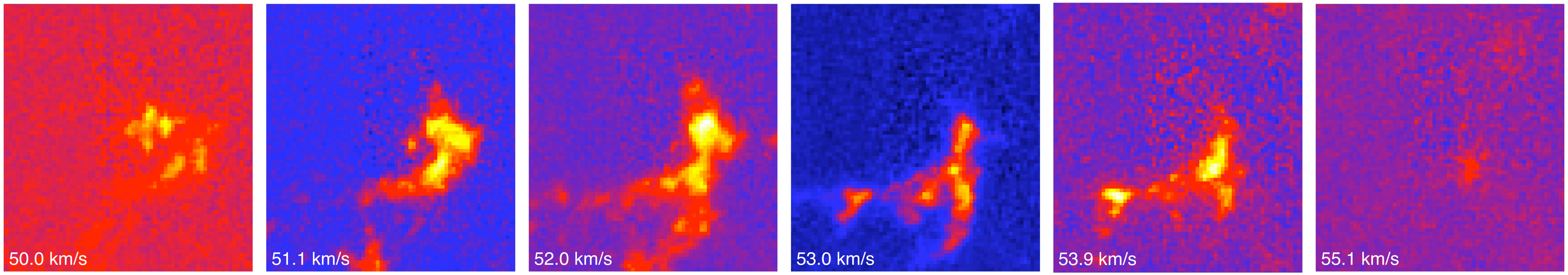


Blue = 8μm, green = 24μm, red = 350μm

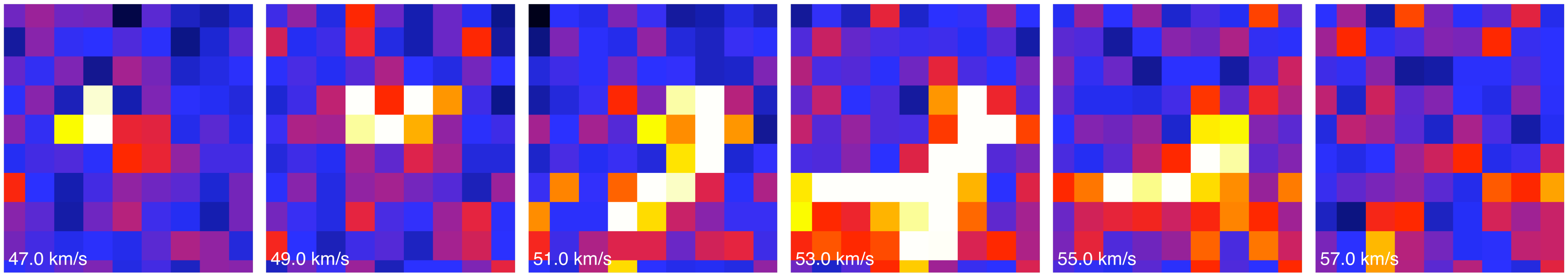
- Galactic HII region originally identified by Sharpless (1959)
- Consists of 2 separate components, G29.1-0.7 and G29.0-0.6

RCW175 Observations

^{13}CO (1-0) data from the Galactic Ring Survey (Jackson et al. 2006)

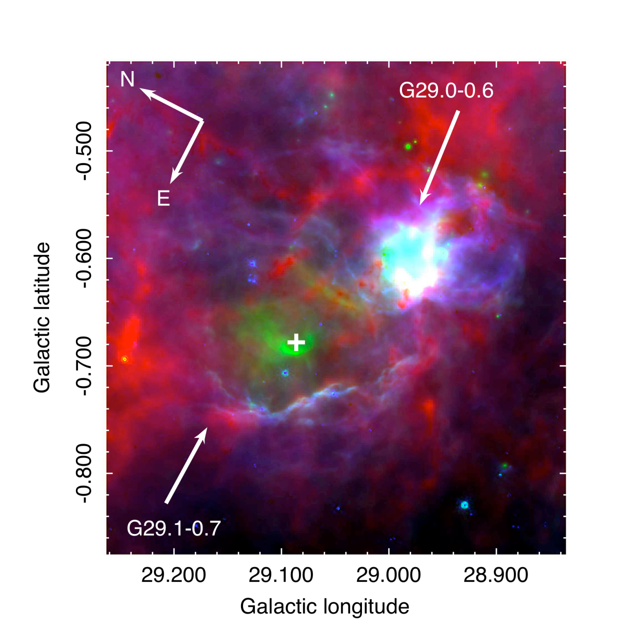


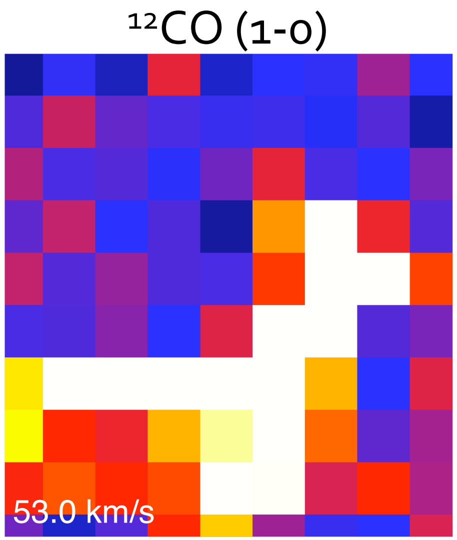
^{12}CO (1-0) data from the Massachusetts-Stony Brook Galactic Plane Survey (Sanders et al. 1986)

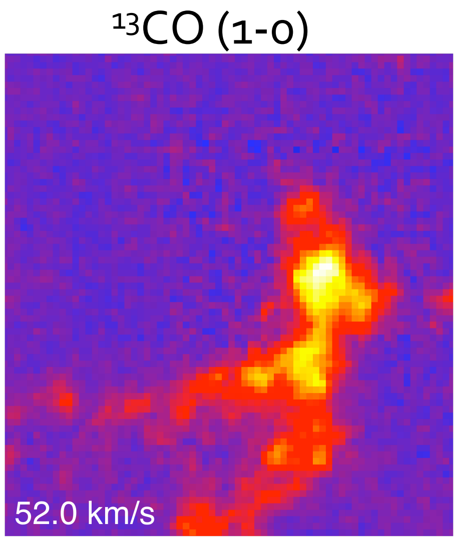


=> $D = 3.2 \pm 0.1$ kpc and $R = 5.4 \pm 0.2$ kpc

Morphology of RCW175



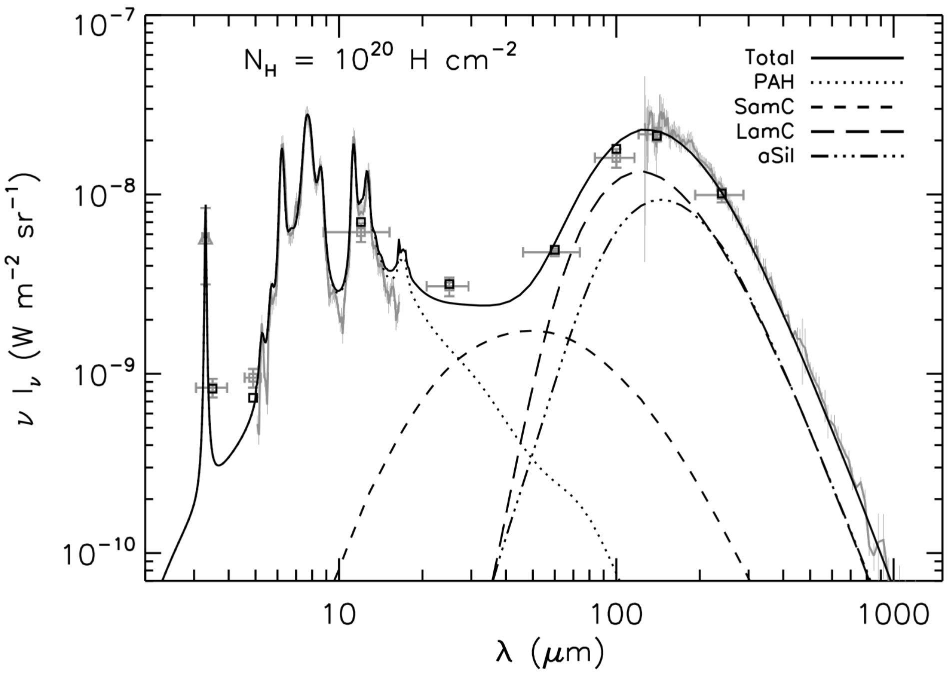




- CO traces the compact component G29.0-0.6 and the dust filament along the edge of G29.1-0.7.
- Similarity between the CO data and the Herschel data.

Dust Modelling

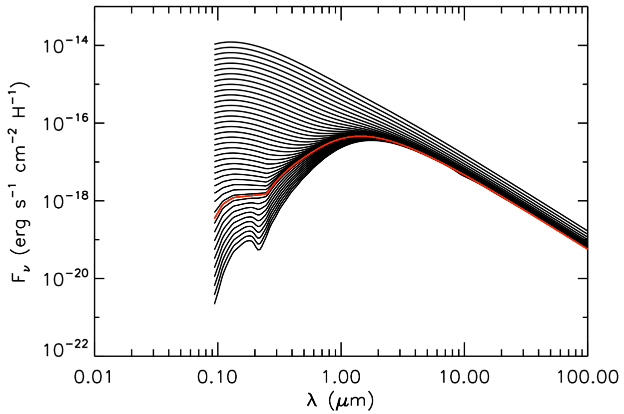
- DUSTEM (Compiègne et al. 2011) is a dust emission model based on the formalism of the Desert et al. (1990) model.
- Previously been used to characterise the dust properties:
  - in the regions of diffuse emission on the Galactic plane (Compiègne et al. 2011)
  - in the Eagle Nebula (Flagey et al. 2011)
  - in the Perseus molecular cloud (Tibbs et al. 2011)

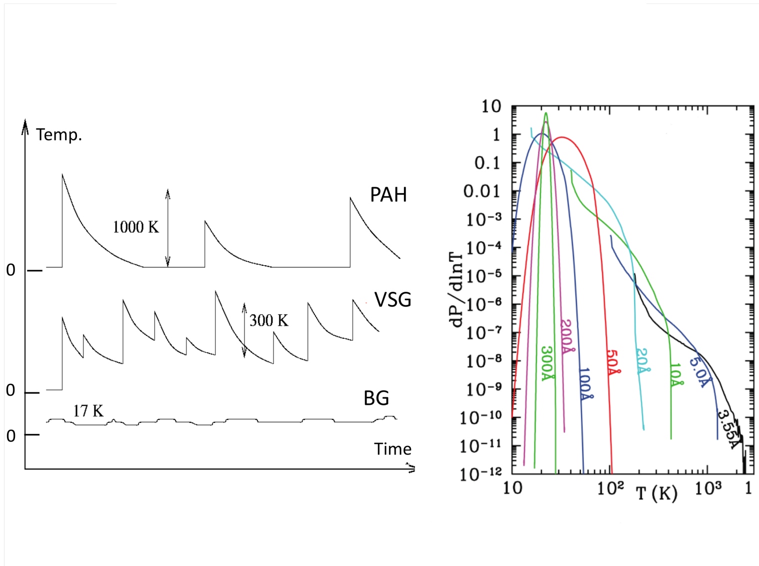


Compiègne et al. (2011)

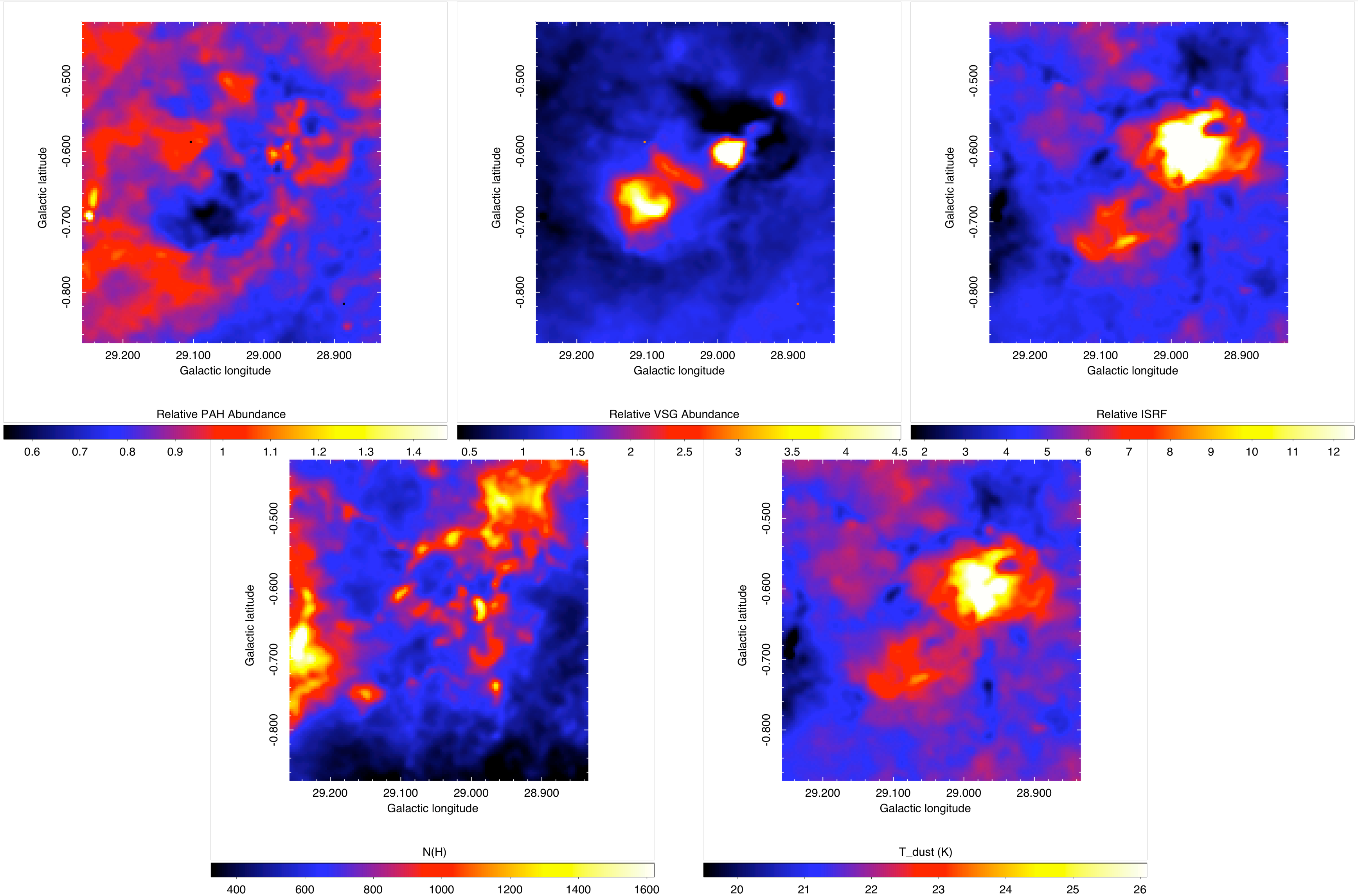
Dust Modelling

- Use IR data 8, 24, 70, 160, 250, 350 and 500μm.
- Convolve all maps to common angular resolution of 35 arcsec.
- Use DUSTEM with grain species:
  - $PAH^0 + PAH^+$ => PAHs
  - SamC => VSGs
  - LamC + aSil => BGs
- Fit for:
  - Abundance of PAHs and VSGs with respect to BGs (Y_{PAH} and Y_{VSG})
  - Interstellar radiation field (χ_{ISRF})
  - Column density of hydrogen (N_H)

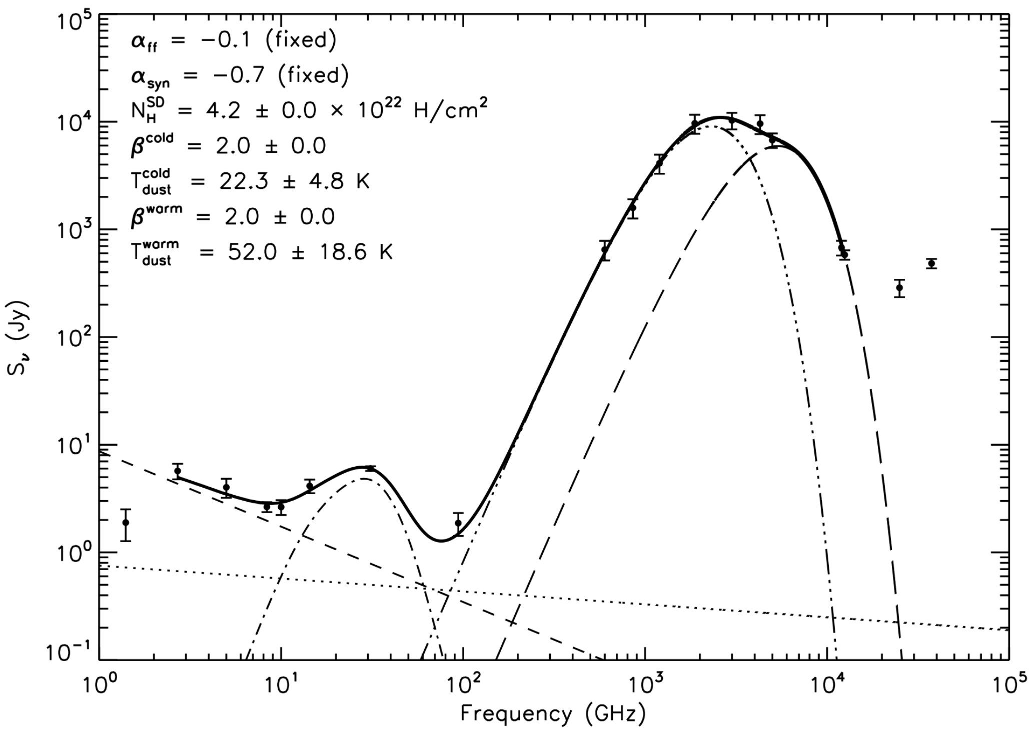




Dust Modelling



SED



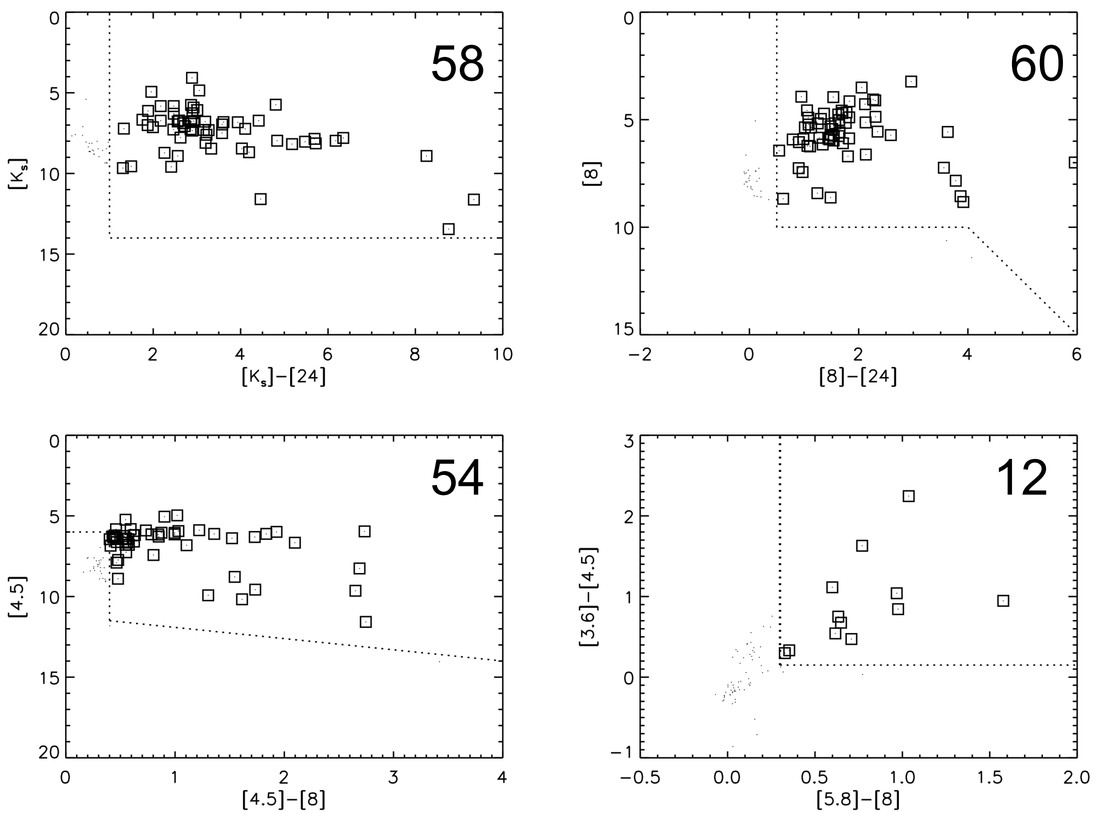
$S_{31GHz}/S_{100\mu m} = 5.8 \pm 1.1 \times 10^{-4}$

~80% of the 31GHz is anomalous

- Flux densities computed using aperture photometry.
- This is an update of the SED produced by Dickinson et al. (2009) for this region.
- We simultaneously fit the data with two power-laws, spinning dust model (WIM) and 2 modified black body curves.
- Find synchrotron contribution from nearby SNRs.
- We fit 2 modified black body curves to represent the cold and warm dust as we know the entire region is not at one temperature.
- We fit a generic WIM spinning dust model.

YSO Candidates

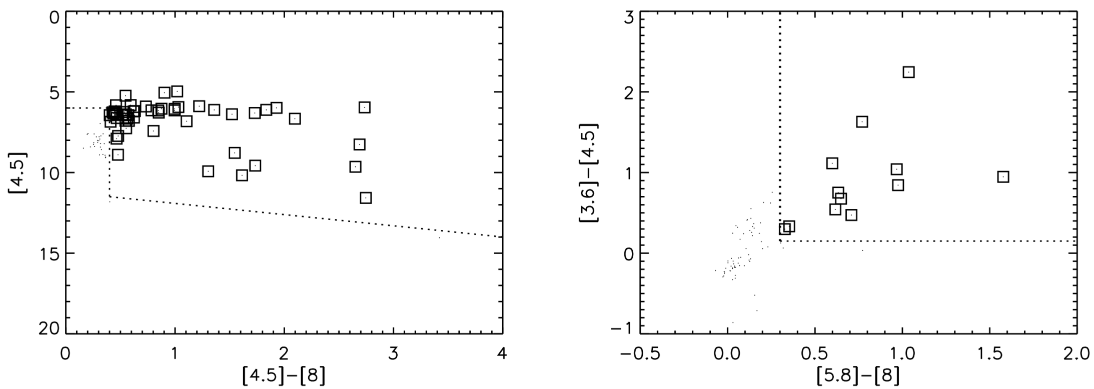
- Use the MIPSGAL Point Source catalogue (Shenoy et al. in prep) which is band merged with the GLIMPSE (3.6, 4.5, 5.8 and 8μm) and 2MASS (J, H and K) source catalogues.
- We select only sources with > 95% reliability, and find 95 sources with vicinity of RCW175.
- To find YSOc we implement a colour-colour selection criteria adopted from Rebull et al. (2010).



YSO Candidates

- Use the MIPSGAL Point Source catalogue (Shenoy et al. in prep) which is band merged with the GLIMPSE (3.6, 4.5, 5.8 and 8μm) and 2MASS (J, H and K) source catalogues.
- We select only sources with > 95% reliability, and find 95 sources with vicinity of RCW175.
- To find YSOc we implement a colour-colour selection criteria adopted from Rebull et al. (2010).

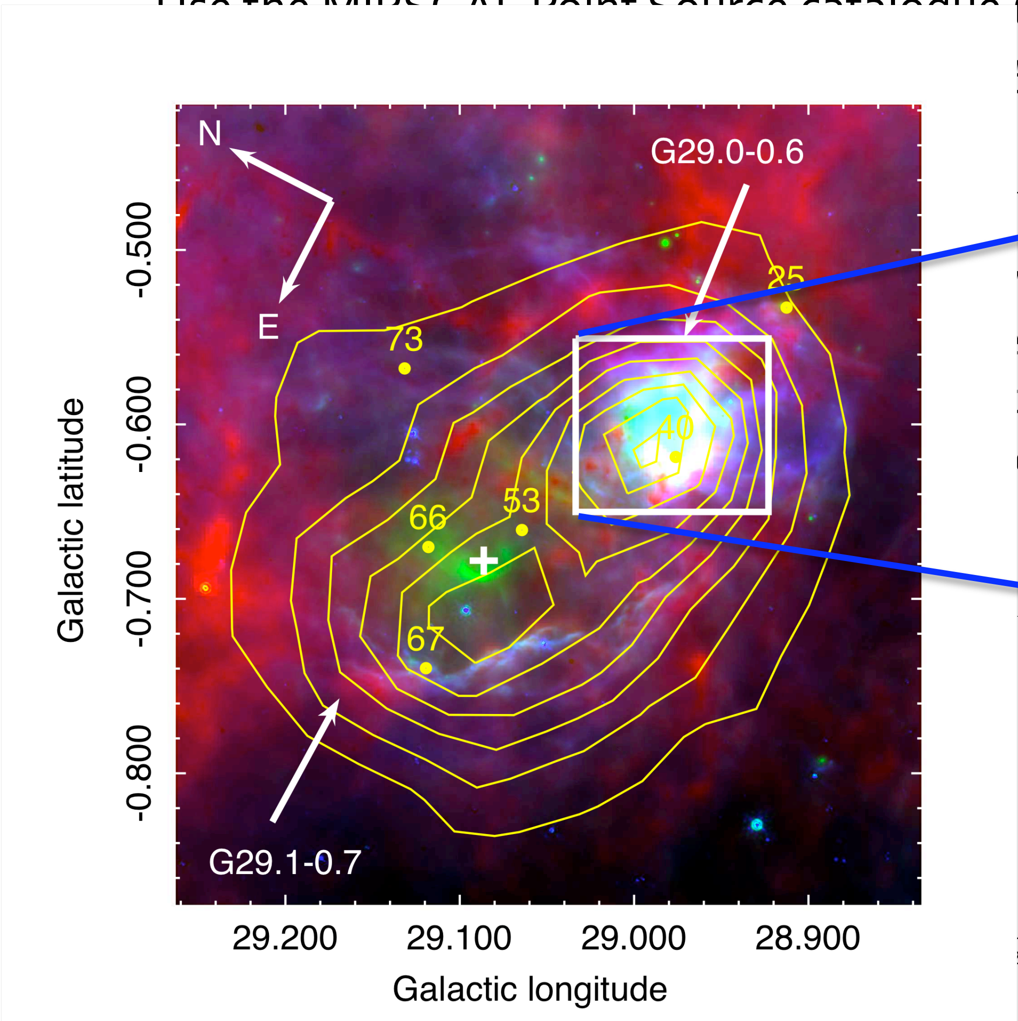
- End up with 6 YSO candidates
  - one of which has previously been identified as a possible YSOc.
  - other 5 have no counterparts in SIMBAD.



YSO Candidates

Use the MIPSGAL Point Source catalogue (Shenoy et al. in prep) which is

5.8 and 8μm) and 2MASS (J, H

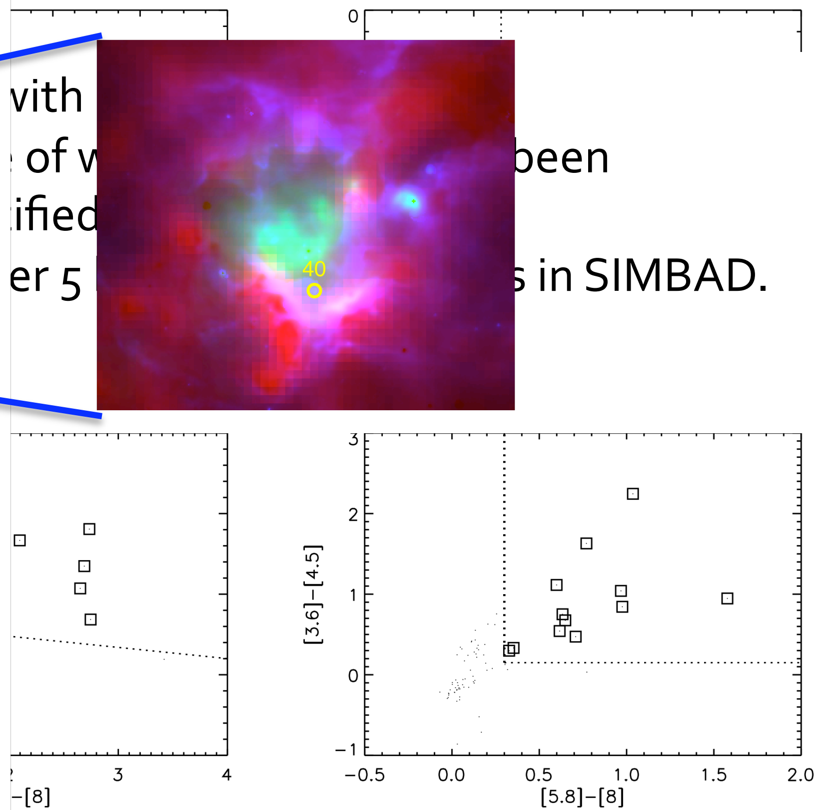


with

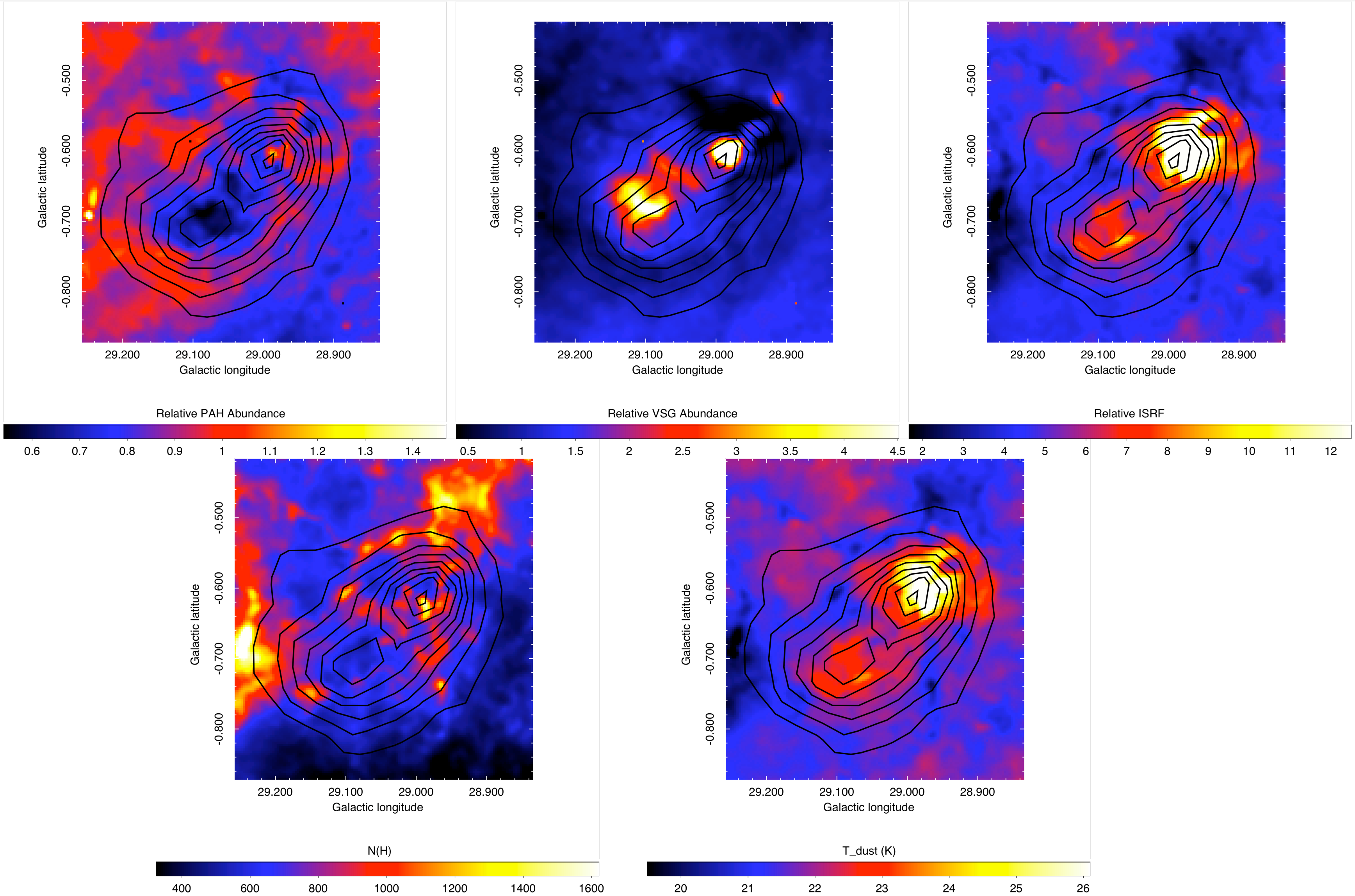
of w been

ified

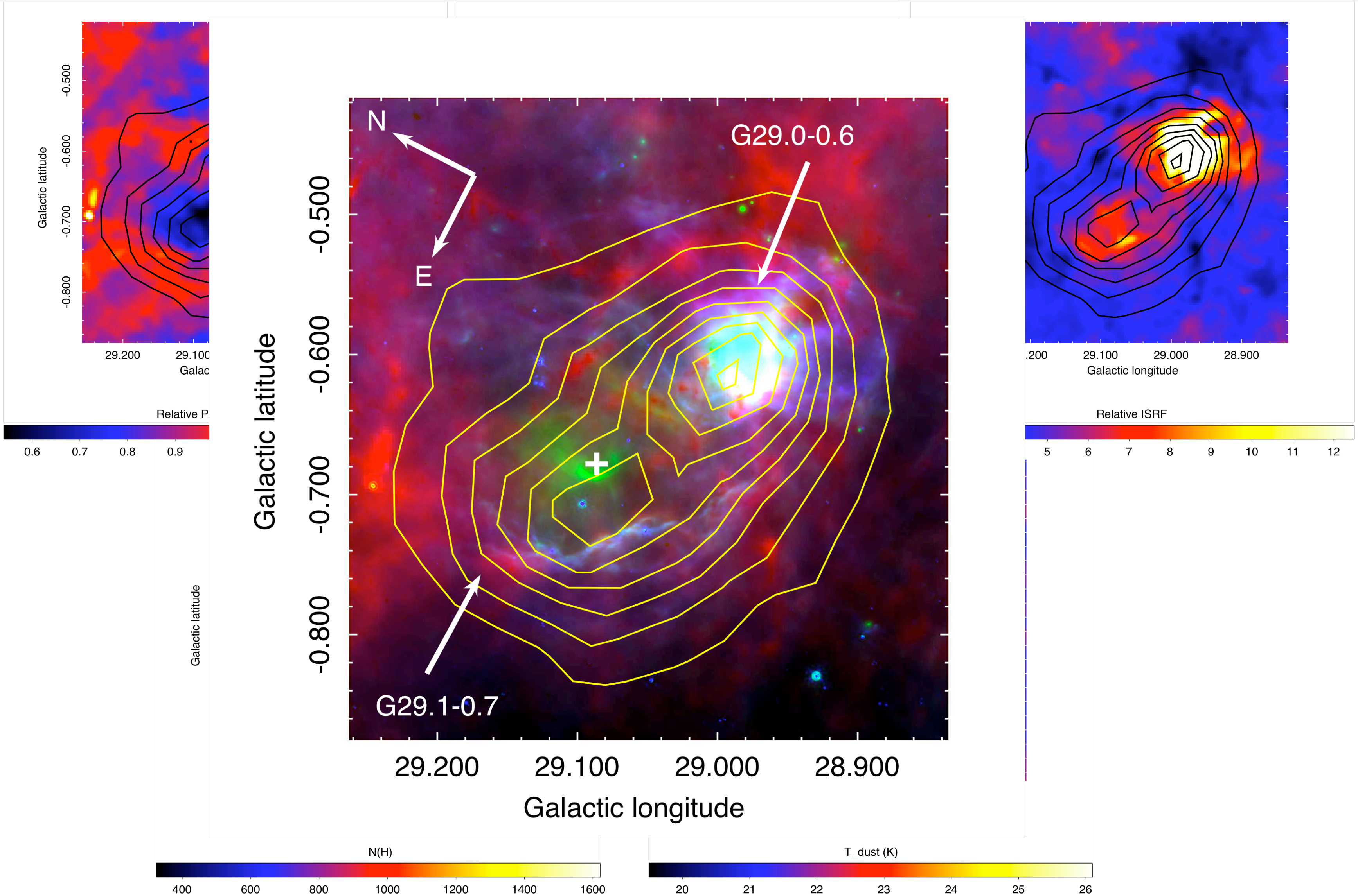
er 5 s in SIMBAD.



Origin of the AME

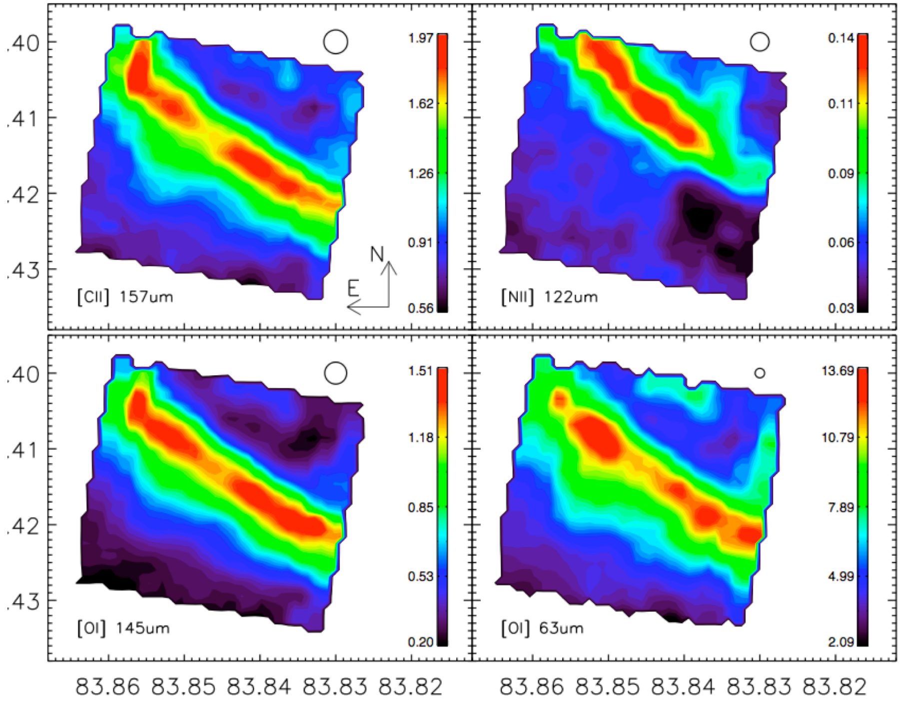


Origin of the AME



Origin of the AME

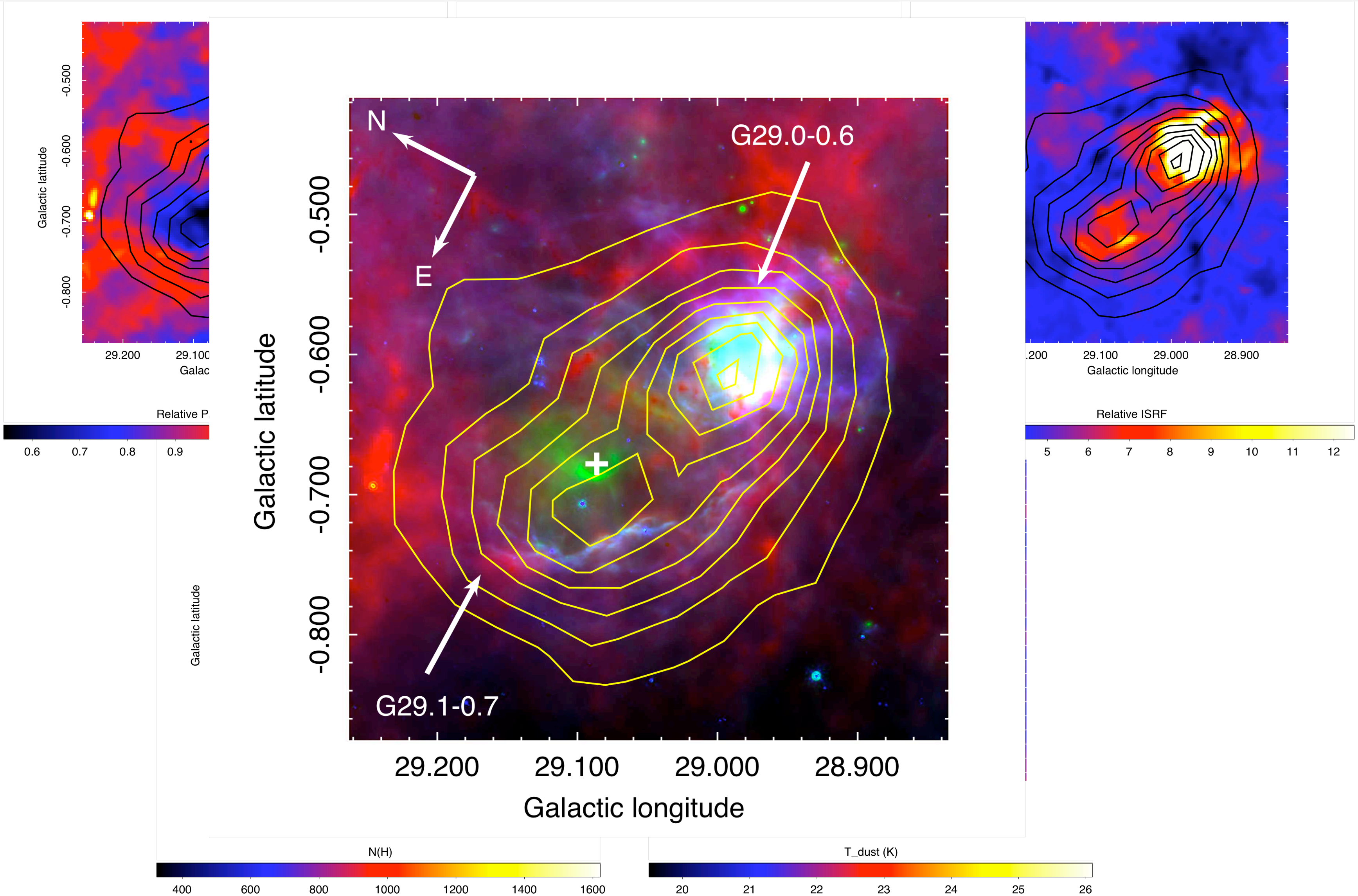
- The Orion Bar in the Orion nebula
- Exposed to a strong radiation field => PDR
- Many studies on this region.
- One such study by study by Bernard-Salas et al. (2011) which shows the stratification present in PDRs.



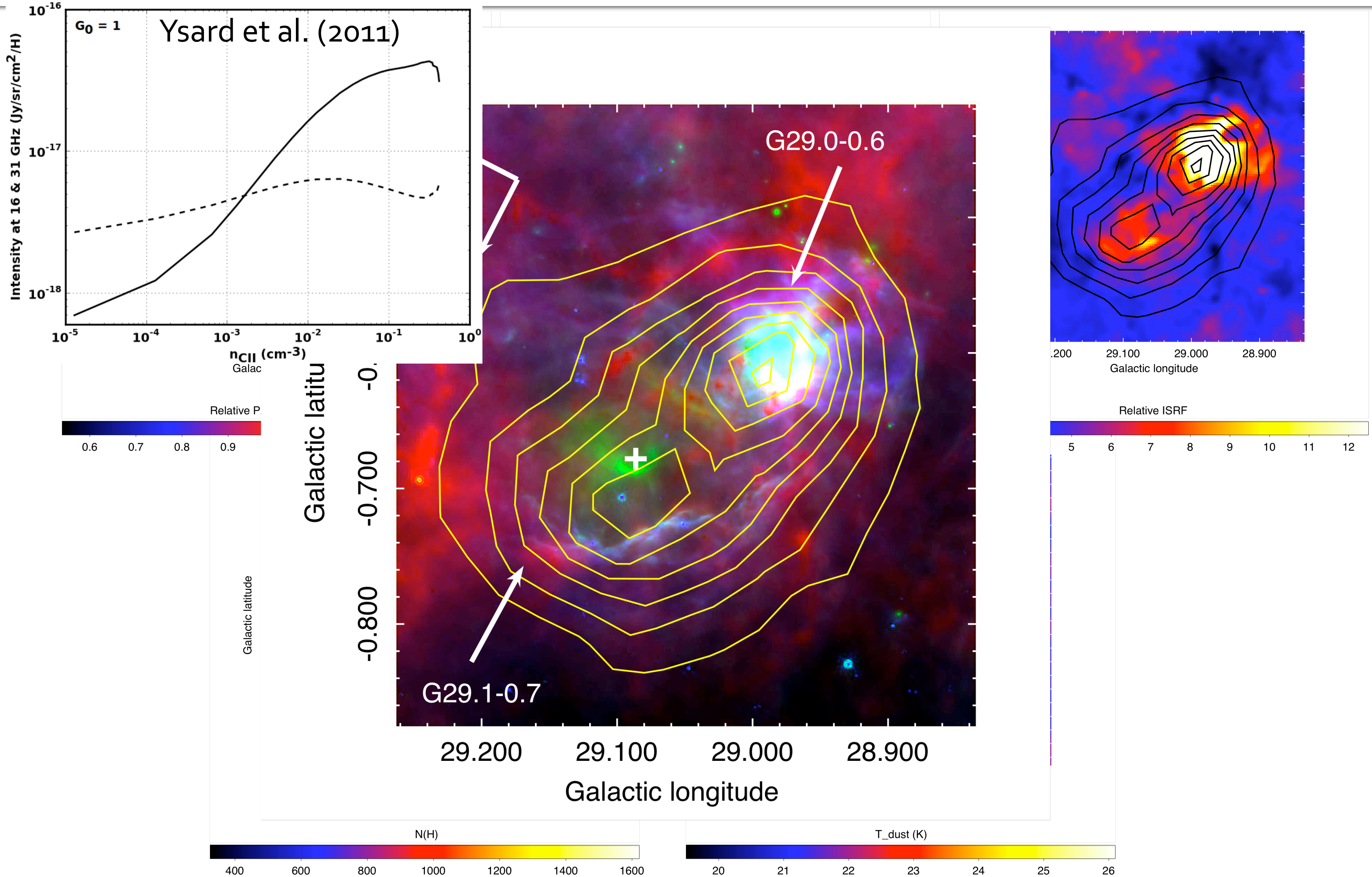
Bernard-Salas et al. (2011)

Fine structure line mapping using Herschel PACS spectrometer. [CII] 158μm; [NII] 122μm; [OI] 145μm; [OI] 63μm.

Origin of the AME



Origin of the AME



Conclusions

- The CBI 31 GHz emission is originating from 2 peaks of AME.
  - One of the peaks is located towards G29.0-0.6 and the other is located towards G29.1-0.7.

- The AME is correlated with the exciting ISRF in both components.

- The AME in G29.1-0.7 is not correlated with the PAHs in the PDR and we speculate that the major gas ions may be contributing to the observed spinning dust.