ATCA Observations of RCW 49: is it anomalous microwave emission ?

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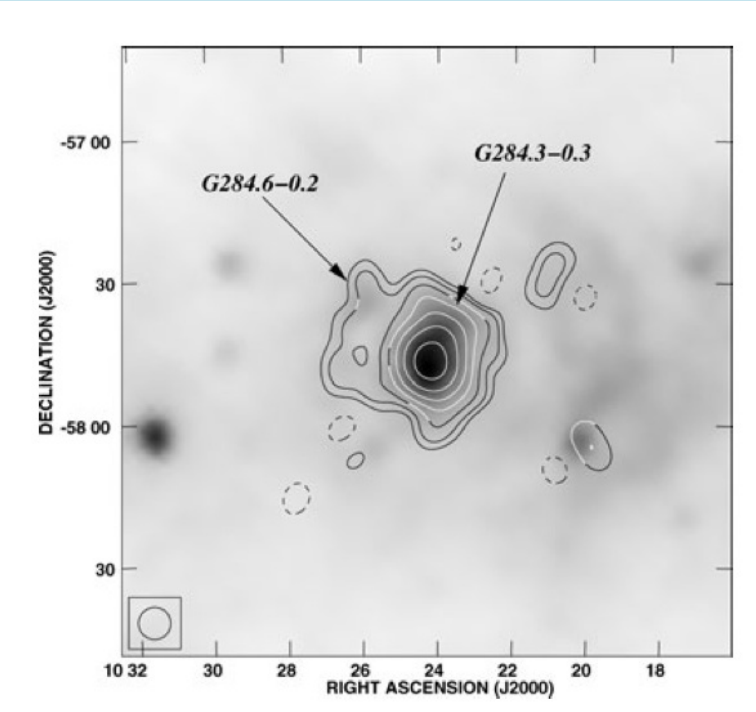
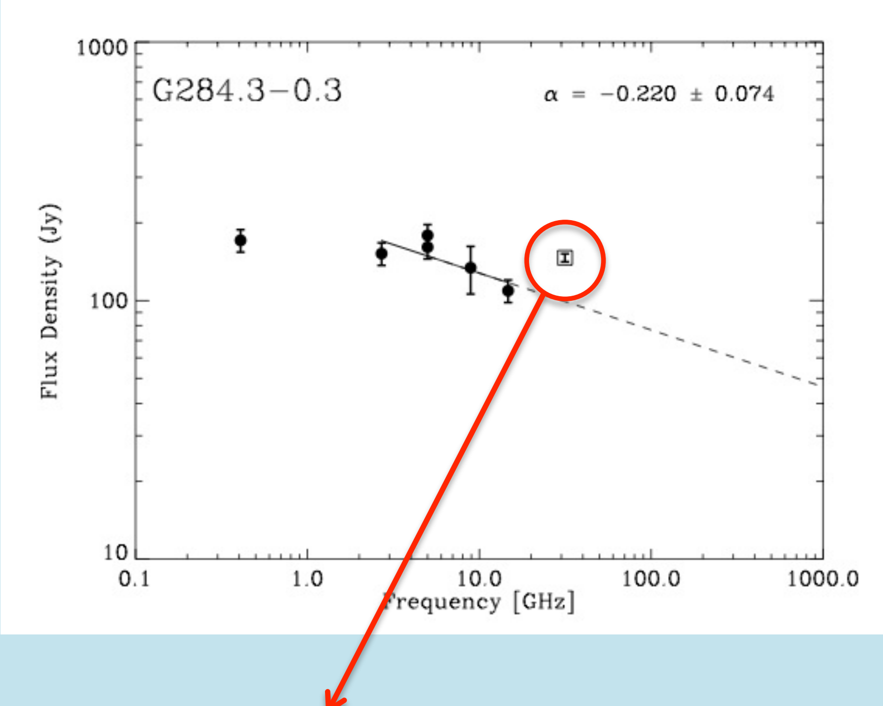
Before ATCA observations….

CBI data @ 31 GHz : Dickinson et al. 2007





3.3 σ detection

Motivations - I

→ AME is detected in several HII regions (RCW 49, RCW 175, etc..)

→ according to models (e.g Draine & Lazarian 1998a, b) warm plasma appears to provide favorable environment for the AME

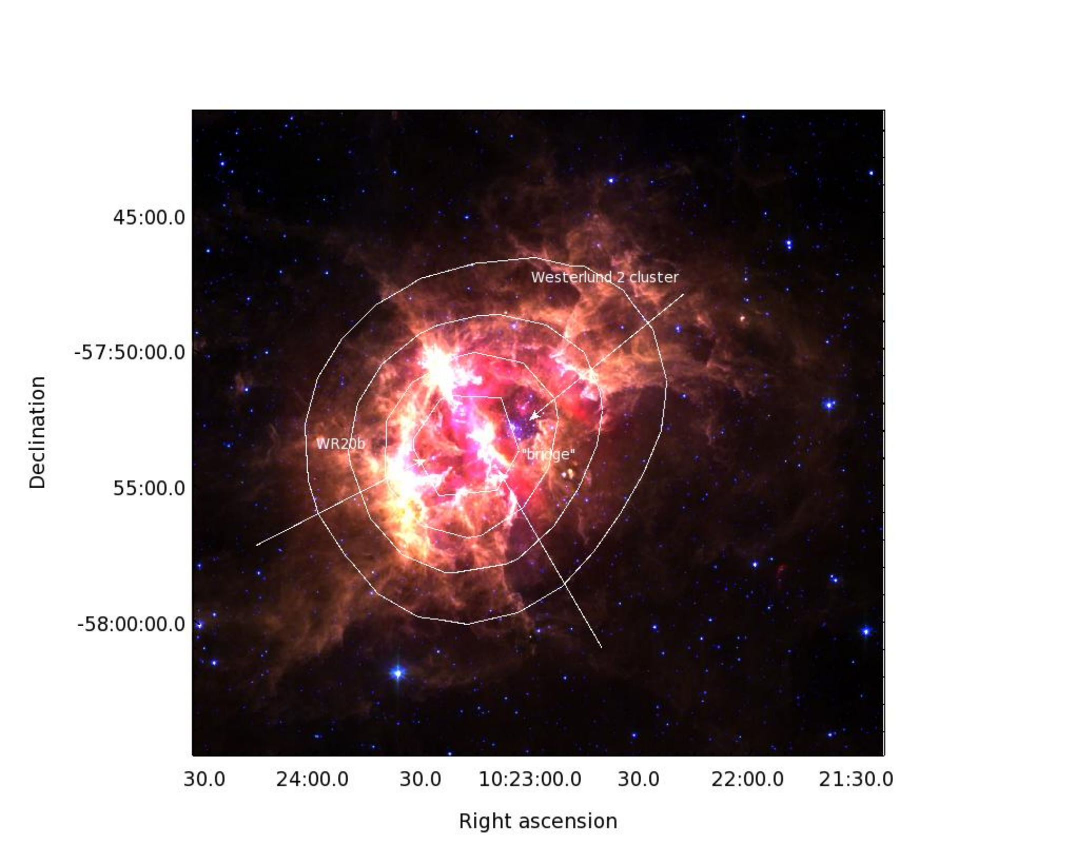
→ <u>however:</u> the interior of HII regions is typically depleted of small grains (e.g. Povich et al. 2007, Draine 2011)

→ Tibbs et a. (2012) analysis of RCW 175 shows that AME is not correlated with abundance of small grains

→ Q: can the observed microwave excess in HII regions be attributed to spinning dust ? Or is this another mechanism ?

Motivations - II

Recent Spitzer/GLIMPSE (i.e. IRAC) observations



Whitney et al. 2004

The ATCA observations

The ATCA observations (December 2008 – February 2009) have been designed to overlap with the area covered by the CBI data, i.e. an area of 7.8’ X 5.6’ centered on the core of RCW 49. In particular:

- radio continuum -> 6 cm, 1.2 cm, 8.8 mm

  (i.e. 5 GHz, 19 GHz, 34 GHz)

- configurations -> 6 cm: 1.5km (1.5C)

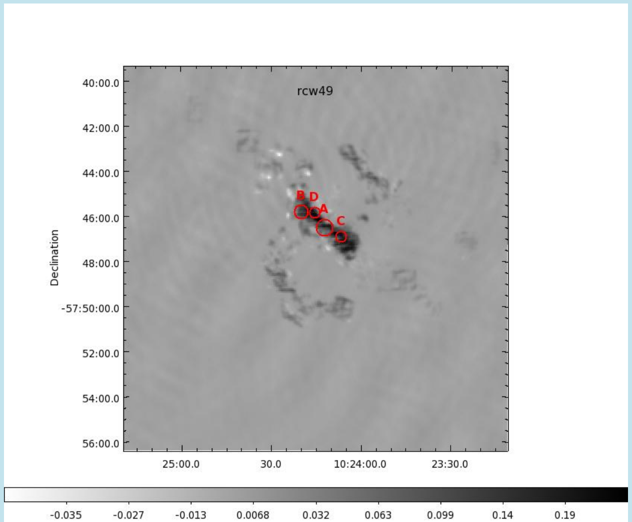
  1.6 cm / 8.8 mm: 352m (EW352)

- RRLs observations: 6 cm (H109α)

RRLs observations I – recap of observations

ν (GHz)	RRL	Δv (km/s)
5.008	H109α	1.875

RRLs observations II – analysis



Region	ν_L (MHz)	FWHM (km/s)	v (km/s)	T_e^* (K)
B	5008.7	9.2	14.5	5731
C	5009.0	3.1	-4.1	15758
D	5008.7	12.4	14.5	3965
all	5008.8	15.1	10.3	6901

$$T_e^* = \left[6943 \nu^{1.1} \frac{S_C}{S_L \Delta V} \left(\frac{1}{1+Y^+} \right) \left(\frac{\tau_C}{e^{\tau_C} - 1} \right) \right]^{0.87}$$

Roelfsema & Goss 1992

Since: $\tau_C = 8.24 \cdot 10^{-2} T_e^{-1.35} \left(\frac{\upsilon}{5GHz} \right)^{-2.1} EM$ **and** $n_e \approx \sqrt{\frac{EM}{l}}$

(l ~ 2 pc)

EM ~ 681 pc/cm^6

n_e ~ 18.4 cm^{-3}

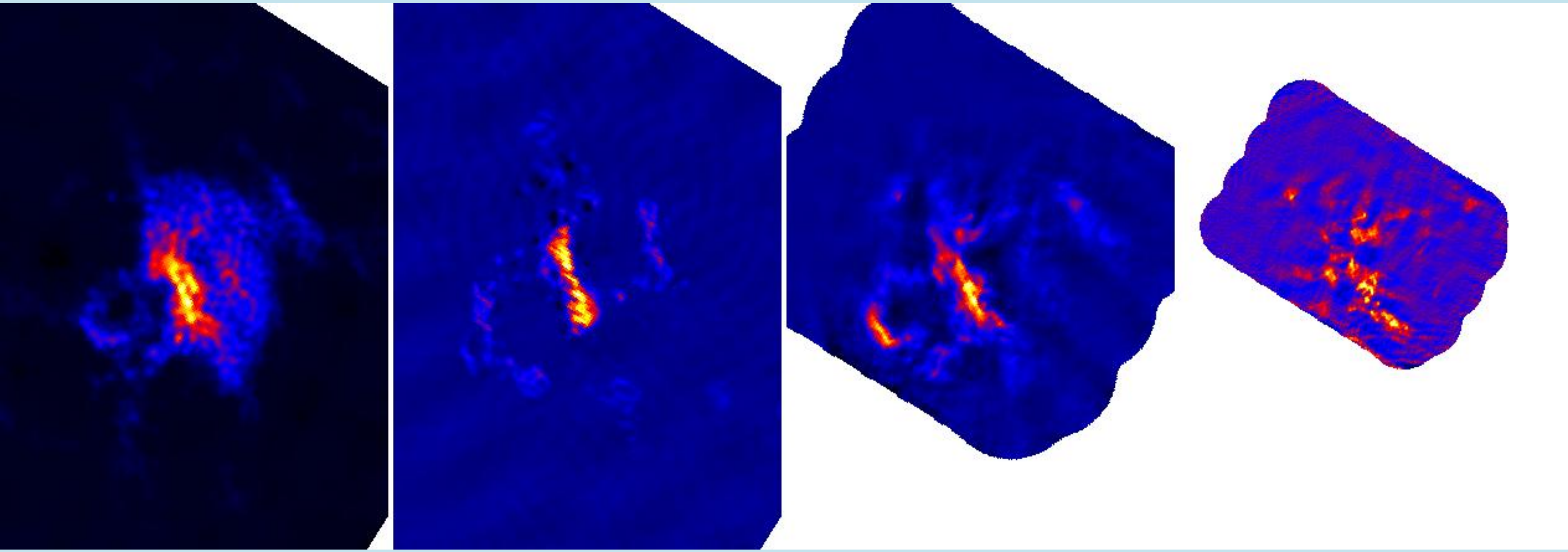
Radio continuum I – recap of observations

Obs. date	ν (GHz)	ATCA conf.	Integ. Time (hrs)	Synt. Beam (")	I_{max} 10^{-3} Jy/beam	rms 10^{-3} Jy/beam
archive	1.4	1.5B	~10	24.8 X 17.4	2151	7
Dec. 2008	5	750B	10.9	7.3 X 7.3*	295*	6*
Jan. 2009	5	1.5C	10.4	7.3 X 7.3*	295*	6*
Feb. 2009	19	EW352	10.1	8.4 X 6.1	175.4	1.2
Feb. 2009	34	EW352	10.4	8.3 X 4.2	28	1

*** Values refer to concatenated map: 750B + 1.5C**

Radio continuum II – the maps

1.4 GHz (ATCA archive) | 5 GHz | 19 GHz | 34 GHz



Whiteoak & Uchida 1997

Radio continuum III – analysis of <u>low frequency</u> maps: 1.4 and 5 GHz

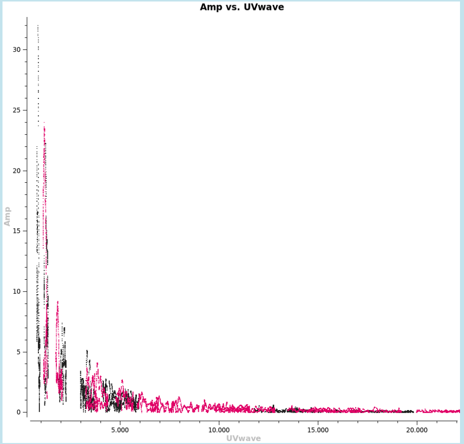
1. The RRL analysis excludes the presence of UCHII regions (at least along the “bridge”)

2. We have used a canonical free-free spectral index -0.1 to extrapolate the 1.4 GHz map to 5 GHz (but we will come back on this point later). NOTE: -0.1 is consistent with Dickinson et al. 2007 (they find -0.11+/-0.13 between 2.7 GHz and 8.9 GHz)

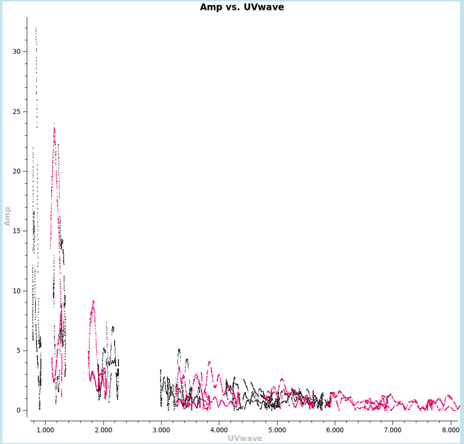
3. We have concatenated in the uv plane the 1.4 GHz data (extrapolated to 5 GHz) and the 5 GHz data

5 GHz

1.4 GHz



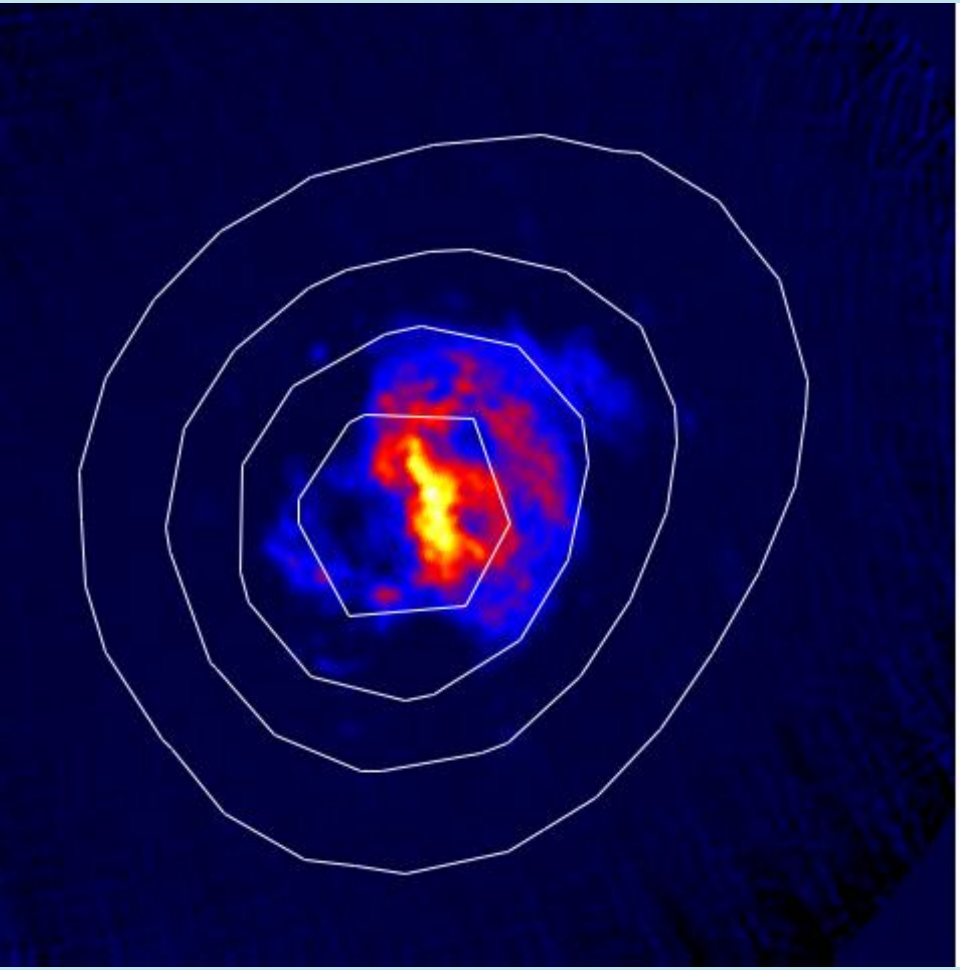
→



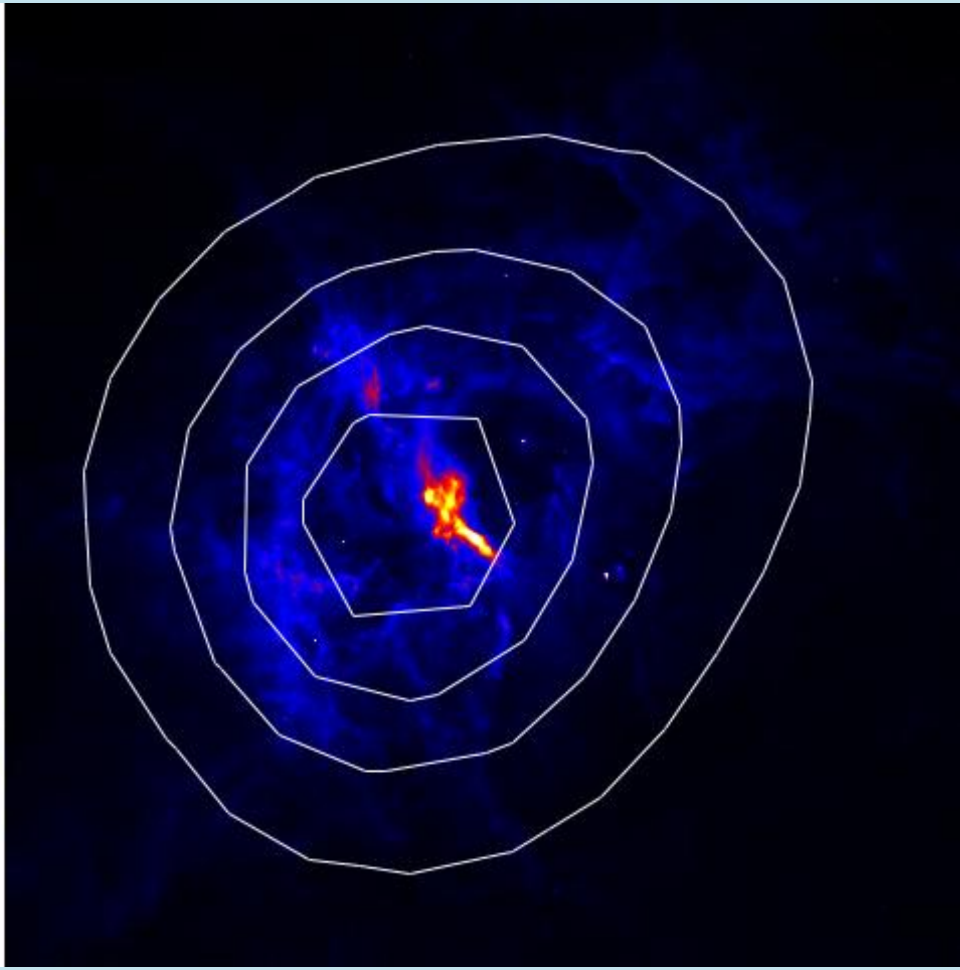
Good overlap of spatial frequencies in uv-plane

1.4/5 GHz maps: concatenation result

ATCA 1.4 GHz + 5 GHz



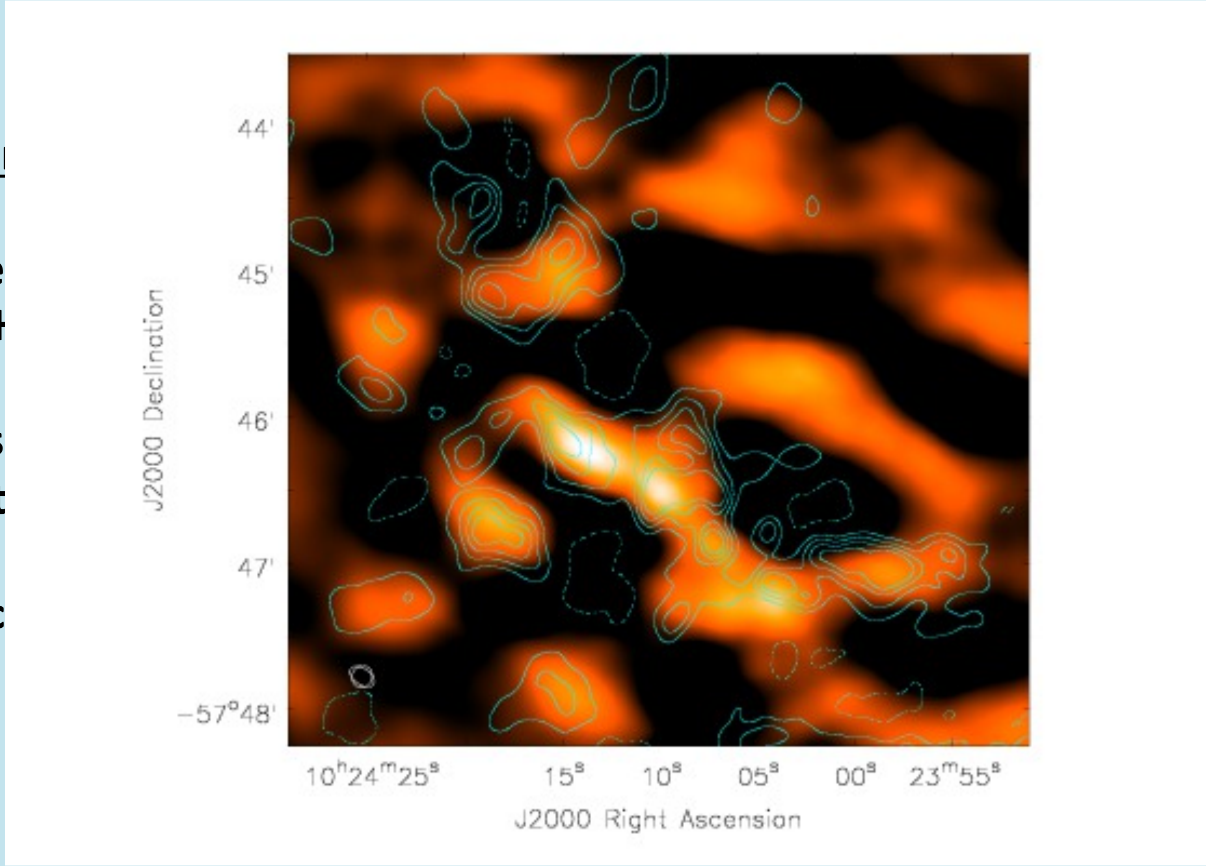
IRAC 8 μm



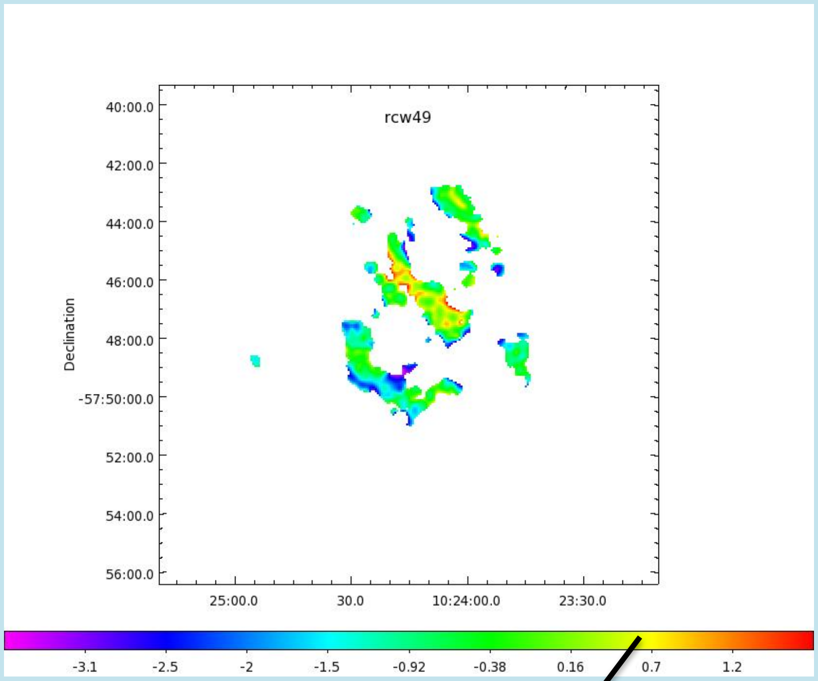
Radio continuum III – analysis of high frequency maps: 19 and 34 GHz

Procedu

1. **We e** **map to 34 G**
2. **We s** **n using the t**
3. **We c**



Spectral index map: we did try to make one..



0.6 – 0.7: spectral index values compatible with stellar winds (Panagia & Felli 1975)

1. **By filtering spatial frequencies in uv-plane for 1.4 and 5 GHz maps**
2. **By convolving the 5 GHz to the 1.4 GHz resolution**
3. **By then fitting a power-law for each pixel in the map**

BUT

Interferometer acts as a high-pass filter→ spectral index map is not fully reliable (at least, at present – more simulations needed)

Summary

→ The on-going analysis of ATCA observations of the core of RCW 49 shows a possible excess of emission at 34 GHz at RA = 10:23:58, DEC = -57:47:0.3

→ATCA RRLs observations appear to exclude that the origin of this excess can be attributed to inverted free-free (i.e. UCHII)

→ However, uncertainties due to the impossibility of performing an accurate spectral index analysis have to be taken into account

→ We have coming OT2 Herschel (PACS & SPIRE) observations (coming up (SPIRE already observed / June 23rd 2012)…
stay tuned !