Dust and Gas in NGC3627

Dust and Gas in NGC3627 Using Observations from SCUBA-2

By

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Abstract

Saw some dust and wanted to do something about it!

Ultra/Luminous infrared galaxies (U/LIRGs) are some of the most amazing systems in the local universe exhibiting extreme star formation triggered by mergers. Since molecular gas is the fuel for star formation, studying the warm, dense gas associated with star formation is important in understanding the processes and timescales controlling star formation in mergers. We have used high resolution (∼2.3") observations of the local LIRG Arp 299 (D= 44Mpc) to map out the physical properties of the molecular gas. The molecular lines ^{12}CO J=3-2, ^{12}CO J=2-1 and ^{13}CO J=2-1 were observed with the Submillimeter Array and the short spacings of the ^{12}CO J=3-2 and J=2-1 observations have been recovered using James Clerk Maxwell Telescope single dish observations. We use the radiative transfer code RADEX to measure the physical properties such as density and temperature of the different regions in this system. The RADEX solutions of the two galaxy nuclei, IC 694 and NGC 3690, show two gas components: a warm moderately dense gas with $T_{kin} \sim$ 30-500 K (up to 1000 K for NGC 3690) and $n(\mathrm{H_2}) \sim 0.3$ - 3×10^3 cm^{-3} and a cold dense gas with $T_{kin} \sim$ 10-30 K and $n(\mathrm{H_2}) > 3 \times 10^3$ cm^{-3}. The overlap region is shown to have a well-constrained solution with $T_{kin} \sim$ 10-30 K and $n(\mathrm{H_2}) \sim$ 3-30 $\times$ 10^3 cm^{-3}. We estimate the gas masses and star formation rates of each region in order to derive molecular gas depletion times. The depletion time of each region is found to be about 2 orders of magnitude lower than that of normal spiral galaxies. This can be probably explained by a higher fraction of dense gas in Arp 299 than in normal disk galaxies.

To my family and Poly.

Acknowledgements

When life looks like easy street, there is danger at your door... -Robert Hunter

Thank Chris and group members of course. Don't forget Christian!

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Chapter 1

Hello

1.1 S'up

1.1.1 yo

Chapter 2

Observations and Data Preparation

2.1 SCUBA-2

The Submillimetre Common-User Bolometer Array 2 (SCUBA-2) was designed to decrease the observing time of its predecessor SCUBA to allow for rapid data acquisition in the submillimetre regime of the electromagnetic spectrum, in particular the 450μm and 850μm bands. Prior to SCUBA-2, other bolometer camera's such as LABOCA, BOLOCAM and SHARC-II were limited to less than 100 pixels, whle the new SCUBA-2 has been able to incorporate over 10,000 pixels in its design and effectively reduce observing time. Increasing the amount of pixels by 100 times, was possible by the advent of new technology such as high precision micromaching, superconducting transition edge sensors, and superconducting quantum interference device amplifiers **?**.

The first science images were taken of NGC3627 in order to determine appropriate scan methods. Observations were taken in grade 3 weather ($0.08 < \tau < 0.12$). In all 'X' observations were taken of NGC3627, and 'Y' were used in the reduction.

It might be nice to have one large table with all of the rms values, beams used for convolution, and beam sizes for each of the wavebands observed

2.2 SCUBA-2

- What is SCUBA-2 and what does it look at and why is it an important/how is it relevant among today's instrumentation
- Discuss the nature of the observations and their reduction, things like weather grade, number of images used. Technical details.
- maybe include figure of emission window for scuba-2

2.2.1 Image Creation

- Use SMURF MAKEMAP command and give brief description of overall process. Include $img_gen.sh$ in an appendix?
- Implement maps in the ast and flt portion of makemap. Explain what these do for the image overall (should reduce noise and help to flatten background)
- use flt.filtering to remove any large scale features. Helped with smoothing background noises.
- apply FCF values that are determined from calibrations from Uranus

- 850 gridded to 8sq" and 450 gridded to 4sq" pixels.
- for 850μm needed to remove $CO_{j=3-2}$ emission from continuum band. Reference the drabek paper and a brief outline of what she did. QUOTE THE NUMBER USED TO CONVERT UNITS.

2.2.2 Image Properties of 450μm and 850μm

- show calibration data?
- beam shape of 450 and 850. Discuss fitting methods for both single and double gaussian shapes also give rms values of noise before any convolution.
- show beams in color image w/contour and plot across the middle

2.3 Supporting Images

- Discuss what you need other images for. Herschel for SED fits. THINGS, KUNO, and Heracles for dust-to-gas ratio.
- Images needed to be run through makemap as a fake source in order to remove any small scale structure from original images. I should have several figures showing the amount of flux removed from each of the images.

- Reference the Kingfish Survey, Kuno et al., Heracles survey and THINGS survey for their sources. ¡–Leave this as a paragraph on it's own or introduce smaller subsections?

Chapter 3

Results

3.1 Will they ever get here?

Chapter 4

Discussion

4.1 Talk to the hand

Chapter 5

Conclusions

Sandstrom et al. (2013)

Bibliography

Sandstrom, K. M., Leroy, A. K., Walter, F., Bolatto, A. D., Croxall, K. V., Draine, B. T., Wilson, C. D., Wolfire, M., Calzetti, D., Kennicutt, R. C., Aniano, G., Donovan Meyer, J., Usero, A., Bigiel, F., Brinks, E., de Blok, W. J. G., Crocker, A., Dale, D., Engelbracht, C. W., Galametz, M., Groves, B., Hunt, L. K., Koda, J., Kreckel, K., Linz, H., Meidt, S., Pellegrini, E., Rix, H.-W., Roussel, H., Schinnerer, E., Schruba, A., Schuster, K.-F., Skibba, R., van der Laan, T., Appleton, P., Armus, L., Brandl, B., Gordon, K., Hinz, J., Krause, O., Montiel, E., Sauvage, M., Schmiedeke, A., Smith, J. D. T., & Vigroux, L. 2013, ApJ, 777, 5