Analysis of APEX CO(2-1) emission line observation of a nearby galaxy

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This abstract is abstract.

I. INTRODUCTION

II. THEORY

A. Single-dish

The primary mirror is the first optical element of a telescope, encountered by light. The telescope's primary mirror is called a dish in radio/(sub-) mm bands (bands meaning frequency observation windows). Radio/(sub-)mm telescopes are either made with 1) A single dish meaning one single antenna connected to one or several receivers 2) $N \geq 2$ antennas working as an interferometer. The second option provides a larger collecting area and better spatial resolution. However, single dishes are very optimal for studying very extended, low surface brightness structures and/or for surveys of large areas of the sky [1].

Examples of radio and sub-millimeter single-dish facilities are APEX and LMT. Atacama Pathfinder Experiment, APEX, operates at millimeter and submillimetre wavelengths - between infrared light and radio waves. It is placed at an elevation of 5100 meters in Chile's Atacama region [2]. The Large Millimeter Telescope is situated in Volcán Sierra Negra at an altitude of 4600 meters and is specifically designed to observe in the wavelength range of 0.85 - 4 mm [3].

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Figure 1. APEX depicted in the image on top [4] and LMT depicted on the bottom [5].

The antenna temperature is equal to the brightness temperature of the source convolved with the normalized beam pattern of the antenna [1].

$$F_\nu \equiv \Gamma F_\nu \rightarrow F_\nu = \Gamma^{-1} F_A^* \tag{1}$$

$$L'_{CO}[K\ km/spc^2] = (3.25 \cdot 10^7) \frac{D_L^2}{V_{obs^2}(1+z)^3} \int_{\Delta\nu} S_\nu d\nu \tag{2}$$

$$M_{H_2+He}[M_\odot] = \alpha_{CO} L'_{CO} \tag{3}$$

III. METHOD

The data obtained from APEX consist of observations from different sources, among other things, the observation of the molecular line transition CO(2-1) of the galaxy IRAS 13120-5453, a nearby ultraluminous infrared galaxy. The redshift of this galaxy is $z = 0.0308$, which corresponds to a luminosity distance of $D_L = 139.4Mpc$ (using $H_0 = 67.8km/s$, $\Omega_M = 0.307$, $\Omega_\Lambda = 0.693$ and $k = 0$, i.e. flat geometry) [6].

A. Curve fit by Gaussian profile

Our goal is to analyze the CO(2-1) emission line. As emission lines closely resemble a Gaussian curve, it is, therefore, an interest to curve fit a Gaussian profile to the emission line.

$$g(x, \mathbf{P}) = ae^{-\frac{(x-b)^2}{2c^2}} + d;\ \mathbf{P} = (a, b, c, d) \tag{4}$$

The purpose of the fitting is to optimize the parameters in P based on the data. The parameters are as follows

a: the amplitude of the Gaussian. The difference in the minimum value of your spectral line and the minimum.

b: the mean of the gaussian. The position of the peak on the x-axis.

c: width of the Gaussian.

d. y-value of the baseline. The maximum value of the spectrum

IV. RESULTS

spect_only-eps-converted-to.pdf

Figure 2. Caption

V. DISCUSSION

VI. CONCLUSION

ACKNOWLEDGMENTS

I would like to thank myself for writing this beautiful document.

Appendix A: Name of appendix

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Appendix B: This is another appendix

Tada.

Appendix C: References

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