Origin of the excess IR luminosity in an apparently isolated LIRG

Nelli Cárdenas-Martínez [1] , Isaura L. Fuentes-Carrera [1]

[1] Escuela Superior de Física y Matemáticas del Instituto Politécnico Nacional (ESFM-IPN), México D.F., México

E-mail: ncardenas@esfm.ipn.mx, isaura@esfm.ipn-mx

We present the extended kinematics of the ionized gas of an apparently isolated late-type galaxy displaying LIRG activity. We identify a morphological peculiarity associated with double peaked profiles which could be related to two different kinematic components. We propose this to be a signature of an infalling satellite galaxy. CIG 302 might be an example of a minor interaction inducing very strong star formation in the Local Universe.

INTRODUCTION :

Luminous infrared galaxies (LIRGs) have infrared (IR) luminosities between 10^{11} and 10^{12} Lsun (Sanders & Mirabel, 1996) . These luminosities result from the thermal heating of dust in regions of intense star formation (SF) or active galactic nuclei (AGN). The dust absorbs the ultraviolet and optical radiation, and reemits that energy in a broad thermal peak in the mid to far IR 8-100 μm.

LIRGs and ULIRGs have long been recognized as one of the best laboratories to study the process of violent SF in the Local Universe. In order for a star forming galaxy to emit at a LIRG level, it must have a very high star formation rate (SFR) (Melbourne et al.,2005).

In the Local Universe, these high SFR are primarily triggered by galaxy-galaxy interactions or mergers (Ishida, 2004).

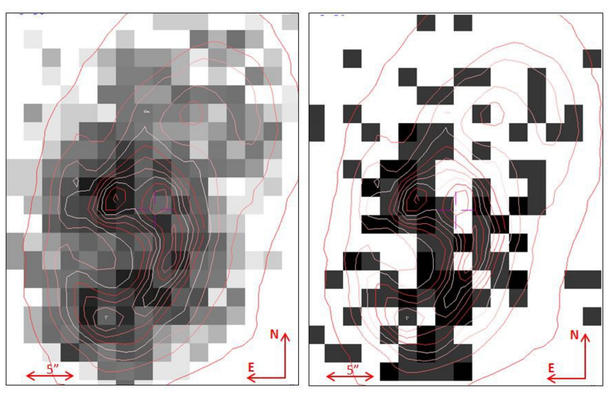

Fig. 1- CIG 302 GALEX images Left: Near UV , Rigth: Far UV. Isophotes correspond to g' SDSS band.

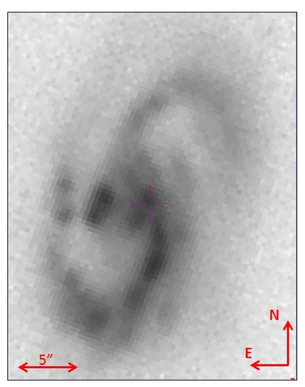

Fig. 2- CIG 302 SDSS z' band images.

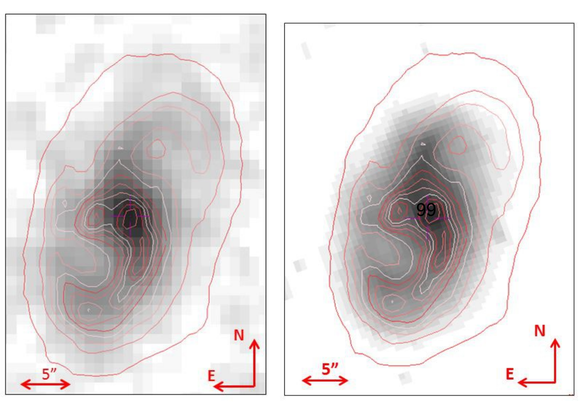

Fig. 3- CIG 302 **Left:** 2MASS H band images. **Rigth:** Images from the Spitzer telescope at 7.82μm. Isophotes correspond to the g' SDSS band.

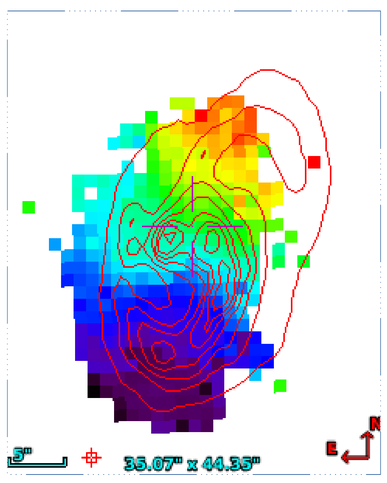

Fig. 4- CIG 302 velocity map derived from PUMA Fabry-Perot observations in Hα. Isophotes correspond to the g' SDSS band.

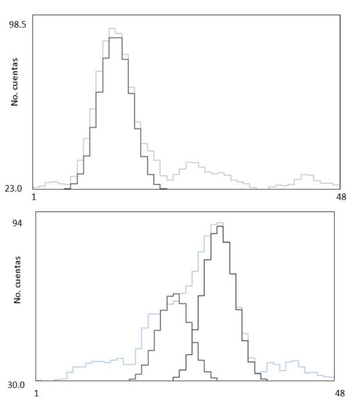

Fig. 5- Different line profiles. **Top: S**imple profiles and a gaussian function fit. **Bottom:** Composite profiles and two different gaussian functions fit.

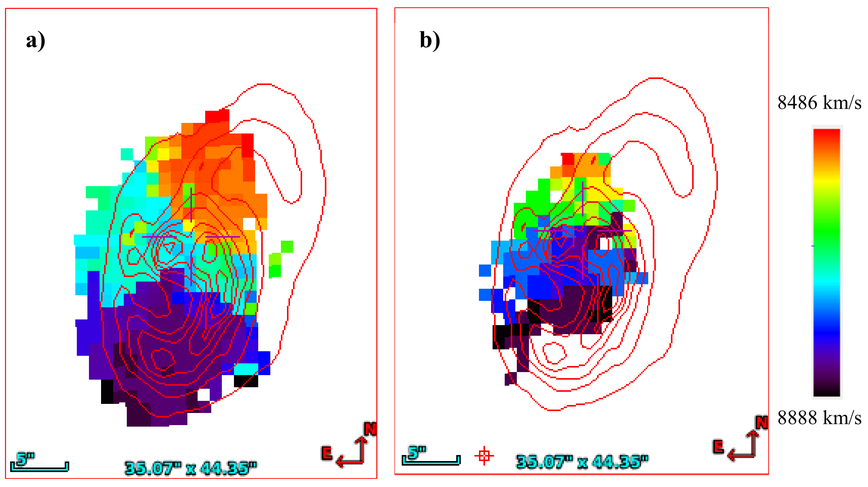

Fig. 6- Each of the complex profiles is associated with a different motion, so they were analyzed separately and two different the velocity maps were derived a) and b). Isophotes correspond to the g' SDSS band.

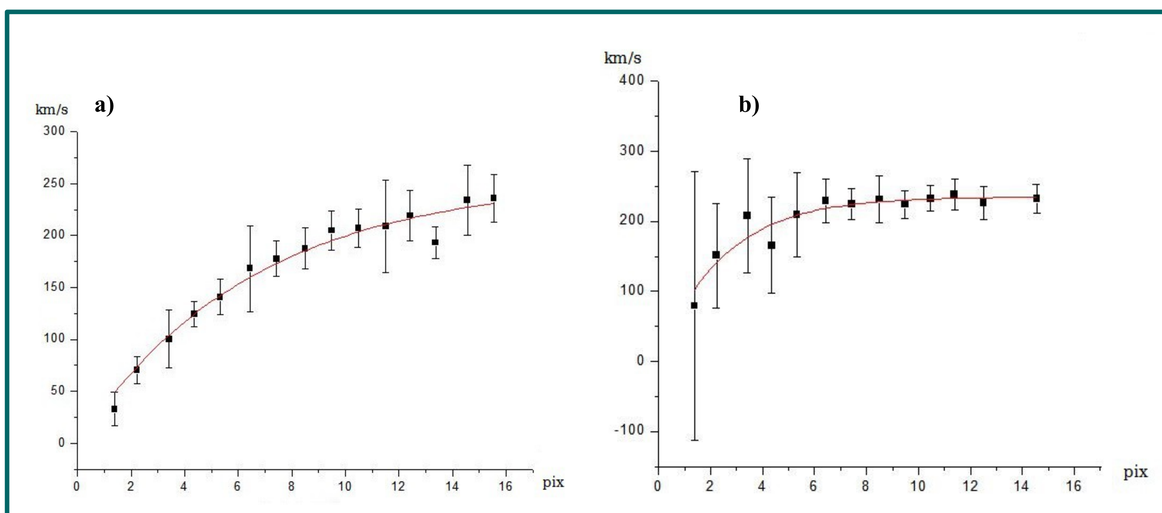

Fig. 7.- Rotation curves **a)** from the velocity map showed in Fig. 4. Best fit in red. **b)** Rotation curve derived from velocity field of the main component (see Fig. 6-a) and best fit in red

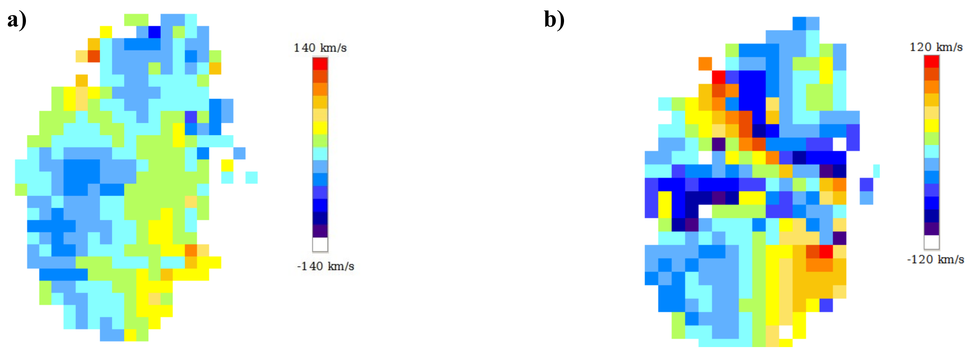

Fig. 8- Residual velocity map from the best fit of the rotation curve for both cases, using Fig. 7-a (a) and Fig. 7-b (b)

Observations

Observations of CIG 302 were done on Agust 2010 at the f/7.5 Cassegrain focus of the 2.1m telescope at the OAN-SPM (Mexico) using the scanning Fabry-Perot interferometer PUMA (Rosado et al. 1995),

Parameters of the observation are listed in **Table 1**.

Data were processed using the ADHOCw software (developed by J. Boulesteix).

CIG 302

CIG 302 is a late spiral with a higth IR luminosity (see **Tabla 2**). According to Karachentseva (1973) a recent morphological reevaluation of the CIG galaxies in the context of the Analysis of the interstellar Medium of Isolated GAlaxies project (AMIGA) (Verdes-Montenegro et al. 2005), CIG 302 is an isolated galaxy, also with no nuclear activity (Poggianti & Wu 2000) .

Poggianti & Wu (2000) and Sabater et al. (2008) classified it as an HII galaxy, the integrated spectrum is dominated by nebular emission lines due to photoionization by the presence of a large number of O and B stars.

Figures 1 to 3 show the galaxy at different wavelengths. Notice the feature on the eastern side of the galaxy.

Table 1. Observations

Telescope	2.1 m (SPM-OAN)
Fabry Perot Scan	PUMA
CCD detector	Thomson 2000 2048x2048
Binning	3x3
Spatial resolution	1.08"/pixel
Order of Interference	330
Free spectral range	20.86 A° 19.4 km/seg
Spectral resolution	0.43A° 19.4 km/seg
Fiinesse	24
Channels	48
Exposure time per channel	90 sec

Table 2. CIG 302 general properties

Name	NGC 2761
Morphologic	SA (s) c Dusty Starburst isolated
Readshift	0.029162
L_{IR}	$10^{11.02} – 10^{11.49}$ L_{sun}
Inclination	55°
SFR_{FIR}	53.2 M_{sun}/yr
$SFR_{H\alpha}$	1.22 M_{sun}/yr

Velocity maps were computed using the barycenter of the Hα profile peaks at each pixel (see Fig 4). We noticed that some of the profiles could be the result of two or more gaussian shaped profiles (see Fig 5). They were separated and analyzed as two individual profiles, each one associated with a different motion. They were analyzed separately and we derived two different velocity maps, both shown in Fig. 6. There is a main profil extended over all the galaxy and can be associated with a rotating disk. Surprisingly the second component (right panel) has also a velocity gradient and it is associated with the feature seem in other wavelengths (see Fig 1, 2 and 3).

Fig. 7 shows the rotation curve before and after the profiles decomposition. And Fig 8 shows the residual veolicity map in each case.

Conclusions

CIG 302 is an isolated LIRG without obvious signs of interaction but when we looked carefully we noticed an small feature near to the center. We could identify two different velocity gradients in CIG 302, the first gradient is associated to the main disc and the second gradient is associated with the feature that is also visible in the morphology and residual brightness profile.

This is an example in the Local Universe of a minor interaction inducing very strong star formation.

Bibliography

Ishida, C. M. 2004, Ph.D. Thesis

Karachentseva, V. E. 1973, Soobshch. Spets. Astrofiz. Obs, 8, 72

Melbourne, J., Koo, D. C. & Le Floc'h 2005,ApJ, 632,65

Poggianti, B.M. & Wu, H. 2000, ApJ , 529, 157

Rosado, M., Langarica, R., Bernal et al. 1995, RMxAA , 3, 263

Sanders, D. B. & Mirabel, I. F. 1996, ARA&A, 34, 749

Verdes-Montenegro, L., et al. 2005, A&A, 436, 443