RevMexAA (Serie de Conferencias), **35**, 249–250 (2009)

THE LOCAL DWARF IRREGULAR GALAXY IC10: IONIZED GAS BEHAVIOR

M. Valdez-Gutiérrez,[1] M. Rosado,[2] and I. Puerari[3]

RESUMEN

Presentamos resultados preliminares relacionados a la cinemática del gas ionizado de la galaxia IC 10, una enana irregular del Grupo Local. Nuestra meta principal es estudiar la interacción entre el gas y estrellas en este objeto. Realizamos observaciones Fabry-Perot en las líneas de Hα, [SII], [NII] y [OIII] con un muestreo espectral de $\sim$ 19 km s^{-1} y una resolución espacial de $\sim$ 0.6 seg arc/pixel.

ABSTRACT

We present preliminary results related to the ionized gas kinematics of the Local Group dwarf irregular galaxy IC 10. Our main goal is to study the interaction between the gas and stars in this object. Scanning Fabry-Perot interferometry was performed in the Hα, [SII], [NII] and [OIII] lines to a moderate spectral sampling $\sim$ 19 km s^{-1} and spatial $\sim$ 0.6 arcsec/pixel resolutions.

Key Words: galaxies: irregular — galaxies: ISM — galaxies: Local Group — H II regions

1. INTRODUCTION

Following our kinematic studies in nearby and Local Group irregular dwarfs (Valdez-Gutiérrez et al. 2001, 2002; Rosado et al. 1998, 2001, and references therein), in this contribution we assess the ionized gas content in the Local Group dwarf irregular galaxy IC 10 by means of scanning Fabry-Perot interferometry.

IC 10 is an interesting object in many aspects. It is an outlying member of the Andromeda subgroup but due to a large Galactic foreground obscuration its luminosity class is uncertain. Its DDO classification is IrIV and optical and H I radio centers agree within their errors. Compared to the SMC, IC 10 has comparable present luminosity, half an effective radius (r_e=0.5kpc), higher oxygen abundance (12+log(O/H)=8.20) and 5.1 WR stars kpc^{-2}. In terms of its global SFR per kpc^{-2} and total SFR (0.04–0.08) $M_\odot$ yr^{-1}, IC 10 has been classified as an starburst or a BCD. Ramsey et al. (2006) report that it hosts one ultraluminous X-ray source (ULXs) which is optically associated to a WR star (Massey et al. 1992). H I counterrotation was reported by Cohen (1979), who interpreted such an H I kinematics in terms of a warped gas-layer rotating normally and seen face-on.

[1]Instituto de Astronomía, UNAM, Apdo. Postal 877, Ensenada, B. C., México (mago.valdez@gmail.com).

[2]Instituto de Astronomía, UNAM, Apdo. Postal 70264, 04510, México D. F., México (margarit@astroscu.unam.mx).

[3]INAOE, Luis Enrique Erro 1, Tonantzintla, Puebla, Mexico (puerari@inaoep.mx).

2. OBSERVATIONS

All observations were made using the UNAM Scanning Fabry-Perot (FP) interferometer PUMA on the 2.1 m telescope at the Observatorio Astronómico Nacional at San Pedro Mártir, B.C., Mexico. A description of PUMA's setup is given in Valdez-Gutiérrez et al. (2001) and is the same we used in this work. The PUMA's field of view is 10′ in diameter. Thus our observations covered the entire optical extension of IC 10. We obtained a set of direct images (without the FP on the optical axis), in the lines of Hα, [S II] (λ 6717, 6731Å), [N II] (λ 6584Å) and [O III] (λ 5007Å).

Scanning FP data cubes were obtained in the four lines already mentioned: Hα, [S II], [N II] and [O III]. Depending on the line of interest the FP data cubes are composed of a number of steps or channels covering the free spectral range. The integration time per step in the case of the Hα filter was of 60 seconds at bin = 3 and the free spectral range scanning was performed in 48 channels. In the cases of more than one data cube per observing run, we added them in order to increase the signal-to-noise. According to the line under scanning, different lamps were observed before and after each pointing to provide wavelength calibration.

FP data reductions (phase calibration and kinematical analysis) were carried out as described in Valdez-Gutiérrez et al. (2001), mainly using the software ADHOC package (Boulesteix 1993). The photometry was performed under IRAF[4].

[4]IRAF is distributed by the National Optical Astronomy

Our data cubes in Hα are contaminated with line-sky emission such as the lines of OH at 6568.78 Å and 6568.77 Å. Those night-sky lines fall inside the main emission of IC 10, centered at channel 14 or at heliocentric velocity +295 km s^{-1}. These night-sky lines have been subtracted using an interactive routine of ADHOC and consequently our radial velocity dispersions are free of them. The data cubes in the [S II], [N II] and [O III] lines are less contaminated by line-sky emission; however, the S/N ratio is not so good as for the Hα cubes and they were used to compare and to complement the Hα observations.

To extract the kinematic information from the FP data cubes we proceed as it is described in Valdez-Gutiérrez et al. (2001). The radial velocity profiles were fitted by Gaussian functions once deconvolved by the instrumental function (an Airy function). We also constructed a set of moment maps. In the calculation of the first moment (the radial velocity map), ADHOC finds the barycenter in the radial velocity profile of each pixel. Cleaning this map at 2σ the value of the standard background emission ensures galactic membership of the remaining features. The second moment map (the velocity dispersion map) was derived using the Adhoc package. Finally, ADHOC calculates a monochromatic map after integration of the radial velocity profile (velocity versus intensity along the 48 channels) of each pixel, up to a certain fraction of the peak (usually 70%). This map enables us to separate the monochromatic emission from the continuum (Boulesteix 1993).

Observatories, operated by the Association of Universities for Research in Astronomy, Inc., under cooperative agreement with the National Science Foundation.

3. RESULTS

On galactic scales the radial velocity field for IC 10 does not show ordered structure and this fact prevents a proper calculation of the rotation curve with traditional methods and is matter of further investigation for the authors. On local scales the kinematics reflects the superposition of shells, filaments, SNRs, WR nebulae and diffuse gas. At many locations rich in diffuse ionized gas (DIG), the velocity widths are supersonic and many times larger than those found in the adjacent HII regions. This result is similar to the one we found in the nearby dwarf galaxy NGC 4449 (Valdez-Gutiérrez et al. 2002). IC 10 as well as IC 1613 are good galaxy examples of how hard is to perform a gaseous mass and dark matter estimations (see the moment 1 map in Valdez-Gutiérrez et al. (2001). Further analysis is being carried out.

REFERENCES

Boulesteix, J. 1993, ADHOC Reference Manual (Marseille: Publications de l'Observatoire de Marseille)
Cohen, R. J. 1979, MNRAS, 187, 839
Massey, P., Armandroff, T. E., & Conti, P. S. 1992, AJ, 103, 1159
Ramsey, C. J., et al. 2006, ApJ, 641, 241
Rosado, M., et al. 1998, A&A, 329, 631
_________. 2001, AJ, 122, 194
Valdez-Gutiérrez, M., et al. 2001, A&A, 366, 35
_________. 2002, AJ, 124, 3157