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# A NEW SOUTHERN BLUE COMPACT DWARF GALAXY ESO 105-ig11: IS THERE AN EXPANDING SUPERSHELL?

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## I. INTRODUCTION

ESO 105-IG11 (IC 4870, IRAS 19327-6555, AM 1932-655) was catalogued as a starburst galaxy by Véron-Cetty and Véron (1987), and Green et al (1992). On the other hand, this galaxy has been classified as a Seyfert 2 galaxy by Dahari and De Roberts (1988), and Sadler et al (1995). Veron-Cetty (1984)'s observations showed that ESO 105-IG11 is very blue with $B-V$=−0.04 and $U-B$=−0.34. Dressler (1991) determined the heliocentric radial velocity of 889 km/sec, and the total apparent magnitude of $B_T$ = 13.92 mag. This galaxy is also known as a low luminosity IRAS galaxy (Zhenlong et al 1991) of log $L_{IR}$ = 8.68 $L_\odot$, and was detected in X-ray by *Einstein* with the X-ray luminosity of log $L_x$ < 39.923 erg sec$^{-1}$ (Green et al 1992). Until now, relatively thorough studies are not avaiable for this galaxy. In our investigation, we present an extensive spectroscopic study for ESO 105-IG11.

## II. OBSERVATION

We carried out low resolution spectroscopic observations on 1991 July 12-13 with the Cassegrain spectrograph on the MSO 74 inch telescope equiped with blue-PCA. The 300 lines/mm grating was employed for low resolution spectra. The low resolution spectra cover the wavelength range $3,400\ \text{Å} < \lambda < 7,200$ Å with a resolution of 3 Å /pixel. The slit was positioned along the east-west orientation. High-resolution longslit spectroscopic observations with 1,200 lines/mm grating were carried out for 12 different slit position angles with the Cassegrain spectrograph on the MSO 74 inch telescope equiped with 385 ×578 UV-enhanced CCD camera. The high resolution spectra cover wavelength range of 200 Å with a resolution about 0.4 Å /pixel near $H_\alpha$ and $H_\beta$. Data reduction with IRAF was made using a standard CCD spectroscopic reduction procedure.

## III. RESULTS

Our deep CCD images (Sung & Chun 1996, in preparation) show that ESO 105-IG11 has two nuclei; a bright compact core, A, of radius 13″ and the other smaller compact object, B, of radius 6″ which is 10″ east of A. Our low resolution spectroscopic observations confirm that these two components are active star-forming regions. The spectra of ESO 105-IG11 confirm typical highly excited emission lines of blue compact dwarf galaxies. The elemental abundances can be estimated empirically from the observed emission line intensity ratios (Dinerstain and Shields 1986). We derived the mean electron temperature and the electron number density from emission line intensity ratios $T_e$ = 16,000 ± 600 K, and $N_e$ = 8 electron cm$^{-3}$, respectively. The determined oxygen abundance, 12 + log(O/H) is 7.76 ± 0.1 which is the mean abundance of typical blue compact galaxies with 1/11 of the solar value.

Figure 1 shows four rotaion curves for the slit position angles of $\phi$=67, 130, 145, 146 among 12, obtained from our high dispersion spectroscopic observations. The apparent rotation curves show two components; a solid body rotation of radius $r$ = 30″ (1.7 kpc) with the amplitude of about 25 km/sec except the central region of $r$ = 10″ (0.6 kpc) and the strong anomaly of the velocity field near the nuclus of the galaxy with the amplitude of about 50km/sec. Simliar anomaly was observed in the starburst galaxy NGC 253 by Ulrich (1978). An interesting possibility of the anomaly of the velocity field is that there exists an expanding supershell due to the massive starforming activities at the centeral part of the galaxy. Meurer et al (1992) found the expanding supperbubble for NGC 1705 with the expanding velocity of about 150 km/sec related to the starforming region. From the rotation velocity curves of ESO 105-IG11, a mass within $r$ = 30″ was derived $M$= 3.8 × 10$^8$ $M_\odot$. The mass of H II gas, $M_{HII}$ = 1 × 10$^7$ $M_\odot$, was adapted from the calculation from $H_\beta$ flux, $L_{H_\beta}$ = 4.1 × 10$^{40}$ erg/sec (Sung et al 1996, A&Ap submitted). The total gas mass within $r$ = 30″ was roughly estimated $M_g$ = 2 × 10$^7$ $M_\odot$. Assuming uniform expanding shell, with the expanding velocity $v_e$, the estimated mechenical energy of the gas in the expanding shell, $E_k$ = 1/2 $M_{flow}$ × $v_e^2$ = 3 × 10$^{53}$ erg, where $M_{flow}$ is the gas mass of the shell. Meurer et al (1992) estimated roughly 80 % of the neutral gas and about 17 % of the ionized gas. We adopted the mass of the gas in the shell, $M_{flow}$ = 1 × 10$^7$ $M_\odot$. The kinetic energy of the supershell of ESO 105-IG11 seems to be less than that of NGC 1705 and similar to the value of NGC 253. A rough estimation of the maximum mass loss per year from the nuclus is, $M_{loss}$ = 1 $M_\odot$ / year, assuming that the gas observed in a circle centered 0.5 kpc from the center has on average traveled 0.5 kpc in 10$^7$ year. This mass loss rate seems to be larger than NGC 253.

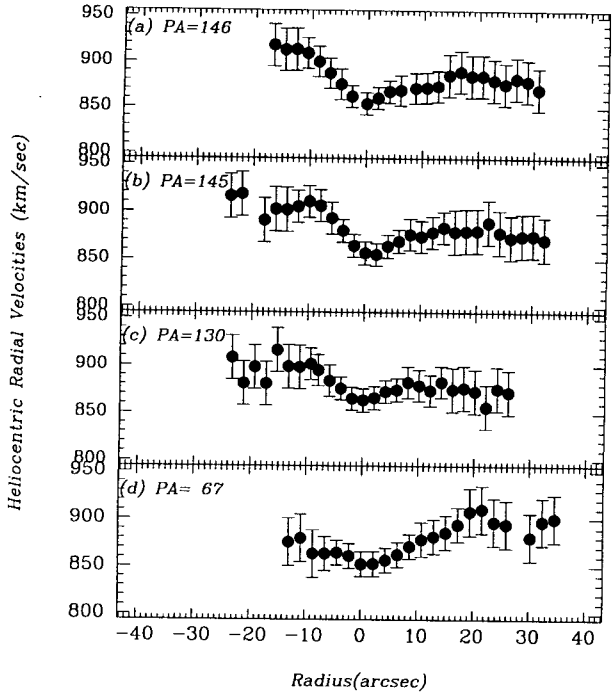


Fig. 1.— Heliocentric radial velocity distributions. (a) the radial variation with the position angle $\phi = 146°$, (b) for $\phi = 145°$, (c) for $\phi = 130°$, and (d) for $\phi = 67°$.

## IV. SUMMARY

1. Our low resolution spectra confirm that ESO 105-IG11 (IC4870) is a new blue compact dwarf galaxy. Optical CCD images suggest that this galaxy has two active star-forming regions near its center.

2. Abundance analysis from the emission line intensity ratios shows that the determined oxygen abundance, 12 + log(O/H) is 7.76 ± 0.2 which is a typical abundance of blue compact galaxies, and the helium abundance 12 + log(He/H) is estimated as 10.84 ± 0.2, very similar to that of the solar value.

3. The radial velocity curves from the high resolution spectroscopy show two components; the rigid body rotation with the maximum amplitude of 25 km/sec extends to $r \leq 30''$ and the unusual velocity field near the nuclus of the galaxy with the amplitude of 50 km/sec and the radius of $r = 10''$ due to expanding supershell. The kinetic energy of the expanding supershell is estimated as $3 \times 10^{53}$ erg/sec.

4. The mass of the gas for ESO 105-IG11 inside the $r = 30''$ was estimated as $2 \times 10^7$ $M_\odot$. In this area the dynamical mass was $3.8 \times 10^8$ $M_\odot$.

5. The heliocentric radial velocity of ESO 105-IG11 of 898 ± 10 km/sec was derived from the spectroscopic observations. We derived the distance, $D = 12$ Mpc assuming a Hubble constant, $H_o = 75$ km sec$^{-1}$ Mpc$^{-1}$.

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