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INTERACTIONS BETWEEN GALAXIES IN A LOW-REDSHIFT GROUP: THE NGC 4065 GROUP

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ABSTRACT

We presents a study of interactions between galaxies in the low-redshift group known as the NGC 4065 group. Imaging data were taken using the 2.4 meter telescope at the Thai National Observatory (TNO) for B, V and R_c broadband filters and [S ii] and Red-continuum narrowband filters. There are 21 galaxies in our sample. The results show that most early type galaxies (ETGs) with equivalent width $EW(\mathrm{H}\alpha) <$ 10 Å are gas-deficient galaxies, while late type galaxies (LTGs) show more $EW(\mathrm{H}\alpha)$ and are bluer than the ETGs. This means that star formation activity in the LTGs could be triggered by tidal interactions between galaxy members due to dense environmental effects in the compact group.

Key words: galaxies: interactions – galaxies: star formation – galaxies: groups: individual (NGC 4065)

1. INTRODUCTION

The data for this research were taken using a 2.4 meter Ritchey-Chretien, alt-azimuth drive reflecting telescope at the Thai National Observatory (TNO) on 25–27 February and 9–11 March, 2014. Ten pointing observations were done, using a U-42 Apogee CCD with exposure times of 900 s, 600 s and 300 s for BVR_c broadband and 900 s for both [S ii] and red-continuum narrowband filter systems, respectively. The targets are sample galaxies in a low-redshift group, the NGC 4065 group. Twenty-one galaxies were confirmed to be members in this group by redshifts collected from the NASA/IPAC Extragalactic Database (NED).

2. METHODOLOGY

The diameter of the galaxies in the sample were taken to be the B_{25} isophotes, with an ellipse fitting of the galaxy profile perofrmed using ESP-ELLPRO (a package of Starlink software). ESP-ELLPRO produces three parameters for the fits, i.e., the ellipticity (e), semi-major axis (a_{25}) and position angle (PA). Then, the B_{25} diameter was applied to measure B, V and R magnitudes and flux counts for the red-continuum and [S ii] filters.

The galaxy morphology of the sample in this research was classified following the de Vaucouleurs classification and T-Type systems. We found that most of our sample are ETGs; ten elliptical, six lenticular and five spiral galaxies. Of these spiral types, three of them are peculiar galaxies. We also found one radio galaxy and two galaxies with active galactic nucleus (AGN).

The equivalent width of Hα, $EW(\mathrm{H}\alpha)$, a parameter corresponding to star formation activity, was obtained by subtracting the red-continuum flux count from the [S ii] narrowband flux count, and using the following equation (Gavazzi et al., 2006; Kriwattanawong et al., 2011):

$$EW\left(\mathrm{H}\alpha\right) = \frac{\int T_n\left(\lambda\right) d\lambda}{T_n\left(6563\left(1+z\right)\right)} \frac{C_{\mathrm{H}\alpha}}{C_{\mathrm{c}}} \quad (1)$$

where $T_n(\lambda)$ is the throughput of the [S ii] filter band, z is the redshift of the galaxy, $C_{\mathrm{H}\alpha}$ is the continuum subtracted Hα signal count within the B_{25} diameter, and C_{c} is the continuum signal count within the B_{25} diameter.

3. RESULTS

The results show that the $B - R$ color of our sample varies from 0.9 to 1.4, while the M_B magnitude is scattered over a wide range without correlation with the color index, as shown in Figure 1.

The plot of the $B - R$ color vs T-Type in Figure 2 shows that the LTGs of our sample tend to be bluer than the ETGs, except for the radio galaxy and two galaxies with AGN. This is the cause of the widely scattered colors for the late type subsample.

The plot of $EW(\mathrm{H}\alpha)$ vs T-Type in Figure 3 shows that the LTGs tend to have higher $EW(\mathrm{H}\alpha)$ than the ETGs. Particularly, the radio galaxy exhibits the highest star formation activity. All late type and two of the S0 type galaxies show high star formation ($EW(\mathrm{H}\alpha) >$ 10 Å), whereas the other early type sample was found to have $EW(\mathrm{H}\alpha)$ with scattered values lower than 10 Å.

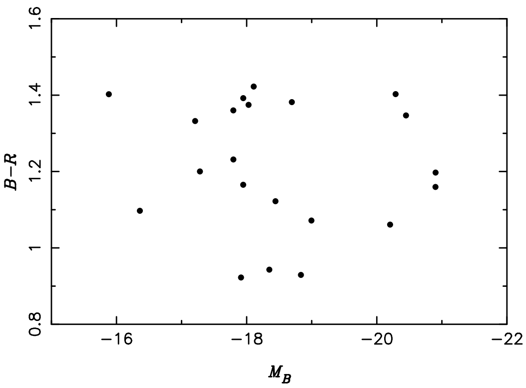

Figure 1. The plot between $B - R$ color and absolute magnitude M_B

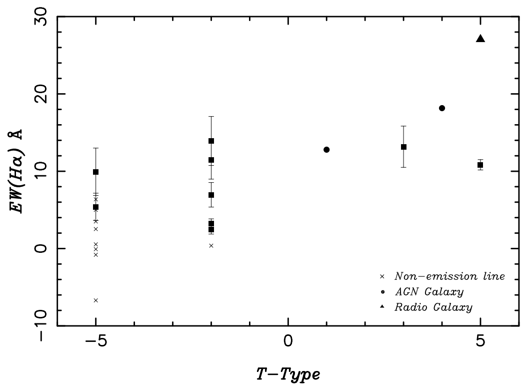

Figure 3. The plot between $EW(H\alpha)$ and $T - Type$. Crosses represent galaxies with S/N of $EW(H\alpha) < 3$, whereas the others are emission line galaxies.

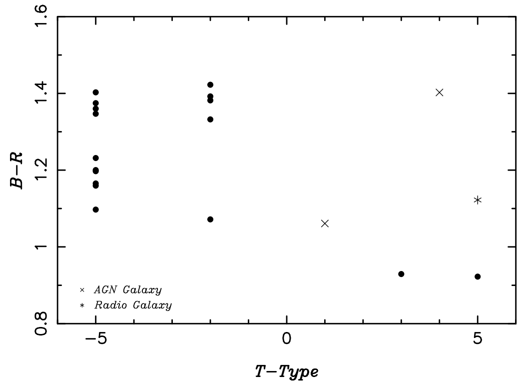

Figure 2. The plot between $B - R$ color and $T - Type$ with marked symbols for the radio galaxy (asterisk) and AGN (cross)

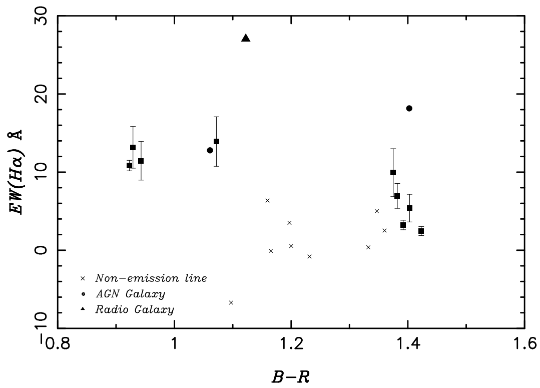

Figure 4. The plot between $EW(H\alpha)$ and $B - R$ color.

Figure 4 illustrates a diagram of $EW(\mathrm{H}\alpha)$ versus the $B - R$ color. It was found that for emission line galaxies, the bluer galaxies tend to have higher $EW(\mathrm{H}\alpha)$ than the ETGs. All LTGs, including 3 active galaxies, and blue ETGs with $B - R$ less than 1.1 show ongoing high star formation rates ($EW(\mathrm{H}\alpha) > 10$ Å).

4. CONCLUSIONS

Studying a sample of galaxies in the low-redshift compact group NGC 4065, we find that the ETGs seem to be redder than the LTGs. All LTGs and two blue lenticular galaxies show ongoing high star formation rates, whereas the others are ETGs with $EW(\mathrm{H}\alpha)$ less than 10 Å or no emission line. We know the ETGs have a lower star formation rate than the LTGs because of insufficient gas material to produce star formation (Haynes & Giovanell., 1984). However, some of the ETGs sample show high star formation rates even though they are not in dense H I regions (Freeland et al., 2009) which are abundant in hydrogen to produce star formation. Freeland et al. (2010) found evidence of ram pressure and tidal interaction in a star-forming galaxy, UGC 7049, one of our sample galaxies. These results indicate that most of the ETGs in this compact group are gas-deficient galaxies, while rich-gas LTGs could be affected by a dense environment. The formation of young massive stars might be triggered by tidal interactions among galaxy members (Boselli et al., 2006; Moss., 2006) and cause the emission line galaxies to have bluer colors than the passive ETGs.

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