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PHYSICAL PARAMETERS IN CIRCUMNUCLEAR STAR FORMING REGIONS

G. F. Hägele,[1] M. V. Cardaci,[1,2] A. I. Díaz,[1] E. Terlevich,[3] R. Terlevich,[3] and M. Castellanos[1]

We present a spectrophotometric study of circumnuclear star forming regions (CNSFRs) in the spiral galaxies: NGC 2903, NGC 3351 and NGC 3504, all of them of over solar metallicity according to standard empirical calibrations. The low excitation of the regions, as evidenced by the weakness of the [OIII] λ 5007 Å line, precludes the detection and measurement of the auroral [OIII] λ 4363 Å necessary for the derivation of the electron temperature. It is therefore impossible to obtain a direct determination of the oxygen abundances. Empirical calibrations have to be used instead.

A detailed measurement of their line intensity ratios is made after careful subtraction of the very prominent underlying stellar absorption. It is found that most regions show the highest abundances in HII region-like objects according to empirical calibrations, such as O_{23} (= ([OII] λ 3727,29 + [OIII] λ 4959,5007) / H_β; Pagel et al. 1979) and N2 (= [NII] / H_α; Denicoló et al. 2002), and also the highest N/O ratios.

From the [SII]/[SIII] ratio, which has been shown to be a good ionization parameter indicator (Díaz et al. 1991), it is also seen that CNSFRs show the lowest excitation of a sample of HII-like objects from the literature. A hint on the ionizing temperature of the regions can be obtained through the use of the η' (= ([OII] λ 3727,29 + [OIII]λ 4959,5007) / ([SII] λ 6717,6731 + [SIII]λ 9069,9532)) parameter, which is a measure of the softness of the ionizing radiation (see Vílchez & Pagel 1988) and increases with decreasing ionizing temperature. These parameter shows that the CNSFRs, as a class, segregate from the disk HII region family, clustering around smaller η' values, and therefore higher ionizing temperatures.

On the other hand, we have measured gas and stellar velocity dispersions in 5 CNSFRs and the nucleus of NGC 3351. The stellar velocity dispersions have been obtained from high resolution spectra of the Ca triplet (CaT) lines at λ 8494,8542,8662 Å, while the gas velocity dispersions have been measured by Gaussian fits to the Hβ and [OIII] λ 5007 Å lines on high dispersion spectra.

The CNSFRs, with sizes of about 100 to 150 pc in diameter, are seen to be composed of several individual star clusters with sizes between 1.7 and 4.9 pc on an HST image. Using the stellar velocity dispersions and applying the virial theorem assuming that systems are gravitationally bound and spherically symmetric, we have derived dynamical masses for the entire starforming complexes and for the individual star clusters. Values of the stellar velocity dispersions are between 39 and 67 km s^{-1}. Dynamical masses for the whole CNSFRs are between 4.9×10^6 and $4.3 \times 10^7 M_\odot$ and between 1.8 and $8.7 \times 10^6\, M_\odot$ for the individual star clusters. These values are between 5.5 and 26 times the mass derived for the super star cluster (SSC) A in NGC 1569 by Ho & Filippenko (1996).

Stellar and gas velocity dispersions are found to differ by about 20 km s^{-1} with the Hβ lines being narrower than both the stellar lines and the [OIII] λ 5007 Å lines. We have found indications for the presence of two different kinematical components in the ionised gas of the regions. The radial velocity curve shows deviation from circular motions for the ionised hydrogen consistent with its infall towards the central regions of the galaxy at a velocity of 25 km s^{-1}. A similar result was found by Rubin et al. (1975) from high dispersion observations of the Hα line in the central region of this galaxy.

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[1] Dpto. de Física Teórica, C-XI, Universidad Autónoma de Madrid, Cantoblanco, 28049-Madrid, Spain (hagele@uam.es).
[2] XMM Science Operations Centre, European Space Astronomy Centre of ESA, P.O. Box 50727, 28080 Madrid, Spain.
[3] INAOE, Tonantzintla, Apdo. Postal 51, 72000 Puebla, México.