

# SPECTROSCOPIC ANALYSIS OF THE CIRCUMNUCLEAR REGIONS OF THE SEYFERT 1.2 GALAXY NGC 7214

MARIO RADOVICH, PIERO RAFANELLI

*Dipartimento di Astronomia, Università di Padova, Italy*

**ABSTRACT.** We discuss here the spectroscopic properties of the Seyfert 1.2 galaxy NGC 7214. Circumnuclear emission line regions were isolated and line ratios were measured and fitted with photoionization models; this allowed to discriminate between thermal and non thermal ionization. For the regions where non thermal ionization by the active nucleus is negligible compared to thermal ionization by stars we computed the star formation rates per unit area and compared them with the values detected in a sample of non active galaxies. We find that one of the analyzed HII regions shows evidence of enhanced star formation.

## 1. Introduction

NGC 7214 ( $z=0.023$ , SB(s)bc), classified as a Sy 1.2 by Winkler (1992), is one (a) of the four components of the Hickson group H91 and is closely interacting with a SBa galaxy (d) at 0.6' N. Interaction is likely to induce bursts of star formation in HII regions surrounding the Seyfert nucleus and to power the far infrared emission,  $L(60 - 100\mu m) = 1.4 \times 10^{44}$  erg s<sup>-1</sup> (Lonsdale 1989). This would also explain the relatively high emission at 60  $\mu m$  compared to that at 25  $\mu m$  which corresponds to a spectral index  $\alpha(60, 25) \sim -2$ , steeper than in a typical Sy1,  $\alpha(60, 25) > -1.5$ .

We show here the results of a spectroscopic analysis of the circumnuclear regions of NGC 7214. Observations were performed at LaSilla with the ESO 3.6m telescope + EFOSC, with a 2" wide long slit located at position angles of 180°, 200° and 270° along the galaxy. HII regions and regions ionized by the AGN were discriminated plotting the line ratios [OIII]  $\lambda 5007/H\beta$  vs. [NII]  $\lambda 6583/H\alpha$ , [SII]  $\lambda\lambda 6716+6731/H\alpha$  and [OI]  $\lambda 6300/H\alpha$  in the Veilleux-Osterbrock diagrams (Veilleux and Osterbrock 1987, VO hereafter). A grid of photoionization models was computed using the latest release of the G. Ferland's code, Cloudy 90 (Ferland 1996), in order to find the physical parameters (hydrogen density, ionization parameter) that better fit the observed line ratios.

## 2. Results

The circumnuclear regions closest to the nucleus ( $r \sim 2-3$  kpc) are typical of a region ionized by a non-thermal source ( $n_H \sim 10^3$  cm<sup>-3</sup>). At  $r \geq 5$  kpc the situation is more complex: in some cases the position of the line ratios in the VO diagrams lies between the AGN and HII region domain. Assuming that no shock ionization is present, it

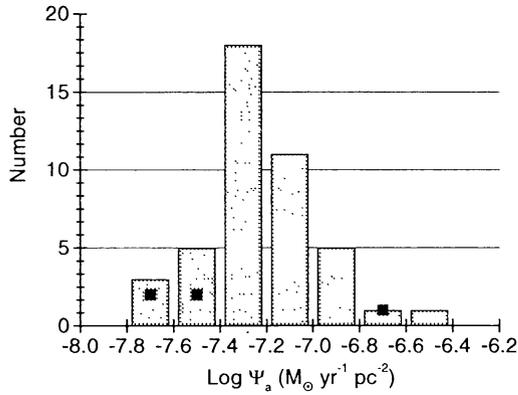


Fig. 1. Star formation rates per unit area in the sample of Kennicutt (1988) compared to the values found in the HII regions of NGC 7214 (filled squares).

follows that these line ratios can be produced only in HII regions illuminated by the power law continuum emitted by the AGN. This is confirmed by the values of the ratio  $\eta = Q_{\text{nuc}}/Q_{\text{ion}}$ , defined as the ratio of the number of ionizing photons (a) produced by the AGN and reaching the region, corrected for geometrical dilution and (b) required to produce the  $L(\text{H}\alpha)$  luminosities corrected for internal extinction: this results to be higher ( $> 4\%$ ) in those regions showing 'intermediate' VO ratios, while it is lower ( $\sim 3\%$ ) in those falling in the HII-region zone. Given these criteria, we selected five regions which are more likely to be HII regions unaffected by the non-thermal ionizing source. For each of these regions we computed the star formation rates per unit area (Hunter & Gallagher 1986) and compared them with the values found for the HII regions of non active spiral galaxies in the study of Kennicutt (1988), as shown in Fig. 1. Four regions do not show evidence of enhanced star formation ( $\Psi_a < 10^{-7.4} M_{\odot} \text{ yr}^{-1} \text{ pc}^{-2}$ ). However, the value of the star formation rate per unit area measured in the region located at  $14^{\circ}\text{E}$  ( $\sim 6$  kpc) along  $\text{P.A.} = 270^{\circ}$  is high,  $\Psi_a \sim 10^{-6.8} M_{\odot} \text{ yr}^{-1} \text{ pc}^{-2}$ ; the  $\text{H}\alpha$  luminosity, corrected for internal extinction, is equivalent to  $\sim 1500$  O5 stars, which is typical of "supergiant" HII regions such as 30 Doradus in the LMC (Kennicutt 1988).

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