RADIO CONTINUUM EMISSION AND OPTICAL EMISSION-LINE ACTIVITY IN THE NUCLEI OF SPIRALS

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ABSTRACT. As a step towards the understanding of the phenomena occurring in galactic nuclei, we find that the ratio between the radio continuum emission of the nuclei of spiral galaxies and their optical luminosity is related to optical signs of nuclear activity, such as the emission line strengths of the H_α and [NII] λ6584 lines.

1. INTRODUCTION

It has been claimed that the radio continuum emissivity of spirals can be considered as a sensitive indicator of star formation activity; in fact, this quantity appears to be closely related to the far-infrared emission (de Jong et al., 1985), H_α emission strengths and colours of spirals (Gavazzi and Jaffe, 1985), which can be taken as tracer of star formation activity.

In the present study we have deemed it interesting to check whether also the radio continuum emission of spiral nuclei is related to pronounced optical signs of nuclear activity, such as the emission line strengths of the H_α and [NII] λ6584 lines. This can be of aid in understanding the phenomena occurring in galactic nuclei.

2. ANALYSIS AND RESULTS

From the radio surveys of Hummel (1980) and, in a few cases, from those of Hummel et al. (1985) and Kotanyi (1980) we have taken the radio fluxes (or their upper limits) of the central

E. Ye. Khachikian et al. (eds.), Observational Evidence of Activity in Galaxies, 493–496.

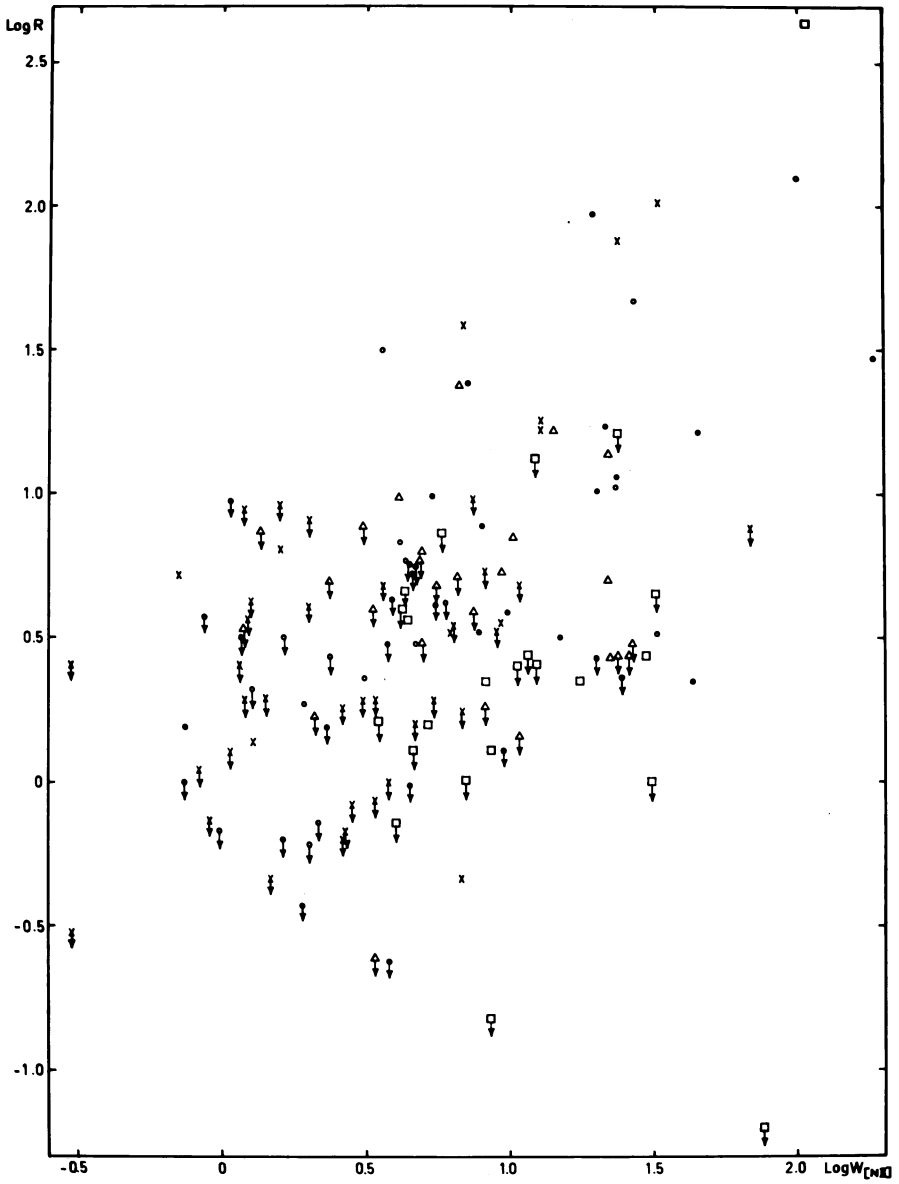

Fig. 1

https://doi.org/10.1017/S0074180900155536 Published online by Cambridge University Press

sources of all spiral galaxies whose nuclear emission line properties in the $H\alpha$ wavelength region have been observed by Heckman et al. (1980), Stauffer (1982), Keel (1983), Keel et al. (1985), Dahari (1985). We have transformed all the fluxes to the frequency of 1.415 GHz using the power law spectrum $f_\nu \sim \nu^{-0.8}$. In order to remover the well-known dependence of the radio emissivity on the optical luminosity (Hummel, 1981), we have evaluated the common logarithm of the ratio R between the radio continuum (at a frequency of 1.415 GHz) and the optical luminosity, defined as

$$\text{Log } R = \log f_\nu + 0.4\ (B_T^o - 12.5) \qquad (1)$$

where B_T^o is the corrected blue total magnitude in the RC2 (de Vaucouleurs et al., 1976) system and f_ν is the flux density at 1.415 GHz in mJy.

For all spiral galaxies which have measured $H\alpha$ or [NII] emission lines and which have been observed in the above-mentioned radio surveys, plots of Log R versus Log $W_{H\alpha}$ or Log $W_{[NII]}$ (logarithms of the $H\alpha$ or [NII] emission line equivalent widths, expressed in angstroms) indicate a marginal correlation between Log R and Log $W_{H\alpha}$ and a fairly good correlation between Log R and Log $W_{[NII]}$ (see Fig. 1, where S0/a and Sa spirals are denoted by open circles, Sab and Sb spirals by crosses, Sbc spirals by dots, Sc spirals by triangles and spirals of later morphological types or irregulars by squares). Evaluating the Spearman correlation coefficients r_S for the two relations Log R - Log $W_{H\alpha}$ and Log R - Log $W_{[NII]}$, we have obtained $r_S = 0.23$ (for N=49 galaxies with know R) and $r_S = 0.37$ (for N=51 galaxies with known R), respectively, which are significant at the 94% and 99% confidence levels, respectively (r_S provides useful statistical information indipendently of the distribution function involved). The distributions of the upper limits, not being shifted to lower values of Log R for greater values of Log $W_{H\alpha}$ or Log $W_{[NII]}$, do not reduce the significance of these correlations.

To conclude, we have found that the (known) correlation between the global radio continuum emission of a spiral and its global $H\alpha$ emission strength extends also to the central galactic regions. This extension does not seem to be a trivial result, since for example, the global correlation between the IRAS far-infrared radiation of a spiral and its radio continuum power does not extend to its central radio source (Brink, 1986).

https://doi.org/10.1017/S0074180900155536 Published online by Cambridge University Press

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