man patterns, will be published later. I also plan to pursue the tests of the "Robinson" method and other methods of Hs measurements.

This preliminary study of Resolved Zeeman Pattern allowed the determination of the surface magnetic field strength of HD 187474, and its mean inclination on the line of sight at the time of observation.

Moreover, the comparison of observed and calculated Zeeman broadening functions shows that the "Robinson" method will be suitable to measure the surface magnetic field, at least in slowly rotating CP stars.

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The Clouds which Form the Extended Emission Line Region of NGC 4388

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Introduction

Since the discovery of Seyfert galaxies (Seyfert, 1943) and Quasars (Schmidt, 1963) most of the attention to these active galaxies has been directed towards understanding the physics of the nuclear non-thermal source, the structure of the inner emission line regions, (the so-called *Broad Line Region),* where the observed broad and variable emission lines are produced, and the coupling between both phenomena.

Further out, there exist extended emission-line regions with sizes up to a few kpc and where the observed strong optical, narrow forbidden lines are formed. These regions, usually called *Narrow Line Regions,* are considered as the link between the nuclear regions and the outer interstellar medium.

Work by Heckman and collaborators (Heckman et al., 1981) and subsequently by Whittle (Whittle, 1985a, b) showed the presence of a blue asymmetry as a general feature of the spatially unresolved [OIII] λ 5007 Å line profile in Seyfert galaxies. This characteristic, not observed in the HII and starbust galaxies, was interpreted as a consequence of peculiar motions in the central regions of these active galaxies. Models considering outflowing emission clouds embedded in a dusty medium, i.e. the receding clouds being preferentially obscured, or infalling dusty clouds, producing the opposite effect, most likely explain these observations.

Direct correlations between the line width of the spatially unresolved narrow emission lines and the ionization potential or the critical density have been observed in Seyfert galaxies (De Robertis and Osterbrock, 1984, 1986). This indicates some kind of stratification in the physical conditions present in these regions, and covering a range which extends continuously from the Broad Line Region, $N_e \approx 10^9\ cm^{-3}$, through the Narrow Line Region, $N_e \geq 10^3\ cm^{-3}$.

Spatially resolved spectroscopic observations of the extended emission line regions in nearby Seyfert galaxies are crucial to understand how the physical, kinematical and ionizing structure of these regions evolve as a function of distance from the nucleus and position within the galaxy, how their structure is affected by the presence of the nonthermal nuclear source and which is the role of the interstellar medium.

Observations

Observations of NGC 4388 have been done at the Cassegrain focus of the La Silla 2.2-m telescope using the ESA Photon Counting System, the scientific model of the Faint Object Camera (see di Serego et al., 1985 for a detailed description). In the spectroscopic mode, the ESA PCD uses an array of 1,024 × 256 pixels (spectral x spatial direction) with a pixel size of 25 μm. The slit width was 1.5 arcsec and the scale along the slit was 1 $arcsec \cdot pixel^{-1}$ giving a total length of the slit of 256 arcsec on the sky.

Long-slit spectroscopy covered the spectral range [OIII] λλ 4959, 5007 Å + H β at 21 Å/mm giving an effective resolution of 56 $km \cdot s^{-1}$ (FWHM at λ 5000 Å). Typical exposure times were 40 minutes divided into two periods of 20 minutes each. To monitor the geometrical distortion and to make the final wavelength calibration, HeAr comparison spectra were obtained after each single exposure. The observations in the various slit positions were optimized with respect to the position of the object on the sky in order to minimize the differential refraction effects. Finally, in each two dimensional spectrum, the signals of three adjacent spatial pixels were combined to increase the S/N ratio and to take into account the seeing effects.

Discussion

NGC 4388 is a highly inclined spiral galaxy located at the core of the Virgo cluster and classified as Seyfert 2 galaxy. Long-slit spectroscopy was obtained at position angles 23° and 152°. The slit at 23° was positioned to cover the direction at which a radio emission region extending over 40 arcsec was previously reported (Hummel et al., 1983). Emission on the [OIII] lines was observed over a total extension of 24 arcsec symmetric to the nucleus.

Contrary to the general behaviour observed in the [OIII] line profile of Seyfert galaxies, NGC 4388 shows a peculiar red-asymmetry (Fig. 1). The overall [OIII] λ 5007 Å line profile is composed, both at *P.A.* 23° and *P.A.* 152°, of five clearly distinguishable components, separated by up to 600 $km \cdot s^{-1}$ (see Table 1). The main component, C_2, extends over the central region from 3 arcsec NE to 6 arcsec SE. The other two major components, C_3 and C_4, appear to extend over a region of ± 6 arcsec symmetrically with respect to the nucleus. Finally, the smaller components, C_1 and C_5, are concentrated at the centre. These components could be

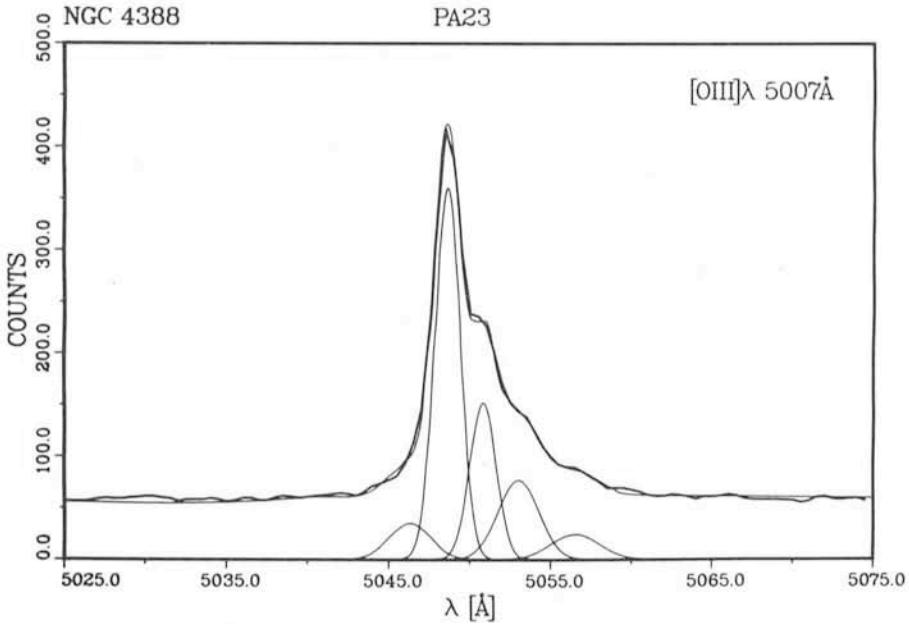

Figure 1: *[OIII] λ 5007 Å integrated profile along the slit at P.A. 23°. The prominent individual components producing the observed red asymmetry are indicated as well as the obtained fit for the overall profile.*

associated with a system of giant clouds confined to the inner six arcsec from the nucleus. Considering the [OIII] luminosity, L ([OIII]) = $1.6 \cdot 10^{40}$ erg $\cdot$ s^{-1}, this gives a total mass M_T = 5,000 $M_\odot$ and energy $E_T = E_k$ *(kinetic)* + E_t *(turbulent)* = $3 \cdot 10^{51}$ erg for the system of clouds. This situation is similar to those observed in NGC 1068 (M_T = 186 $M_\odot$, E_T = $3.7 \cdot 10^{50}$ erg; Pelat and Alloin, 1980) and in NGC 4151 (M_T = *1,100*$_\odot$, E_T = $4.7 \cdot 10^{50}$ erg; Pelat and Alloin, 1982) where a direct association between the nuclear radio emission and the clouds has been suggested (Wilson, 1983).

TABLE 1: *Emission line components in P.A. 23°. Derived parameters.*

Component	V ([OIII]) *Km* $\cdot$ *s*$^{-1}$	FWHM *Km* $\cdot$ *s*$^{-1}$	I/I (tot.)
C_1	2352	140	0.06
C_2	2468	109	0.55
C_3	2604	110	0.23
C_4	2734	175	0.12
C_5	2942	175	0.04

The [OIII] emission towards the NE of the nucleus at P.A. 23° is intriguing. In this region, Hummel et al., (1983) noted the presence of a radio elongation. A broader [OIII] λ 5007 Å line, FWHM ≈ 300 *km* $\cdot$ *s*$^{-1}$ and FWQM (full width at quarter maximum) ≈ 500 *km* $\cdot$ *s*$^{-1}$, is observed. This line is broader at FWHM than the same line in the SW region by a factor two to three (see Fig. 2). The existence of such a relation between the radio emission and the emission line for large samples of Seyfert galaxies has been pointed out by different authors (Wilson and Heckman, 1985 and references therein) in terms of a [OIII] luminosity and FWHM ([OIII]) vs. 21 cm radio luminosity correlations. Also in 3 C 305 (Heckman et al., 1982), the same phenomena have been reported in the sense that the [OIII] lines appear to be broader in the regions coincident with radio emission. This suggests a direct connection between the presence of anomalous motions, radial motions, turbulence, and the existence of radio synchrotron radiation, which needs further detailed studies.

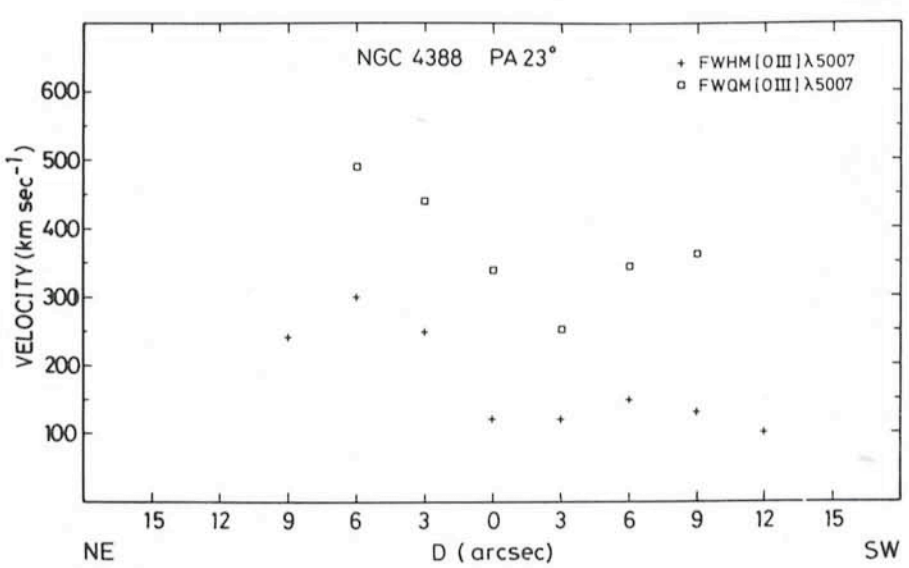

Figure 2: *The FWHM and FWQM (full width quarter maximum) of the [OIII] λ 5007 Å profile as a function of distance from the optical nucleus for position angle P.A. 23°.*

A detailed study of the extended emission line region in NGC 4388 is contained in a forthcoming paper (Colina, L., Fricke, K.J., Kollatschny, W., Perryman, M.A.C., 1987, *Astron. Astrophys.* in press). A similar study, by the same authors, of NGC 2992 was published in *Astron. Astrophys.*, **178,** 51 (May (II), 1987).

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