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14. Abstract/Notes

Analysis of a sample of high resolution narrow [OIII] emission line profiles from Seyfert galaxies showed that: (i) emission line width *correlates with galaxy disk inclination to the line of sight, indicating a planar nature of the emitting region; (ii) emission line* shape *correlates with dust content, indicating that there are dust* inside *the emitting region, situated mainly in low-velocity clouds.*

15. Remarks

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AGN [OIII] EMISSION LINE PROFILES: DEPENDENCIES ON GALAXY INCLINATION AND BALMER DECREMENT

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INTRODUCTION

Some recent studies of the Narrow Line Region (NLR) in Active Galactic Nuclei (AGN) concentrated in studying the [OIII] 5007 A emission line profile in a significante number of objects, searching for statistical trends in parameters which describe the line shape, as well as correlations between these parameters and other observed nuclei properties (Heckman et al. 1981, hereafter HMBB, Heckman et al. 1984, hereafter HMG, Vrtilek and Carleton 1985, Whittle 1985a, hereafter Wa, Whittle 1985b, hereafter Wb).

As part of a program aimed at obtaining high resoltuion line profiles for a number of southern AGN in the regions of Halfa + [OIII] and Hbeta + [OIII], we obtained 35 km/s resolution profiles of [OIII] 4959/5007 A for 13 objects. The observations were made with the 1.6m telescope/coudé spectrograph combination of Laboratorio Nacional de Astrofísica (Brazil), using as detector an intensified Reticon system.

In this communication, we describe some results obtained after combining our [OIII] 5007 A data with other similar data in the literature and looking for dependencies between profile characterization parameters, NLR Balmer decrement and host galaxy inclination. We also found previously unknown dependencies between line shape and radio properties, which will be reported elsewhere.

DATA:

We compiled from the literature all profile data for [OIII] 5007 A obtained with resolutions better than 130 km/s and measured in the system proposed by HMBB/HMG. Measures of line width (W) at 80, 50, 20, 10 and 0% fractional peak levels, as well as asymmetry measures (AI) at 50, 20 and 10% levels and "line kurtosis" (R20 = W20/W50 and R = W10/W/50) were collected, when available the main data sources were:

	Res.(km/s)	Number of objects
Vrtilek and Carleton 1985	23	32
Busko and Steiner 1987	35	13
Whittle 1985a	30 - 70	36
Heckman et al. 1984	70 - 110	85

We also included isolated high resolution data published for some objects by other authors. The resulting data set includes 165 objects for which at least a measure of FWHM exists with resoltuion better than 130 km/s. For a significative number of objects. AI and R measures at least for the 20% level also exists.

Other observed properties of the objects were compiled from:

Veron-Cetty and Veron 1984	- photometry, radio properties, AGN class
Steiner 1981	- spectroscopy, spectrophotometry
Kirhakos 1986	- galaxy morphology and axial ratio
Lonsdale et al. 1985	- IRAS fluxes

RESULTS

We studied sistematicaly the statistical distributions of W, AI and R parameters, with similar results as those reported by HMBB, HMG, Wa and Hb. We also studied sistematicaly all possible correlations between profile parameters and other observed properties of the objects. The results were similar also to those obtained by Wb.

However, contrary to his findings, we found a relatively strong dependency of line width (W50) with galaxy axial ratio b/a. We looked carefuly in order to include only unambigous disc galaxies in our sample, since this may be a problem in previous work on this subject.

The dependency occurs only in faint broad line objects, as can be seen in Fig.1. Formal linear correlation significance for this subset is 99.4%. A similar behavior, but with greater scatter and smaller angular coefficient, is seen on the "base" line width W20 (see below discussion on R parameter). The "core" line width W80 shows the same behavior as W50, but the number of objects is insufficient to derive any conclusion.

Assuming a decomposition of NLR velocity field in turbulent and planar components (equation B2 of Wa):

$$Vo^2 = Vt^2 + (Vp \sin i)^2 \qquad (1)$$

we found least-squares values for Vp = 400 and Vt = 60 km/s. So, for this type of AGN (BLO with low luminosity) a strong component of the NLR velocity field may be co-aligned with the host galaxy plane (dependencies with luminosity are treated in more detail elsewhere).

As regards the line assymetry at the 20% peak level (Fig. 2), there is maybe a weak tendency for edge-on BLOs to have more symmetric or red-asymmetric lines, but we must take this result with caution, since it depends strongly on few edge-on objects. The effect seems to be absent at the 10% peak level. What is more significative is again the difference between BLOs and NLOs: almost all the red-asymmetric lines are found among the NLOs (91% formal significance, 1-tail).

Profile "kurtosis" also shows a dependence with galaxy axial ratio (Fig. 3), but also with NLR Balmer decrement (Fig. 4). This last correlation is not obeyed by a few objects with very peaky lines, so it seems that at least two mechanisms (or geometric/dynamic conditions) are responsible for producing peaky [OIII] lines in AGN; one of them is directly linked with the presence of dust in the NLR.

The fundamental correlation seems to be kurtosis vs. Balmer decrement, since both types of objects (BLOs and NLOs) obey it. If we combine its slope with the Balmer decrement vs. b/a slope (an already known correlation, Fig. 5), we can correct Fig. 3 (both BLO and NLO) of the Balmer decrement effect. the result is that, in both types of nuclei, face-on objects can have only gaussian lines. No luminosity effects were found affecting this result.

CONCLUSIONS

Presence of dust, and the orientation of the host galaxy plane, seem to play a role in constructing the (observed) NLR velocity field in many AGN.

Broad-line objects with low luminosity show strong velocity components aligned with the galaxy plane. Both broad-line and narrow-line objects have [OIII] lines more gaussian-like when the host galaxy is viewed edge-on. This suggests that rotation aligned with the galaxy may play a role in defining velocities of NLR gas clouds, at least in velocity ranges around 200 - 400 km/s.

Dust embedded in the NLR seems to selectively absorb radiation from the same velocity ranges, partialy balancing the above effect. Since dust effects are normally stronger in narrow-line objects, the presence of narrow lines (W50 around 200 km/s as in Fig. 1) in edge-on narrow-line objects can be readly understood.

FIGURE CAPTIONS

Fig. 1: [OIII] 5007 Å profile width at 50% peak level (W50) as a function of host galaxy axial ratio (b/a). Face-on galaxies have b/a = 1. Crosses: BLOs with nuclear magnitude fainter than Mv = -22. Open circles: BLOs brighter than Mv = -22. Filled circles: NLOs (all have magnitudes fainter than -22.2). Arrow points to NGC1068 (W50 = 1500 km/s). Curved line is least-squares fit oof eq. (1) to the crosses.

Fig. 2: [OIII] 5007 Å profile asymmetry at 20% peak level (AI20) as a function of host galaxy axial ratio (b/a). Face-on galaxies have b/a = 1. Crosses: BLOs with nuclear magnitude fainter than Mv = -22. Open circles: BLOs brighter than Mv = -22. Filled circles: NLOs (all have magnitudes fainter than -22.2).

Fig. 3: [OIII] 5007 Å profile "kurtosis" (R) as a function of host galaxy axial ratio.(b/a). Face-on galaxies have b/a = 1. Circles: BLOs Squares: NLOs. Open symbols: radio-quiet objects. Filled symbols: radio-loud objects. Arrows shows R value appropriate for a Gaussian. All objects have nculear Mv fainter than -22.2.

Fig. 4: [OIII] 5007 Å profile "kurtosis" (R) as a function of narrow-line Balmer decrement. Circles: BLOs. Squares: NLOs. Open symbols: radio-quiet objects. Filled symbols: radio-loud objects. Triangle depicts the only object with Mv brighter than -22. Arrow shows R value appropriate for a Gaussian.

Fig. 5: Narrow line Balmer decrement as a function of host galaxy axial ratio (b/a). Face-on galaxies have b/a = 1. Circles: BLOs. Squares: NLOs.

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FIGURE 1

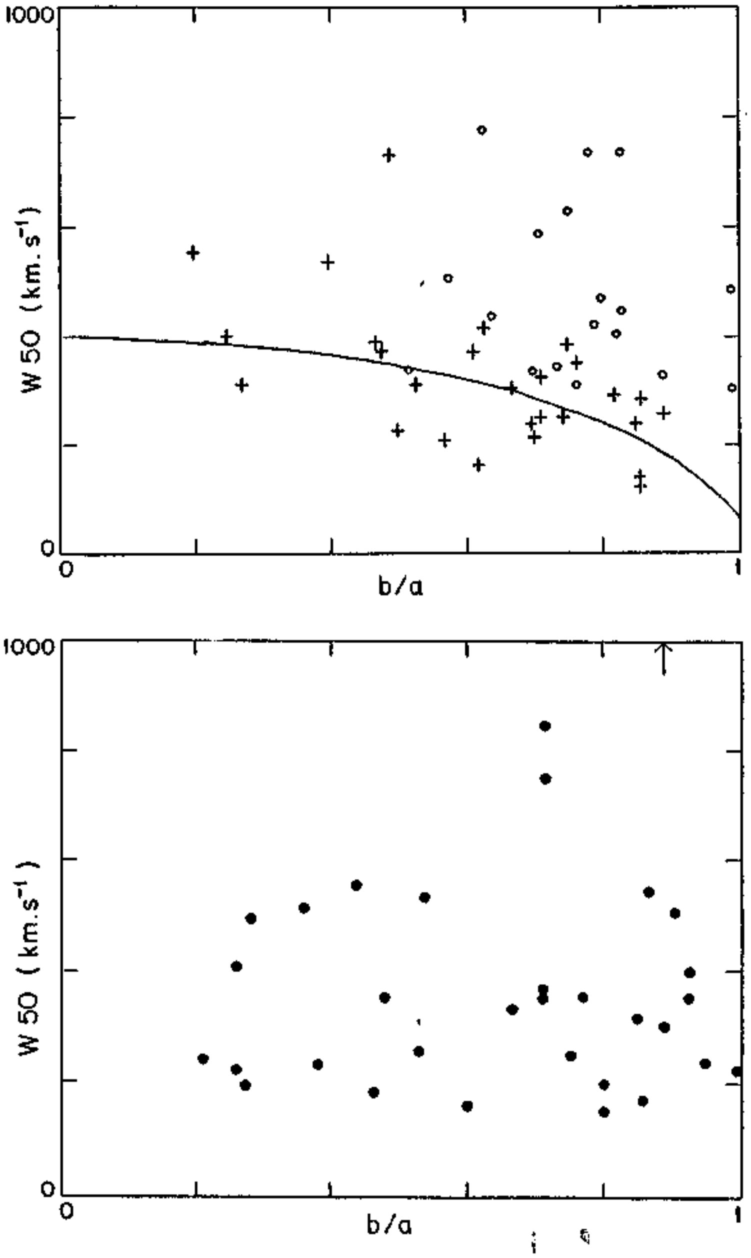
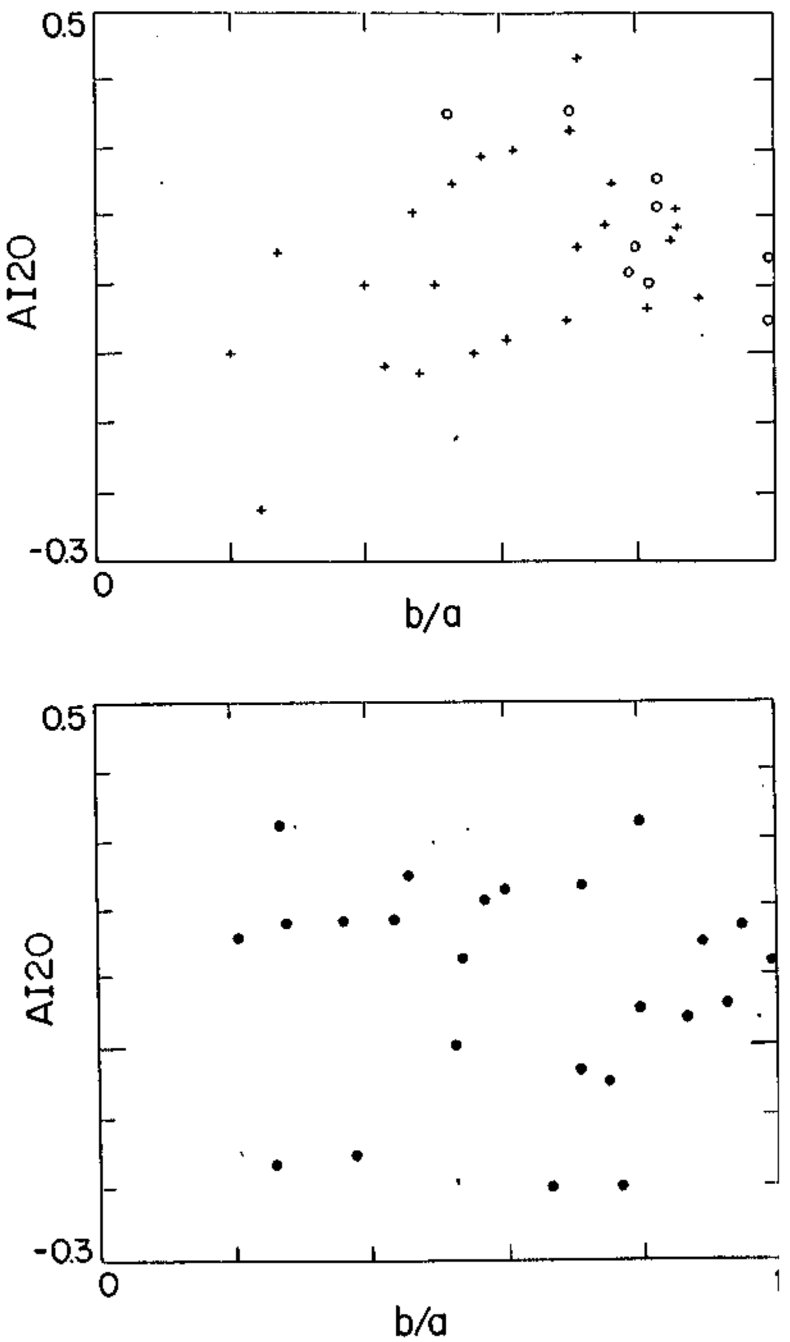


FIGURE 2



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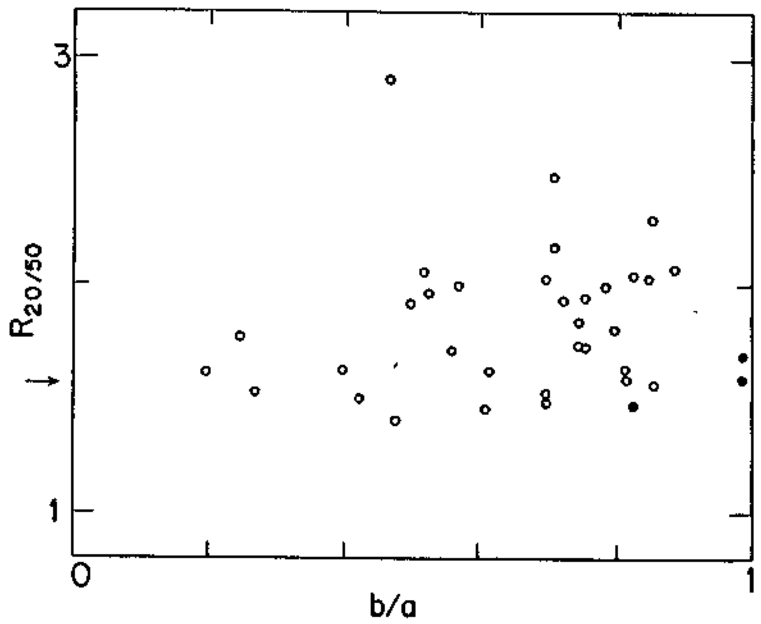

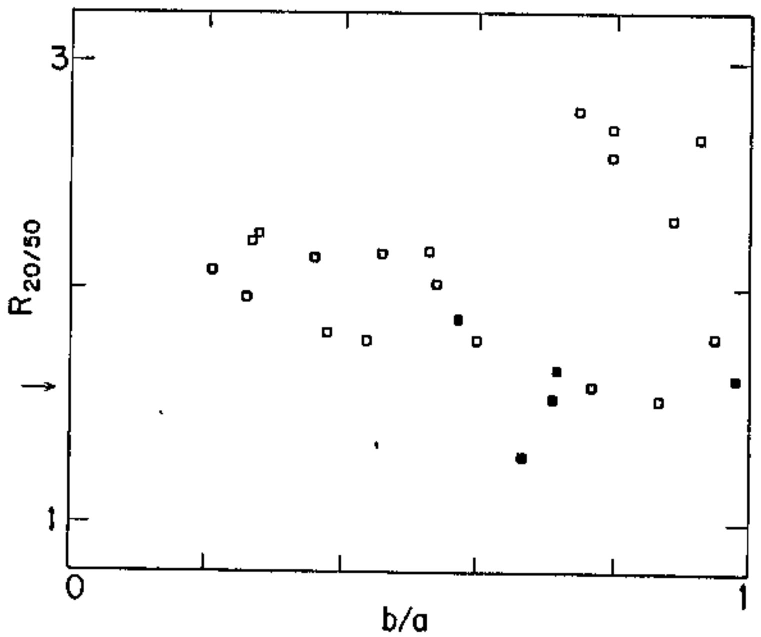

FIGURE 4

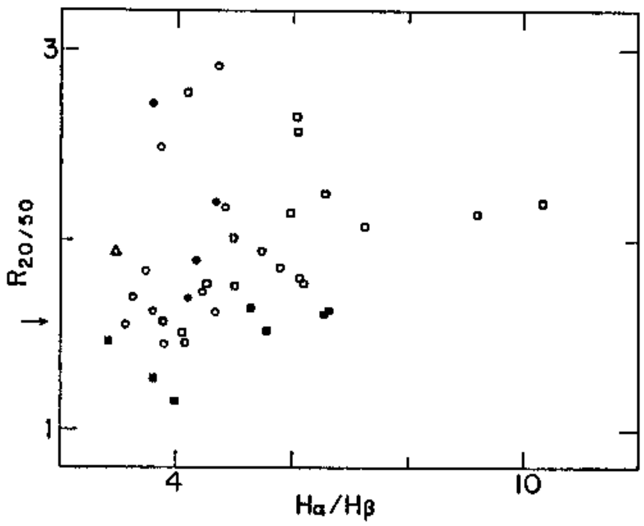

FIGURE 5