

## Line-Profile Variations in AGN

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**Abstract.** Line-profile variations in the Seyfert galaxies NGC 5548 and NGC 4593 are discussed. The variations of individual line segments are different from line to line and from outburst to outburst.

### 1. Introduction

Most Seyfert galaxies are variable in the continuum and in the broad emission lines. The variation of the intensity and of the line profiles can give us information on the structure and distribution of the broad-line region (BLR) as well as on the kinematics of the line-emitting gas.

For this kind of variability study one needs galaxy spectra over long periods (months to years) with dense temporal sampling (days to weeks) and with high signal-to-noise ratio. Therefore, only a few Seyfert galaxies have been monitored by international collaborations up to now.

Here we report on broad emission-line profile variations in the Seyfert galaxies NGC 5548 AGN Watch: Peterson et al. 1991; Kollatschny & Dietrich 1996a) and NGC 4593 (LAG campaign: Robinson 1995; Kollatschny & Dietrich 1996b).

### 2. Observations

NGC 5548 was monitored in the optical from 1988 December until 1989 October in the first year of the AGN Watch by different observers with different telescopes. High-quality H $\alpha$ , H $\beta$ , H $\gamma$ , He I, and He II spectra were obtained for 30 to 70 epochs. H $\alpha$  and H $\beta$  spectra of NGC 4593 were taken at La Palma with the WHT and INT from 1990 January through June for 23 epochs.

### 3. Results

1. The continuum and the broad emission lines varied up to 70% in NGC 4593 and up to 20% in NGC 5548 during the observing campaigns.
2. The blue and red emission-line wings varied in different ways. Line asymmetries are different from line to line and from outburst to outburst. There

is a trend that the line profiles become more symmetric with increasing line flux.

3. The individual emission lines have different mean and rms profiles.
4. The rms profiles as well as the difference line profiles between individual epochs indicate that the broad-line profiles consist of at least some strong subcomponents. These components have different Balmer decrements. The components vary neither simultaneously nor with the same amplitude. But there is a trend in NGC 4593 that the pairwise components at  $v_{\text{rel}} = -3000, -1000, 1000,$  and  $2700 \text{ km s}^{-1}$  vary in a similar way. Individual components varied on time scales of days only.
5. The cross-correlation functions of the light curves of individual line segments with the continuum light curves gave the following results: The outer line wings tend to respond faster than the line cores. But sometimes the blue or the red wings responded faster in NGC 5548 if we considered individual outbursts only. Furthermore, the response is different from line to line during the same outburst.
6. Strong radial motions can be excluded to be dominant in the BLR. The BLR seems to be clumpy and to consist of a limited number of clouds or cloud complexes only. These clouds or the ionizing source might have a bidimensional structure.

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## References

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