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The O I λ8446 emission line in NLS1 galaxies

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Abstract. In studying Ca II $\lambda\lambda\lambda$8498,8542,8662 spectral region of NLS1, we have observed that 7 NLS1 do not show O I λ8446 line emission. We have investigated the reasons of this disappearing analysing the excitation mechanism of O I λ8446 and the physical conditions of BLR that permit its emission. With a preliminary study of BLR properties we have found that O I λ8446 emission required a density n_H between 10^{11} and 10^{12} and ionization parameter U between $-1.8 \div -3$ in logarithm.

1. Introduction

The origin and configuration of the gas which emits broad lines in type 1 AGN is not clear yet, especially in NLS1. O I λ8446 usually the strongest O I line in the optical region, has been broadly studied in a large number of objects. In type 1 AGN, this emission line is very common. In particular its excitation mechanisms of O I λ8446 have been investigated by many different authors especially because investigating the O I line formation mechanisms would also provide the knowledge about physical properties of the FeII emitting region. We have focused our attention on a feature showed by NLS1.

2. The disappearing of O I λ8446 line in some NLS1

We have collected from literature (Persson S. E. 1988; Rodriguez-Ardila et al. 2002; Botte et al. 2005) a sample of thirty nuclear spectra of NLS1 covering the range in which the O I λ8446 falls, and we have found for seven of them the absence of this line.

Our aim is to try to establish why O I λ8446 emission is not present in all NLS1 galaxies in order to explore the physics of the gas emitting their spectrum and compare it to that one of the Seyfert 1 (S1).

Firstly we have carried out photoionization model calculations by using the code CLOUDY version 94.00 (Ferland 1996, 2000) for the BLR. We have made several models covering the ranges $-3 \div -1$ for the ionization parameter (U) and $8 \div 12$ for the hydrogen density of the gaseous clouds (n_H) in logarithm scale; solar abundances were adopted according to Grevesse and Anders (1989), and for the shape of ionizing continuum a power law with spectral index (α) in the range $-2 \leq \alpha \leq -1$ was assumed.

As final step we have plotted the theoretical values of λ8446/Hβ_{broad} ratios as a function of U, n_H and α. On these plots we have marked the region covered by the measured values of λ8446/Hβ_{broad} obtained from a sample of 10 NLS1. Excluding the upper and the lower values the λ8446/Hβ_{broad} ratios fall in the range $0.17 \div 0.30$ implying n_H between

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Table 1. Narrow-Line Seyfert 1

Name	R.A.(J2000) hh mm ss	Dec.(J2000) ° ′ ″	z
Mrk359	01 27 32.5	+19 10 44	0.0167
IR04321+4008	04 34 41.5	+40 14 22	0.0201
CTS H34.06	06 09 17.5	-56 06 58	0.0318
CTS J03.19	10 15 56.6	-20 02 27	0.0547
CTS J04.08	10 31 57.3	-18 46 34	0.0403
IC3599	12 37 41.2	+26 42 27	0.0221
Kaz163	17 46 59.8	+68 36 39	0.0637

10^{11} and 10^{12} and log U between $-1.8 \div -3$. In order to test our model, we have constructed the same graphic for other two broad emission line, He II 4686 and Hα. Combining all results, we have obtained $n_H \sim 10^{11}$ cm^{-3}, log U between $-1.8 \div -2.6$ and α between $-1.75 \div -1.5$.

3. Results and conclusions

NLS1 are a subgroup of S1 galaxies that display very peculiar properties which are not yet completely understood.

We have added to these another peculiarity: some NLS1 galaxies do not show O I λ8446 emission in their spectrum.

With a preliminary study of BLR properties we have found that O I λ8446 emission requires density n_H between 10^{11} and 10^{12} cm^{-3} and ionization parameter U between $-1.8 \div -3$ in logarithm. This result is in agreement with Kuraszkiewicz et al. (2000) conclusion: in NLS1 objects the BLR clouds have lower ionizing parameters and higher densities than normal AGNs.

As a consequence, a possible explanation for the absence of O I λ8446 in some objects, could be that the physical conditions of BLR do not allow the production of this line by Lyβ fluorescence (a partially ionized region in the clouds emitting Lyβ photons, O I atoms and large optical depth of Hα.)

Another possibility could be the presence of optically thin gas in the BLR of NLS1.

The disappearing of O I λ8446 lines in some NLS1 remain an open question but it is clear that in order to understand the cause of this unobserved lines our models need to be improved, performing new ones in individual NLS1 with observations of a larger spectral range.

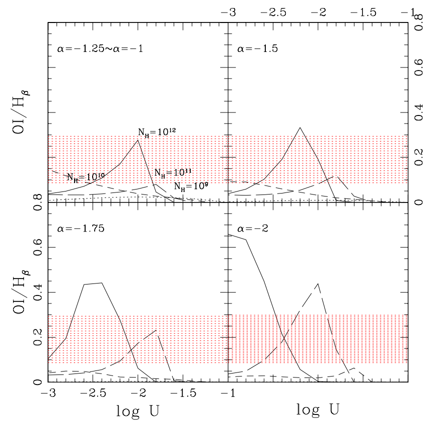

Fig. 1. O I λ8446 relative intensity versus U, for different densities; continuous line: $10^{12} cm^{-3}$; large dashed lines: $10^{11} cm^{-3}$; dashed lines: $10^{10} cm^{-3}$; small dashed lines: $10^9 cm^{-3}$. The regions marked by red colour correspond to O I λ8446 relative intensity measured.

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