3C 390.3 – JET OR DISK

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ABSTRACT. Analysis of the UV and optic spectra of the active galaxy 3C 390.3 shows that the observed line ratios for the broad components of lines: CIV/Lα, Lα/Hβ and Hα/Hβ can be accounted by two system of clouds. One corresponds to the region with an electron density 10^{8-10}cm $^{-3}$, located above an accretion disk - probably in jets. This region emits the high ionization lines Lα and CIV at the distance $\approx$ 40-60 days and low ionization lines Hβ and Hα at the distance $\approx$ 80 days. The other system corresponds to the zone which is probably part of an accretion disk and has a higher electron density 10^{12-13}cm^{-3}.

1. Introduction

3C390.3 is the prototype of the class of AGN showing complex broad-line profiles with displaced distributions and/or an anisotropic illumination of the broad-line region (BLR). The double-peaked emission lines often used as a strong indication of the disk presence (Chen et al.1989;Eracleous and Halpern2003).The outflowing biconical gas stream (Veilleux et al. 1991; Zheng et al. 1991:Gaskell (1996) as a mechanism producing the double-peaked structure of emission line. More complex disk models such as : a localized hot spot in accretion disk (Zheng et al. 1991: two-armed spiral waves in accretion disk (Eracleous at al.1995) or disklike configuration of clouds (Sergeev et al. 2000) have been developed for expending the variable flux ratio of the profile wings. However the double-peaked profiles in optic differ from single-peaked profiles in some galaxies.

2. Analysis of Line Profiles

The UV and optical spectra of 3C390.3 were taken from the AGN Watch database for the period January 1995 – January 1996.. We took the UV and optic spetra at times of maximum and minimum luminosity during the taken period. The profiles of the CIV, Lα, Hβ and Hα lines have been divided into seven parts, the width of each part being equal to 2000 km s^{-1}. The core of the lines is measured between -1000 and +1000 km s^{-1}. The blue in the low-ionization lines Ha and Hb is stronger than in the high ionization lines CIV and La at the maximum of nuclear activity. However the blue peak in the high ionization lines is more prominent at maximum of nuclear activity. The C IV/Lyα ratio is low in the low-velocity regions of the line profile, but becomes higher in the blue wing, particularly when 3C 390.3 is more active. The asymmetry in the line ratios between the blue and red wings could be real, since the blue peak was stronger at this time, but it could also be an artifact of the extreme difficulty in removing NV λ1240 emission from the wing of Lyα in an object with line profiles as complex as 3C 390.3. The observed Lyα/Hβ ratio is high at low velocity and decreases in the wings for both high and low states of the nuclear activity. This velocity dependence is the opposite of what is seen for most AGNs (see Snedden & Gaskell 2004), where Lyα is usually broader than the Balmer lines.

3. Photoionization Models

The modeling of the observed line ratios CIV/Lα, Lα/Hβ and Hα/Hβ has been done with the photoionization code CLOUDY, in its plan parallel version, and assuming solar abundances. The computed line ratios of CIV/La, La/Hb and Ha/Hb for a given luminosities (at maximum and minimum states) were calculated for different distances from the center- (20, 40, 60 and 80) days.

The comparison of the observed and the computed line ratios show that the ratios varies along the line profiles. The ratio CIV/Lα varies in range (0.2-1.8). According to the UV study, the lag of CIV and Lα are equal to 37$\pm$14 days and 60$\pm$24 days respectively (O'Brien 1998). Therefore the theoretical line ratio at the distance from the center may corresponds 10^7cm^{-3} in the center to 10^{10}cm^{-3} in the wings or 10^{12} cm^{-3} in the center of line ratio to the 10^{10}cm-3 in the wings. However the electron density in the wings usually higher than in the center because the center of lines get the contribution from low density narrow line regions. The observed line ratio Lα corresponds to the electron density 10^{10}cm^{-3} in the center of line and 10^{13} cm^{-3} in the wings for the distance from the center 60-80 days. Similar electron density corresponds to the observed line ratio Hα/Hβ for the distance from the center 60-80 days.

4. Discussion

The study of the optical spectra of 3C390.3 for period 1992-2000 (Sergeev et al. 2002) found the lag between continuum and Hβ emission line variation to be 89±11 days. The difference with time lag obtained by Deitrich et al. (1998) and equals 20±8 days is probably due to sampling effects. Sapovalova et al.(2001) give a double value: 100 and 35 days. Arshakian et al. (2006) found that there is the observational evidance for the link between variability of the radio emission of the relativistic jet and optical continium emission in 3C390.3. It indicates that the source of varibility non-thermal continium radiation is located in the innermost part of the relativistic jet. This emission from jet forming the conocal region whith broad emission lines. Therefore it seems resonable to suggest that there are two broad regions: one is localized at the disk and another is forming by the jet with the electron density 10^{8-10} cm $^{-3}$ and localized at the distance from the center about 60-80 days.

References

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