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Analysis of Double-Peaked Profile Lines in 3C390.3

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Abstract.

The analysis of the line ratios along the profiles show that CIV/Lα line ratio is low in the center of lines but high in the wings although the Lα/Hβ line ratio has changed the opposite way. The line ratios have been modeled using the photoionization code CLOUDY. On the bases of the photoionization modeling along the line profiles we discuss the possible geometry of the emitted gas.

The numerous models have been proposed for explanation of the double-peaked line profiles of 3C390.3. Most of them are proposed one mechanism for explanation of the shape and of the variation line profiles. There are: an out-flowing bi-conical gas stream (Zheng et al.1991), a binary black hole system, each with an associated BLR (Gaskell 1996), the photoionization by an anisotropic continuum source (Goad & Wanders 1996) and the emission from the relativistic accretion disk (Chen, Halpern, & Filippenko 1989). All of these mechanisms can in principle produce asymmetric double-peaked profiles although every model has a problems. However, the Balmier line red and blue wings appear to vary independently on long time-scales (Zheng et al. 1991), in conflict with the simplest disk models. Moreover the UV broad emission-line variability lags are different for CIV and Lα lines and both are higher than lag for low ionization lines (O'Brien et al. 1998, Dietrich et al. 1998). These puzzling results are possibly due to the different contribution from the regions with different physical conditions or/and kinematics in the BLR of 3C390.3.

In this paper we report the results of the shapes study for the high (Lα and CIV) and for the low (Hβ) ionization lines at different states of nuclear activity. The IUE and optic spectra were taken from AGN Watch data for period from January 1995 to January 1996. The ratio CIV/Lα is low in the center of lines but it is become higher in the wings for both states of the nuclear activity. However the Lα/Hβ ratio show the opposite situation compare to the CIV/Lα ratio. It is high in the center of lines and decrease in the wings for both states of the nuclear activity.

The photoionization modeling along the Lα, CIV and Hβ profiles shows that the line ratios and a different line lags could be understood if these lines emit from both the regions illuminated by the incident nuclear continuum (IC) and from the regions illuminated by an attenuated (partly absorbed) continuum

(AC) regions. The contribution from these regions varies in a different lines. The emission in Hβ line comes mainly from the AC regions. However the emission in the high ionization lines Lα and CIV prevail in the IC regions. It is interesting to consider the possible geometry of the BLR which could corresponds to such conditions.

The modified accretion disk model with an orbiting hot-spot may explain the changes asymmetry of lines if suggest that an "orbiting hot-spot" may have a significant radial extend in the circular disk. In this case the emissivity of the central disk is modulated by non axisymmetric spiral wave. If the regions at the spiral close to the nucleus (at radius $\approx$20light days) emit mainly from the AC regions than the contribution from the IC regions increases with the distance. Therefore the emission in the high ionization lines are more effective at a longer distance from the center.

The observed double-peaked lines could be produced by both an accretion disk and a bi-conical gas stream. The IC regions producing a significant contributions to the Lα and CIV lines might be located at the cones but the AC regions emitting mainly in the low ionization lines (Hβ) are located at the disk. The disk emission produce the profiles with a double humps (Dumont & Collin-Souffrin 1990) but the two cones formed also double-peaked profiles. Therefore the observed profiles could be a combination of these profiles.

Of course the selections between the models are based on the modeling the profiles of the high and low ionization lines at different epochs but this work is beyond the scope of this paper.

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