A LINK BETWEEN VARIABLE OPTICAL CONTINUUM AND RADIO EMISSION OF A COMPACT JET IN THE RADIO-LOUD SEYFERT GALAXY 3C390.3

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We present an observational evidence for a relation between variability of radio emission of the compact jet, nucleus optical continuum emission and ejections of new jet components in the radio galaxy 3C390.3. We combine results from the monitoring of 3C390.3 in the optical region (Shapovalova et al. 2001; Sergeev at al. 2002) with ten very long baseline interferometry (VLBI) observations of its radio emission at 15 GHz carried out from 1992 to 2002 using the VLBA (Kellermann et al. 2004). For ten VLBA images, we identified five moving components (C4-C8) and two stationary components (D,S1). Proper motions of the moving components correspond to apparent velocities from 0.8c to 1.5c. No significant correlation exists for the moving features between optical continuum and radio emission. However the variations of optical continuum are correlated with radio emission from a stationary feature (S1) in the jet. The optical emission follows radio flares with the mean delays t(S1-opt)$\approx$0.4 year. Most probably the optical continuum is produced near the location of radio emission of the S1 stationary component. The localization of the source of optical continuum with the innermost part of the jet near S1 implies that the broad line emission originates in a conical region (dimension $\approx$ 100 light days) at a distance of $\geq$ 0.4 pc from the central engine. For the components C4-C7, the epochs t(S1) of separation from the stationary feature S1 are coincident, within the errors, with maxima in optical continuum. This suggests that radio ejection events of the jet components are coupled with the long-term variability of optical continuum.

We suppose that the broad emission lines having a double-peaked structure originate in two kinematically and physically different regions of 3C390.3:

1. BLR1 – the traditional BLR (Accretion Disk (AD) and the surrounding gas). It is at the distance $\approx$ 30 light days from the nuclei (Shapovalova et al. 2001).

2. BLR2 – in a subrelativistic outflow surrounding the jet in the cone within $\approx$ 100 light days at a distance of $\geq$ 0.4 pc from the central engine.

During the nucleus maximal brightness periods most of the continuum variable radiation is emitted from the jet and ionizes the surrounding gas, creating a BLR2 that mainly determines the broad line emission. During the brightness minima the jet contribution to the ionizing continuum is decreasing and the main broad line emission comes from the "classical" BLR1 (AD), ionized by nuclei continuum related with the acctretion at BH. Such a scenario explains two maxima ($\approx$ 30d and $\approx$100d) found in the cross-correlation function describing the time-lag of broad line variations relatively to continuum on the base of the results of 3C390.3 optical monitoring in 1996-2000 (Shapovalova et al. 2001).

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References

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