

Rapid Luminosity Decline and Subsequent Reformation of the Innermost Dust Distribution in the Changing-look AGN Mrk 590

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We examined long-term optical/near-infrared (NIR) flux variability of a “changing-look” active galactic nucleus (AGN) Mrk 590 between 1998 and 2007. Multi-band multi-epoch optical/NIR photometry data from the SDSS Stripe 82 database and the Multicolor Active Galactic Nuclei Monitoring (MAGNUM) project reveal that Mrk 590 experienced a sudden luminosity decrease during the period from 2000 to 2001. Detection of dust reverberation lag signals between V - and K -band light curves obtained by the MAGNUM project during the faint state in 2003 – 2007 suggests that the dust torus innermost radius R_{dust} of Mrk 590 had become very small [$R_{\text{dust}} \simeq 32$ light-days (lt-days)] by the year 2004 according to the aforementioned significant decrease in AGN luminosity. The R_{dust} in the faint state is comparable to the $H\beta$ broad line region (BLR) radius of $R_{H\beta, \text{BLR}} \simeq 26$ lt-days measured by previous reverberation mapping observations during the bright state of Mrk 590 in 1990 – 1996. These observations indicate that the innermost radius of the dust torus in Mrk 590 decreased rapidly after the AGN ultraviolet-optical luminosity drop, and that the replenishment time scale of the innermost dust distribution is less than 4 years, which is much shorter than the free fall time scale of BLR gas or dust clouds. We suggest that rapid replenishment of the innermost dust distribution can be accomplished either by (1) new dust formation in radiatively-cooled BLR gas clouds or (2) new dust formation in the disk atmosphere and subsequent vertical wind from the dusty disk launched by radiation pressure.