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Invited lecture

EVOLUTION OF THE BROAD EMISSION LINE PROFILES IN SOME AGN

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An important question in the study of active galactic nuclei (AGN) is the nature of the "central engine". A popular assumption is that the nuclear activity is caused by accretion of gas onto a supermassive black hole. The Broad Line Region (BLR) where broad emission lines form consists of gas obviously linked with the accretion process onto a supermassive black hole and enormous energy fluxes are generated and radiated in this region. It is therefore important to know its structure and kinematics in order to get an insight into the "central engine". However, even for nearby objects, the typical angular size of the BLR corresponds to < 0.001 arcsec, hence we will have to wait for the availability of more sensitive optical interferometers to resolve it. That is why to study BLRs only indirect methods are used. At present the main method for defining quantitative characteristics of the "central engine" including BLR is the spectral and photometrical monitoring of the active galactic nuclei (AGN) by the "Reverberation mapping". It is well known that AGNs vary in luminosity on time scales from years to hours, over the whole wavelength range from radio to X-rays or γ-rays. In particular, the flux in the broad emission lines varies in response to changes in the ionizing continuum with short time delays (days to weeks for Seyfert galaxies), due to light-travel time effects within the BLR. If the BLR gas has systematic motions such as infalling, outflowing, circular motions, etc., then the profiles of the broad

emission lines must vary in a way related with geometry and kinematics of gas in this region and with the processes of gas relaxation that follow the changes in the ionizing flux. In this lecture we present results of the long-time variability ($\geq$10 years) between the flux changes in continuum and in the broad emission line profiles for three Seyfert galaxies - 3C 390.3, NGC 4151, NGC 5548. High quality spectra (S/N$>$ 50 in continuum near Hα and Hβ) were obtained in the spectral range $\sim$ 4000 to 7500 Å, with a resolution between 5 and 15 Å, using the 6-m and 1-m SAO's telescopes (Russia), and the GHAO's 2.1-m telescope (Cananea, México). We analyze line profile variations during the monitoring period, using profiles of the Hα and Hβ lines, study different details (bumps, absorption bands) in the profiles of lines, compare variations of the core and wings of the line profiles and investigate different correlations between the broad line flux and continuum flux, and define time lags between the broad lines and continuum, using different CCFs. Also we analyze the Balmer decrement both for the whole line and for line segments. The line profiles were strongly changing during the monitoring period, indicating a complex BLR with 2-3 kinematically distinct regions. We apply different models to fit the complex broad line profiles in order to explain the BLR geometry.