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Can Self Organized Critical Accretion Disks Generate a Log-normal Emission Variability in AGN?

Chatief Kunjaya, Putra Mahasena, Kiki Vierdayanti, Stefani Herlie

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Active Galactic Nuclei (AGN), such as Seyfert galaxies, quasars, etc., show light variations in all wavelength bands, with various amplitude and in many time scales. The variations usually look erratic, not periodic nor purely random. Many of these objects also show lognormal flux distribution and RMS - flux relation and power law frequency distribution. So far, the lognormal flux distribution of black hole objects is only observational facts without satisfactory explanation about the physical mechanism producing such distribution in the accretion disk. One of the most promising models based on cellular automaton mechanism has been successful in reproducing PSD (Power Spectral Density) of the observed objects but could not reproduce lognormal flux distribution. Such distribution requires the existence of underlying multiplicative process while the existing SOC models are based on additive processes. A modified SOC model based on cellular automaton mechanism for producing lognormal flux distribution is presented in this paper. The idea is that the energy released in the avalanche and diffusion in the accretion disk is not entirely emitted instantaneously as in the original cellular automaton model. Some part of the energy is kept in the disk and thus increase its energy content so that the next avalanche will be in higher energy condition and will release more energy. The later an avalanche occurs, the more amount of energy is emitted to the observers. This can provide multiplicative effects to the flux and produces lognormal flux distribution.

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