Periodic light variations from the triple-disk system around a supermassive binary black hole

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A large fraction of galaxies are thought to harbor supermassive black holes at their center. It has recently been accepted that the supermassive black holes coevolve with their host galaxies. Since galaxies are well-known to evolve through frequent mergers, this strongly suggests that black hole growth is mainly caused by galaxy mergers and subsequent accretion of gas. If so, supermassive binary black holes (BBHs) with a sub-parsec scale separation are inevitably formed before the black holes merge by emitting gravitational radiation. However, there is yet no definitive observational evidence for supermassive BBHs.

In this paper, we investigate simulations of accretion flows around a supermassive BBH and propose a basic methodology for exploring them. In the simulations we consider a triple-disk system composing of two disks around each black hole and one circumbinary disk surrounding the two. When the supermassive BBH is on an eccentric orbit, the mass transfer from the circumbinary disk is shown to be periodic\textsuperscript{[1]}.

We confirm the formation of a nonaxisymmetric accretion disk around each black hole. The light variations from these disks are significantly wavelength-dependent. The UV and X-ray light curves exhibit periodic variations, whereas the optical and IR light curves show little variation with orbital phase. Such properties are unique to supermassive BBHs with triple disks and thus provide a potential observational signature\textsuperscript{[2]}.

References