

AT2018fyk: Candidate Tidal Disruption Event by a (Super)Massive Black Hole Binary

The tidal disruption event (TDE) AT2018fyk has unusual X-ray, UV, and optical light curves that decay over the first ~ 600 d, rebrighten, and decay again around 1200d. We explain this behavior as a one-off TDE associated with a massive black hole (BH) binary. The sharp drop-offs from $t^{-5/3}$ power laws at around 600d naturally arise when one BH interrupts the debris fallback onto the other BH. The BH mass M_{\bullet} derived from fitting X-ray spectra with a slim disk accretion model and, independently, from fitting the early UV/optical light curves, is smaller by two orders of magnitude than predicted from the $M_{\bullet}-\sigma_*$ host galaxy relation, suggesting that the debris is accreted onto the secondary, with fallback cut off by the primary. Furthermore, if the rebrightening were associated with the primary, it should occur around 5000d, not the observed 1200d.

The secondary's mass and dimensionless spin is $M_{\bullet,s} = 2.7^{+0.5}_{-1.5} \times 10^5 M_{\odot}$ and $a_{\bullet,s} > 0.3$ (X-ray spectral fitting), while the primary's mass is $M_{\bullet,p} = 10^{7.7 \pm 0.4} M_{\odot}$ ($M_{\bullet}-\sigma_*$ relation). An intermediate mass BH secondary is consistent with the observed UV/optical light curve decay, i.e., the secondary's outer accretion disk is too faint to produce a detectable emission floor. The time of the first accretion cutoff constrains the binary separation to be $(6.7 \pm 1.2) \times 10^{-3}$ pc. X-ray spectral fitting and timing analysis indicate that the hard X-rays arise from a corona above the secondary's disk. The early UV/optical emission, suggesting a super-Eddington phase for the secondary, possibly originates from shocks arising from debris circularization.

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