THIN ACCRETION DISKS AROUND BLACK HOLES: MODELING THE SECONDARY OUTBURST

Mehmet Deniz Aksulu*†[1], Emrah Kalemci‡[2], and Kazım Yavuz Ekşi§[1]

[1]Istanbul Technical University (ITU) – Turkey
[2]Sabancı University (SU) – Turkey

Abstract

Some low-mass X-ray transients show a secondary maximum in their light curve during the outburst decay which occur after the transition to the hard state. While some of these secondary outbursts could be jet related, historically, they are attributed to the response of the outer disk to the increased X-ray emission from the inner disk.

We hypothesize that as the corona grows during the transition to the hard state, previously shadowed parts of the outer disk get irradiated, hence leading to an increase in the mass ow towards the black hole, leading to a secondary outburst.

To test this hypothesis, we solve the diffusion equation governing the evolution of the geometrically thin accretion disks around black holes. The disk instability model, irradiation of the disk by a lamppost-like source (representing the corona), self-shadowing of the disk, and realistic opacities have been included in the model for self-consistent calculations.

Using realistic corona formation timescales we simulated light curves with different corona sizes and corona luminosities and characterized the properties of the resulting secondary outbursts. We determine parameters that provide observed formation timescale of the secondary outbursts. Most importantly, we observe that secondary outbursts can only occur if the size of the corona is greater than 200 gravitational radii. This may explain why these secondary outbursts are only observed in some cases and can provide a constraint on the corona geometry.

Keywords: accretion disk, irradiation, secondary outburst, BH SXT

*Speaker
†Corresponding author: aksulu@itu.edu.tr
‡Corresponding author: ekalemci@sabanciuniv.edu
§Corresponding author: eksi@itu.edu.tr