Contribution ID: **105**

Type: **Contributed talk in mini symposium**

Disappearing thermal X-ray emission as a tell-tale signature of merging massive black hole binaries

Thursday, December 14, 2023 2:50 PM (10 minutes)

The upcoming Laser Interferometer Space Antenna (LISA) is expected to detect gravitational waves (GWs) from massive black hole binaries (MBHB). Finding the electromagnetic (EM) counterparts for these GW events will be crucial for understanding how and where MBHBs merge, measuring their redshifts, constraining the Hubble constant and the graviton mass, and for other novel science applications. However, due to poor GW sky localisation, multi-wavelength, time-dependent electromagnetic (EM) models are needed to identify the right host galaxy. We studied merging MBHBs embedded in a circumbinary disc (CBD) using high-resolution two-dimensional simulations, with a Γ-law equation of state, incorporating viscous heating, shock heating, and radiative cooling. We simulate the binary from large separation until after merger, allowing us to model the decoupling of the binary from the circumbinary disc. We compute the EM signatures and identify distinct features before, during, and after the merger. Our main result is a multi-band EM signature: we find that the MBHB produces strong thermal X-ray emission until 1-2 days prior to the merger. However, as the binary decouples from the CBD, the X-ray-bright minidiscs rapidly shrink in size, become disrupted, and the accretion rate drops precipitously. As a result, the thermal X-ray luminosity drops by orders of magnitude, and the source remains X-ray dark for several days, regardless of any post-merger effects such as GW recoil or mass loss. Looking for the abrupt spectral change where the thermal X-ray disappears is a tell-tale EM signature of LISA mergers that does not require extensive pre-merger monitoring.

Primary author: KRAUTH, Luke (Columbia University)

Co-authors: Prof. MACFADYEN, Andrew (New York University); Prof. ZRAKE, Jonathan (Clemson University); Dr DAVELAAR, Jordy (Columbia University and Flatiron Institute); Dr WESTERNACHER-SCHNEIDER, Ryan (Leiden University); HAIMAN, Zoltan (Columbia University)

Presenter: KRAUTH, Luke (Columbia University)

Session Classification: GW Astrophysics