THE UNIVERSITY OF HONG KONG

DEPARTMENT OF PHYSICS
RESEARCH SEMINAR

Unveiling Multimessenger Emission from Hidden Cores of Microquasars

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Abstract:

Microquasars are radio-emitting X-ray binaries accompanied by relativistic jets. They are established sources of 100 TeV gamma rays and are considered promising candidates for cosmic-ray acceleration. Motivated by recent detections of ~100 TeV photons from Cygnus X-1 and ~PeV photons from Cygnus X-3 by the Large High Altitude Air Shower Observatory (LHAASO), we employ the Astrophysical Multimessenger Emission Simulator (AMES) to model their multimessenger emission considering compact outflow regions as cosmic-ray accelerators, spanning from radio to ultra-high-energy gamma rays. Our results show that the observed >TeV gamma rays can originate from either p\gamma or pp interactions, depending on the location and physical conditions of the emission region, while also reproducing the lower-energy spectra. In particular, we find that explaining the PeV emission from Cygnus X-3 requires a magnetic field of order ~10^2 G in the AU-scale blob. These different emission-region configurations yield unique, observationally testable predictions. In the 0.1-10 TeV energy range, where current observations provide only upper limits, they predict either a deep dip, a mild suppression, or a power-law spectrum. Additionally, models involving AU-scale blob regions predict strong variability, while those invoking more extended and static external zones show more stable behavior. We also provide a possible qualitative explanation for the distinct modulation patterns across different energy bands, which relies primarily on changes in the Doppler factor and external gamma-gamma absorption. Finally, our neutrino predictions, which properly account for muon and pion cooling effects, reveal a significantly suppressed flux, indicating that detecting these sources may be more challenging than previously anticipated.

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Anyone interested is welcome to attend.