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Catching Close SMBH Binaries with Multi-Wavelength Follow-Ups of Repeating Transients in Galactic Nuclei: the Curious Case of ASASSN-20qc

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Binaries containing a compact object orbiting a supermassive black hole are thought to be the precursors of gravitational wave events, but their electromagnetic identification has been extremely challenging. ASASSN-20qc is an optical astrophysical flare that originated from the nucleus of a seemingly quiescent galaxy at a redshift of 0.056. An extensive multi-wavelength follow-up campaign using optical, UV, X-ray, and radio telescopes revealed the presence of a central SMBH with mass of about 10^7 solar masses and the presence of a newly-formed accretion disk, likely caused by a tidal disruption of a star. Initially, the behavior seemed somehow normal, but we found something rather peculiar. The X-ray data showed a very curious behavior, never seen before in an AGN, changing-look AGN or TDE. We report the detection variable X-ray absorption repeating every 8.3 days indicating quasi-periodic outflows (QPOuts). Using general relativistic magneto-hydrodynamic simulations we show that these QPOuts are explained with an intermediate-mass black hole secondary on a mildly eccentric orbit at a mean distance of about 100 gravitational radii from the primary SMBH. Powerful outflows, with an observed velocity of 30% of the speed of light and capable to exert significant feedback on the host galaxy, are naturally enhanced when the secondary crosses the primary inner accretion disk. This result suggests a scenario in which possibly multiple compact objects (such as black holes and stars) may be zooming through a gaseous disk, in comparison to the classical assumed picture of a simple SMBH accretion flow. This can be an example of the many possible synergies we may get soon combining Rubin-LSST and other space- and ground-based facilities for repeating transients in galactic nuclei, and it opens the possibility to explore the electromagnetic precursors/counterparts of intermediate/extreme-mass ratio inspirals (I/EMRI) expected to be observed with LISA through gravitational waves.

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