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Mysterious repeating signals from the centers of galaxies

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Almost all galaxies contain a supermassive black hole (masses > 100,000 solar masses) residing at their center. In the last decade or so a subsample of these black holes are found to exhibit repeating X-ray modulations with timescales ranging from a few minutes to up to a month. The nature of these recurring signals is currently debated but most ideas can be put into two categories: they are either a result of instabilities occurring in the inner accretion flow or from interaction of orbiting objects with the accretion disk. I will present an overview of the various flavors of repeating extragalactic nuclear transients that we have identified using multi-wavelength studies of several classes of astrophysical objects including stellar tidal distribution events, quasi-periodic eruptions, and AGN outbursts. I will also present state-of-the-art general relativistic hydrodynamic simulations of objects embedded in AGN disks and argue that, in some cases, these repeating transients could be double compact object binaries with direct implications for multi-messenger astrophysics. I will end by highlighting the exciting prospects of discovering more such systems in the imminent era of the Rubin/LSST observatory.

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