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Stellar Graveyards and Shifting Paradigms in Gravitational-wave Astrophysics

Abstract

Gravitational-wave astronomy has transformed our understanding of the universe's most extreme objects. In less than a decade, the LIGO and Virgo observatories have revealed a rich population of merging black holes and neutron stars, uncovering systems that challenge long-standing expectations from stellar evolution. We now see black holes that are heavier, more numerous, and sometimes more complex than any previously known, hinting at environments where they can collide, merge, and grow repeatedly. One such environment may lie in the accretion disks of active galactic nuclei, which can act as cosmic "stellar graveyards" that serve as black-hole assembly lines. In these dense, gas-rich regions, black holes may form binaries, merge multiple times, and even produce electromagnetic or neutrino counterparts. In this talk I will first review how gravitational-wave discoveries have reshaped astrophysics, highlighting what we have learned about compact objects and their origins. I will then explore how the AGN-disk scenario may represent the next paradigm shift, connecting gravitational waves and electromagnetic radiation into a unified multimessenger picture.