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New astrophysical probes of black-hole spin

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Astrophysical black holes can be divided into two populations: stellar-mass black holes formed in the collapse of massive stars, and supermassive black holes that reside in galactic centers. New instruments coming online within the next 10 years will revolutionize our capability to observe both populations, and in particular will allow us to place important constraints on black-hole spin. I will focus on two phenomena sensitive to black-hole spins: binary black-hole mergers and stellar tidal disruption by supermassive black holes. The gravitational waves emitted during stellar-mass black-hole mergers are an important source for the Laser Interferometer Gravitational-wave Observatory (LIGO). I will discuss how the orientation of the spins in these black-hole binaries can teach us about how such systems form. Stars wandering too close to supermassive black holes will be tidally disrupted. Debris from the disrupted star accreted by the black hole can power a bright electromagnetic flare known as a tidal disruption event (TDE). If the tidal radius at which the star is disrupted is close enough to the black hole's event horizon, black-hole spin will affect both the rate at which these TDEs occur and the light curves for individual events. Future observational surveys by instruments like the Large Synoptic Survey Telescope (LSST) should discover thousands of TDEs, allowing us to probe the spins of previously quiescent supermassive black holes for the very first time.