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What happens when black holes and neutron stars merge?

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Neutron star-neutron star mergers and black hole-neutron star (BHNS) mergers are fascinating and violent events which combine strongly curved spacetimes, relativistic speeds, and supernuclear-density matter. They are also promising sources of gravitational waves and potential causes of short-duration gamma-ray bursts. The gravitational waveform and the characteristics of the post-merger accretion disk are strongly affected by the the mass ratio, the neutron star equation of state, and (for BHNS binaries) the pre-merger black hole spin. In the past few years, numerical simulations in full general relativity have made significant progress both in incorporating more realistic NS microphysics and in sampling the astrophysically relevant binary parameter space. In this talk, I review this progress, focusing particularly on studies of BHNS binaries that look at the effects of black hole spin and nuclear equation of state on the gravitational wave signal and the post-merger disk.