

## Black Hole Mergers and Gravitational Waves: Opening the New Frontier

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The final merger of two black holes produces a powerful burst of gravitational waves, emitting more energy than all the stars in the observable universe combined. Since these mergers take place in the regime of strong dynamical gravity, computing the gravitational waveforms requires solving the full Einstein equations of general relativity on a computer. For more than 30 years, scientists tried to simulate these mergers using the methods of numerical relativity. The resulting computer codes were plagued by instabilities, causing them to crash well before the black holes in the binary could complete even a single orbit.

In the past several years, this situation has changed dramatically, with a series of remarkable breakthroughs. This talk will highlight these breakthroughs and the resulting 'gold rush' of new results that is revealing the dynamics of binary black hole mergers, and their applications in gravitational wave detection, testing general relativity, and astrophysics.