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Binary Black Hole Mergers: Breakthroughs, Waveforms, Astrophysics, and Gravitational Waves

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In 2005, three numerical relativity groups achieved breakthroughs that enabled the first fully three-dimensional calculations of merging binary black holes and the resulting gravitational waveforms. This talk will begin with an overview of these achievements, setting them within the context of the numerical and theoretical challenges at the time. We will then discuss how these achievements truly did "break open" the field of numerical relativity, enabling the solution of increasingly more challenging problems, surprising discoveries, and key astrophysical applications. We will conclude with a look at the role of numerical relativity simulations in the experimental discovery of gravitational waves from merging binary black holes.