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Computing Gravity's Strongest Grip

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Gravitational physics is entering a new era, one driven by observation, that will begin once gravitational wave interferometers such as LIGO make their first detections. The gravitational waves are produced during violent events such as the merger of two black holes. The detection of these waves or ripples in the fabric of spacetime is a formidable undertaking, requiring innovative engineering, powerful data analysis tools and careful theoretical modeling. In support of this theoretical modeling, recent breakthroughs in numerical relativity have lead to the development of computational tools that allow us to explore where and how gravitational wave observations can constrain or inform our understanding of gravity and astrophysical phenomena. I will review these latest developments, focusing on binary black hole simulations and the role these simulations play in our new understanding of physics and astronomy where gravity exhibits its strongest grip on our spacetime.