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Visualizing and understanding vortex and tendex lines of colliding black holes HAROON KHAN, GEOFFERY LOVELACE, SAMUEL RODRIGUEZ, California State University, Fullerton — Gravitational waves (GWs) are ripples of spacetime. In order to detect and physically study the GW emitted by merging black holes with ground based detectors such as aLIGO, we must accurately predict how the waves look and behave. This requires numerical simulations of black hole (BH) mergers on supercomputers, because all analytical approximations fail near the time of merger.These simulations also reveal how BHs warpspace and time.My project focuses on using these simulations to visualize the strongly curved space time in simulations of merging BHs. I have visualized the vortex andtendexlines for a binary BH system, using the Spectral Einstein Code. Vortex lines describe how an observer would be twisted by the curvature, and thetendexlines describe an observer would be stretched at squeezed by it. These lines are analogous to how electric and magnetic field lines describe the electromagnetic forces on an observer. Visualizing these will provide a more intuitive understanding of the nonlinear dynamics of the spacetime of mergingBHs. I am exploring how these lines change with time during a simulation, to see whether they vary smoothly in time and how they depend on where they are seeded.

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