MATHEMATICAL MOMENTS

Spinning at Infinity

Colliding black holes produce the strongest gravitational waves since the Big Bang, offering a unique way to test the theory of general relativity. Yet until recently no one knew what the waves would look like, because none has ever been detected. Now, a major computational breakthrough has combined non-Euclidean geometry and differential equations to simulate the collisions and reveal the waves' patterns. This merger of mathematics with supercomputers, while not as momentous as that of black holes, will have ripple effects on astrophysics, either confirming general relativity or leading to new theories.

The new models—which can accommodate different spins and masses of the black holes—divide the collision process into three phases. In the first and final phases, the general relativity equations and integrals are solved analytically, but in the middle phase, when the black holes are within a few radii of each other, the solutions must be obtained numerically. The solutions are made feasible by cleverly changing coordinates and keying the number of data points to the significance of the region. One discovery from these latest simulations is that some collisions are strong enough to eject the black holes from the galaxy.

For More Information: "Computing Cosmic Cataclysms," Joan Centralla et al. *SciDAC Review*, Summer 2008.

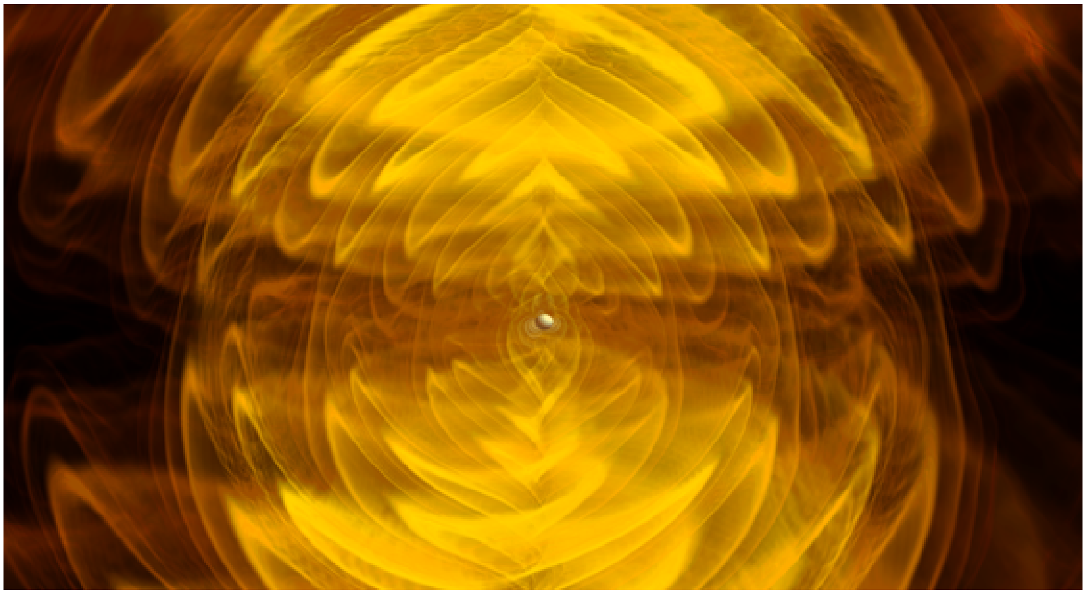

Image courtesy of Chris Henze, NASA.

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