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High-speed black hole collisions with application to trans-Planckian particle scattering[1]

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We review the present status of modeling high-energy collisions of black holes in the context of TeV gravity scenarios, i.e. extensions of the standard model that involve extra dimensions and thus predict a reduction of the fundamental Planck scale to levels closer to the electroweak scale. Particle collisions above the TeV range, such as those performed at the LHC or occurring in cosmic-ray interactions with the earth's atmosphere, offer the exciting opportunity to probe these extra-dimensional models. As gravity becomes the dominant interaction, the relevant particle collisions, should be well described by point-particle collisions or their general relativistic analog, high-energy collisions of black holes. Furthermore, modeling in the framework of classical general relativity should provide a good description of these events assuming that the collision energies exceed the fundamental Planck scale by a sufficient amount. With this motivation in mind, we discuss the simulation of black-hole collisions in the framework of D-dimensional general relativity. Specifically, we summarize our current understanding of the loss of energy and momentum in the form of gravitational waves in these collisions which impacts the analysis of experimental data. We also compare numerical with analytic predictions and discuss the validity of the assumption that internal structure of the particles becomes irrelevant for the modeling.

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