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Memory Effect of Gravitational Wave Pulses in PP-Wave Spacetimes

In this paper we study the memory effect produced in pp-wave spacetimes due to the passage of gravitational wave pulses. We assume the pulse profile in the form of a ramp (which may be considered as an appropriate representation of burst gravitational waves), and analyse its effects on the evolution of nearby geodesics. For a ramp profile, we are able to determine analytical solutions of the geodesic equations in the Brinkmann coordinates. We have plotted the solutions to examine the changes in the separation between a pair of geodesics and their velocity profiles. We find that in the presence of the pulse, the separation (along x or y-direction) increases monotonically from an initial constant value, whereas the relative velocity grows from zero and settles to a final non-zero constant value. These resulting changes are retained as memory after the pulse dies out. The nature of this memory is found to be similar to that obtained by other workers using Gaussian, square and other pulse profiles, thereby validating the universality of gravitational wave memory.

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