The Kasner Universe on the Plane

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Abstract

As early as 1921—only five years after the inception of the theory of general relativity—the mathematician Edward Kasner (1878–1955) found an exact solution of Einstein's vacuum field equations describing an anisotropic universe without matter.[1–3] The corresponding spacetime metric is simplest but nonetheless a very effective tool to explore prominent features of such a universe. Only recently, the Kasner cosmological model has revived interest in relation to $f(T)$ gravity—a gravity theory including an arbitrary function of the torsion scalar aiming to explain in a new way late-time universe acceleration.[4]

Here, we will mainly focus on the Kasner model with two spatial dimensions in order to probe its characteristic properties for future implementations of it in analog models of gravity.[5] However, the Cartan formalism will also allow us to derive interesting analytical results for the generalized $(n+1)$D Kasner universe. A more thorough investigation of the $(2+1)$D spacetime variant has so far been neglected. In this presentation, we explicitly derive and probe some of the most interesting aspects of this spacetime geometry. This comprises the fully analytic solutions for the timelike geodesic equation and also solutions of the scalar wave equation in the $(2+1)$D Kasner background. Concluding the discussion, numerical simulations of the model will help to illustrate the main properties of this spacetime.

References

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