

Scalar waves in conformally symmetric spacetimes

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Solutions to Einstein's field equations (EFEs) are useful in describing compact stellar objects which have very strong gravitational fields and high densities. Finding these solutions is difficult in general because they are a system of complicated nonlinear partial differential equations. Ad hoc methods need to be employed to make them simpler to work with such as assuming a type of symmetry, for example, conformal symmetry. We study the kinematical and dynamical properties of spacetimes that admit a conformal Killing vector (CKV) through a geometrical spacetime decomposition. This provides new insights into the behaviour of physical quantities such as acceleration, expansion, shear and vorticity. Constraint equations are obtained that must be satisfied for a CKV to exist through the decomposition of the energy-momentum tensor. We apply our results to the perfect fluid model and noteworthily we show that the conformal factor satisfies a damped scalar wave equation. We preview spacetime decomposition applied to black holes and comment on gravitational waves.

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