General Relativity and Quantum Cosmology

Killing Vector Fields in Three Dimensions: A Method to Solve Massive Gravity Field Equations

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Killing vector fields in three dimensions play important role in the construction of the related spacetime geometry. In this work we show that when a three dimensional geometry admits a Killing vector field then the Ricci tensor of the geometry is determined in terms of the Killing vector field and its scalars. In this way we can generate all products and covariant derivatives at any order of the ricci tensor. Using this property we give ways of solving the field equations of Topologically Massive Gravity (TMG) and New Massive Gravity (NMG) introduced recently. In particular when the scalars of the Killing vector field (timelike, spacelike and null cases) are constants then all three dimensional symmetric tensors of the geometry, the ricci and einstein tensors, their covariant derivatives at all orders, their products of all orders are completely determined by the Killing vector field and the metric. Hence the corresponding three dimensional metrics are strong candidates of solving all higher derivative gravitational field equations in three dimensions.

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