Solutions of the dilaton field equations with applications to the soliton-black hole correspondence in generalised JT gravity

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Abstract

In this thesis, we explore connections between solitons, black holes, and harmonic maps in two-dimensional gravitation. Euclidean sine-Gordon theory, naturally admitting soliton solutions, and Schwarzschild-type black hole metrics, of physical interest, are studied in detail for the case of JT gravity. Establishing an explicit soliton-black hole correspondence in this setting, new solutions to the associated JT field equations are given. Consequences and concrete applications of the constructed gauge transformations are also discussed, including characterisation of the Killing vector fields and solutions to a nontrivial Eigenvalue Problem using the theory of hypergeometric equations. ^ We next consider a generalised two-dimensional action and establish a correspondence between nonconstant curvature soliton metrics and black hole metrics. The theory is applied to completely solve the static case, as well as study other classical dilaton models, including Spherically Symmetric Gravity and String Inspired Gravity. Finally, a connection between harmonicity and generalised solitons is given through construction of harmonic maps of the plane to the 2-sphere, suggesting new solutions to field equations admitting black hole metrics. Other directions for studying the integrable systems structure of generalised two-dimensional dilaton theories are indicated. ^

Subject Area

Mathematics|Physics, Theory

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