Quintic quasi-topological gravity

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ABSTRACT: We construct a quintic quasi-topological gravity in five dimensions, i.e. a theory with a Lagrangian containing $R^5$ terms and whose field equations are of second order on spherically (hyperbolic or planar) symmetric spacetimes. These theories have recently received attention since when formulated on asymptotically AdS spacetimes might provide for gravity duals of a broad class of CFTs. For simplicity we focus on five dimensions. We show that this theory fulfils a Birkhoff’s Theorem as it is the case in Lovelock gravity and therefore, for generic values of the couplings, there is no $s$-wave propagating mode. We prove that the spherically symmetric solution is determined by a quintic algebraic polynomial equation which resembles Wheeler’s polynomial of Lovelock gravity. For the black hole solutions we compute the temperature, mass and entropy and show that the first law of black holes thermodynamics is fulfilled. Besides of being of fourth order in general, we show that the field equations, when linearized around AdS are of second order, and therefore the theory does not propagate ghosts around this background. Besides the class of theories originally introduced in arXiv:1003.4773, the general geometric structure of these Lagrangians remains an open problem.

KEYWORDS: Black Holes, Classical Theories of Gravity

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