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Electromagnetic generalized quasi-topological gravities in three dimensions

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We present new families of three-dimensional gravities non-minimally coupled to a scalar field whose effective on-shell Lagrangian becomes a total derivative when evaluated in a static spherically symmetric ansatz for the metric and a magnetic-like solution for the scalar field. After integrating once, the resulting equations of motion are of second order at most. We show that these theories, dubbed Generalized quasitopological gravities, exist at every order in curvature. We also present their covariant expression and a recursive relation that allows to construct them at arbritrarily high order. After that, we focus on solutions to the quasitopological family. We check that they corresponds to multiparametric generalizations of the Bañados-Teitelboim-Zanelli black hole, describing a plethora of new analytic black holes and globally regular horizonless spacetimes. Interestingly, in some cases the black holes have no singularity at all, being completely regular.

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