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ELOY AYÓN-BEATO: On the consistent thermodynamics of Lifshitz black holes

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In arbitrary dimension, we consider a theory described by the most general quadratic curvature corrections of Einstein gravity together with a self-interacting nonminimally coupled scalar field. This theory is shown to admit five different families of Lifshitz black holes dressed with a nontrivial scalar field. The entropy of these configurations is microscopically computed by means of a higher-dimensional anisotropic Cardy-like formula where the role of the ground state is played by the soliton obtained through a double analytic continuation. This involves calculating the correct expressions for the masses of the higher-dimensional Lifshitz black hole as well as their corresponding soliton. The robustness of this Cardy-like formula is checked by showing that the microscopic entropy is in perfect agreement with the gravitational Wald entropy. Consequently, the calculated global charges are compatible with the first law of thermodynamics as well as an anisotropic higher-dimensional version of the Smarr formula. Some of these configurations exist on Lifshitz critical points of the theory where all their extensive thermodynamic quantities vanish.

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