Nonspherical horizons from black hole scalarization

Carlos A. R. Herdeiro[†] and Eugen Radu[‡]

[†]Centro de Astrofísica e Gravitação - CENTRA,
Departamento de Física, Instituto Superior Técnico - IST, Universidade de Lisboa - UL,
Avenida Rovisco Pais 1, 1049-001, Portugal

[‡]Center for Research and Development in Mathematics and Applications (CIDMA),
Department of Mathematics, Campus de Santiago, 3810-183 Aveiro, Portugal

Abstract

Recently, several classess of gravity models have been shown to exhibit spontaneous scalarization of black holes (BHs). For example, the Schwarzschild BH possesses scalarized generalizations when viewed as a solution of specific scalar-tensor-Gauss-Bonnet models. We argue that a similar solutions exist in a class of Einstein-Maxwell-scalar (EMS) models. The corresponding BHs bifurcate from the Reissner-Nordström BH trunk, forming an infinite (countable) number of branches, and possess a large freedom in their multipole structure. Unlike the case of electrovacuum, the EMS model admits static, asymptotically flat, regular on and outside the horizon BHs without spherical symmetry and even without any spatial isometries, which are thermodynamically preferred over the electrovacuum state. We conjecture that the existence of static, nonspherical BHs is a generic property of any gravity model exhibiting spontaneous scalarization and discuss such solutions in models with higher curvature corrections.