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E. Radu: Curing conical singularities with scalar hair

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A number of well-known black object solutions in (electro)vacuum general relativity (GR) are plagued by conical singularities which provide the force balance that allows the existence of such configurations. The basic example is the Bach-Weyl (or double-Schwarzschild) solution, which describes two static black holes in four dimensional vacuum GR, with a deficit angle along the section in between the black holes. A different case is provided by the five dimensional static Emparan-Reall black ring, which contains a conical singularity in the form of a disc that sits inside the ring, supporting it against collapse. We argue that the situation in (electro)vacuum GR is not generic, with the possible existence of balanced solutions in i) more general theories or ii) for different spacetime asymptotics. Focusing on the first case, we consider the static black ring in Einstein-Maxwell-gauged scalar field model and argue that the charged scalar hair can balance it, yielding solutions that are singularity free on and outside the horizon. The four dimensional static two static black hole system can be balanced by a real scalar field with an appropriate self-interaction.

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