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Can Brans-Dicke theory with Λ>0 describe stars?

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Partially based on Phys.Rev.Lett. 115 (2015) no.18, 181104, in collaboration with Sourav Bhattacharya, Konstantinos F. Dialektopoulos, Antonio Enea Romano, Theodore N. Tomaras.

Summary

A step-by-step approach is followed to study cosmic structures in the context of Brans-Dicke theory with positive cosmological constant Λ and parameter ω. First, it is shown that regular stationary black-hole solutions not only have constant Brans-Dicke field ϕ, but can exist only for ω=∞, which forces the theory to coincide with the General Relativity. Generalizations of the theory in order to evade this black-hole no-hair theorem are presented. It is also shown that in the absence of a stationary cosmological event horizon in the asymptotic region, a stationary black hole horizon can support a non-trivial Brans-Dicke hair. Even more importantly, it is shown next, that the presence of a stationary cosmological event horizon rules out any regular stationary solution, appropriate for the description of a star. Thus, to describe a star one has to assume that there is no such stationary horizon in the faraway asymptotic region. Under this implicit assumption generic spherical cosmic structures are studied perturbatively and is shown that only for ω>0 or ω⊠−5 their predicted maximum sizes are consistent with observations. We also point out how, many of the conclusions of this work differ qualitatively from the Λ=0 spacetimes.

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