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## Infinitely degenerate exact Ricci-flat solutions in $f(R)$ gravity

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The evidence is mounting that the Universe is currently undergoing a phase of accelerated expansion. One possible alternative is the modification in gravity in the largest possible scales. This leads to the many questions related to black-holes: violation of Birkhoff theorem and no-hair theorem. To confirm/infirm, we need to obtain exact black-hole solutions in these modified gravity theories.

In this talk, we focus on the exact spherically symmetric solutions in  $f(R)$  theories of gravity. We explicitly show that some  $f(R)$  models contain an infinite number of exact static, Ricci-flat spherically symmetric vacuum solutions and, hence, violate Birkhoff's theorem in  $f(R)$  theories. We analytically derive two exact vacuum black-hole solutions for the same class of  $f(R)$  theories. The two black-hole solutions have the event-horizon at the same point; however, their asymptotic features are different. Our results suggest that the no-hair theorem may not hold for generic modified gravity theories. We discuss the implications of our work to distinguish modified gravity theories from general relativity. (Based on arXiv:2003.05139)

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