Abstract

By starting from a generic metric which describes four dimensional stationary black holes in an arbitrary theory of gravity , we show that the $AdS$ near horizon geometry is a consequence of finiteness and double-horizon limit. For the neutral and electrically charged rotating black holes in some theories of gravity such as $f(R)$ gravity which are described by this general metric , we show that applying this limit in the equations of motion results a set of decoupled equations at the horizon which can be solved and give the near horizon parameters. It is shown that these decoupled equations come from variation of a function like entropy function which is evaluated at the horizon by imposing double-horizon limit and without going to the near-horizon coordinate. We simplify Wald formula at the horizon by using this limit and get the results similar to the entropy function method.