

Foliation and the First Law of Thermodynamics for the Kerr Newman Black Hole

Authors : Syed M. Jawwad Riaz

Abstract : There has been a lot of interest in exploring the thermodynamic properties at the horizon of a black hole geometry. Earlier, it has been shown, for different spacetimes, that the Einstein field equations at the horizon can be expressed as a first law of black hole thermodynamics. In this paper, considering $r = \text{constant}$ slices, for the Kerr-Newman black hole, shown that the Einstein field equations for the induced 3-metric of the hypersurface is expressed in thermodynamic quantities under the virtual displacements of the hypersurfaces. As expected, it is found that the field equations of the induced metric corresponding to the horizon can only be written as a first law of black hole thermodynamics. It is to be mentioned here that the procedure adopted is much easier, to obtain such results, as here one has to essentially deal with $(n - 1)$ -dimensional induced metric for an n -dimensional spacetime.

Keywords : black hole space-times, Einstein's field equation, foliation, hyper-surfaces

Conference Title : ICMIPA 2016 : International Conference on Mathematical Physics, and Applications

Conference Location : New York, United States

Conference Dates : June 06-07, 2016