

Isolated Horizons in 4 and other dimensions

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Abstract

We study a geometric structure induced on non-expanding null surfaces contained in $n + 2$ -dimensional vacuum space-time of the signature $(- + \dots +)$. A non-expanding null world tube of a compact n -sub-manifold is called a horizon. If a non-expanding horizon admits a null symmetry, it is ‘isolated’. The 0th law of the isolated horizon thermodynamics is generalized to an arbitrary $n > 2$ dimension. Still, more results are established in the 4 dimensional space-time case. In particular, a local version of the uniqueness theorem holds for the extremal Kerr horizon. Local conditions upon which the geometry of a non-expanding horizon coincides with that of the Kerr event horizon are known. Invariants of the non-expanding horizon geometry are useful to formulate necessary conditions for the existence of a Killing field in a space-time neighborhood. A set of the sufficient conditions, on the other hand, can be used to construct a new “exact” vacuum solution foliated by certain Killing horizons.