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## Boundary terms and Brown-York quasi-local parameters for scalar-tensor theory

Boundary term and Brown-York (BY) formalism, which is based on the Hamilton-Jacobi principle, are complimentary of each other as the gravitational actions are not, usually, well-posed. In scalar-tensor theory, which is an important alternative to GR, it has been shown that this complementarity becomes even more crucial in establishing the equivalence of the BY quasi-local parameters in the two frames which are conformally connected. Furthermore, Brown-York tensor and the corresponding quasi-local parameters are important from two important yet different aspects of gravitational theories: black hole thermodynamics and fluid-gravity correspondence. The investigation suggests that while the two frames are equivalent from the thermodynamic viewpoints, they are not equivalent from the perspective of fluid-gravity analogy or the membrane paradigm. In addition, the null boundary term and null Brown-York formalism are the recent developments (so far obtained only for GR) which is non-trivial owing to the degeneracy of the null surface. In the present analysis these are extended for scalar-tensor theory. The present analysis also suggests that, regarding the equivalence (or inequivalence) of the two frame, the null formalism draws the same inferences as of the timelike case, which in turn establishes the consistency of the newly developed null Brown-York formalism.

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