High Energy Physics - Theory

Violation of the first law of black hole thermodynamics in $f(T)$ gravity

Rong-Xin Miao, Miao Li, Yan-Gang Miao

(Submitted on 4 Jul 2011 (v1), last revised 17 Nov 2011 (this version, v3))

We prove that, in general, the first law of black hole thermodynamics, $\delta Q=T\delta S$, is violated in $f(T)$ gravity. As a result, it is possible that there exists entropy production, which implies that the black hole thermodynamics can be in non-equilibrium even in the static spacetime. This feature is very different from that of $f(R)$ or that of other higher derivative gravity theories. We find that the violation of first law results from the lack of local Lorentz invariance in $f(T)$ gravity. By investigating two examples, we note that $f''(0)$ should be negative in order to avoid the naked singularities and superluminal motion of light. When $f''(T)$ is small, the entropy of black holes in $f(T)$ gravity is approximatively equal to $\frac{f'(T)}{4}A$.

Comments:	18 pages, no figure, version accepted for publication in JCAP
Subjects:	**High Energy Physics - Theory (hep-th)**; Cosmology and Extragalactic Astrophysics (astro-ph.CO); General Relativity and Quantum Cosmology (gr-qc)
Journal reference:	JCAP11(2011)033
Report number:	USTC-ICTS-11-08
Cite as:	**arXiv:1107.0515 [hep-th]**
	(or **arXiv:1107.0515v3 [hep-th]** for this version)

Submission history

From: Miao Rongxin [view email]
[v1] Mon, 4 Jul 2011 02:21:31 GMT (12kb)
[v2] Tue, 8 Nov 2011 05:26:54 GMT (14kb)
[v3] Thu, 17 Nov 2011 15:55:18 GMT (14kb)

Which authors of this paper are endorsers?