Self Sustained Traversable Wormholes and Casimir Energy

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Abstract

In this contribution we review the concept of Self Sustained Traversable Wormholes. We consider configurations which are sustained by their own gravitational quantum fluctuations. The investigation is evaluated by means of a variational approach with Gaussian trial wave functionals to one loop. We interpret the graviton quantum fluctuations as a kind of Exotic Energy. Since these fluctuations usually produce Ultra-Violet divergences, a procedure to keep under control must be introduced. We will discuss two different procedures: firstly, a zeta function regularization is involved to handle with divergences and a renormalization process is introduced to obtain a finite one loop energy. Secondly, we consider the case of Distorted Gravity, namely when either Gravity's Rainbow or a Noncommutative geometry is used as a tool to keep under control the Ultra-Violet divergences. In this context, it will be shown that for every framework, the self-sustained equation will produce a Wheeler wormhole, namely a wormhole of Planckian size. This means that, from the point of view of traversability, the wormhole will be traversable in principle, but not in practice. Some consequences on topology change are discussed together to the possibility of obtaining an enlarged wormhole radius. This paper is submitted for the day 3 session Breakthrough Propulsion.

Keywords: Traversable Wormholes, Quantum Gravity, Casimir Effect

References:

[1] R. Garattini, "Self sustained traversable wormholes?", Class.Quant.Grav. 22 (2005) 1105; ArXiv: gr-qc/0501105.
[2] R. Garattini and F. S.N. Lobo, "Self sustained phantom wormholes in semi-classical gravity", Class.Quant.Grav. 24 (2007) 2401; ArXiv: gr-qc/0701020.
[3] R. Garattini and F.S.N. Lobo, "Self-sustained traversable wormholes in noncommutative geometry", Phys.Lett. B 671 (2009) 146; ArXiv:0811.0919 [gr-qc].
[4] R. Garattini and F.S.N. Lobo, "Self-sustained wormholes in modified dispersion relations", Phys.Rev. D85 (2012) 024043; ArXiv:1111.5729 [gr-qc].
[5] R. Garattini and F.S.N. Lobo, " Gravity`s Rainbow induces topology change", Eur.Phys.J. C74 (2014) 2884; ArXiv:1303.5566 [gr-qc].

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