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TFD formalism and applications in a gravitational theory

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The theory of Gravity is classical by its origin while other fundamental forces describing microscopic aspects of nature are quantum mechanical. There are several attempts to unify gravity with forces in the Standard Model. The search to unify gravitation and electromagnetism has a long history. The first studies were carried out by Faraday, Maxwell, Heaviside, Weyl, Kaluza-Klein, among others. A formal analogy between the gravitational and the electromagnetic fields led to the notion of Gravitoelectromagnetism (GEM) to describe gravitation. GEM allows scattering processes with gravitons as an intermediate state like the photon for electromagnetic scattering. The GEM has been extended from a theory of classical gravity to a quantized theory that allows a perturbative approach to calculating phenomena in gravity. In order to investigate the gravitational effects at finite temperature, the Thermofield Dynamics (TFD) formalism is considered. TFD is a real-time formalism of quantum field theory at finite temperature. There are two necessary basic ingredients to construct this formalism: (i) the doubling of degrees of freedom in a Hilbert space and (ii) the Bogoliubov transformations. So, after a brief introduction of these two theories, GEM and TFD, we will study some gravitational effects at zero and finite temperature. Furthermore, the analogy between gravity and electromagnetism will be explored in the context of the Lorentz-violating standard model extension.

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