Contribution ID: **76** Type: **Poster**

Casimir Effect in Lorentz invarient Non-commutative space-time

Monday 12 December 2022 14:00 (1 hour)

Quantum gravity has been studied using various approaches, and all of these approaches introduce a fundamental length scale in the theory. Non-Commutative space-time is an approach which incorporates this fundamental minimum length scale naturally. Though length scale at which Casimir effect is measured and the scale at which quantum gravity effects are expected are very different, it is worth studying the possible modification of the Casimir effect due to space-time non-commutativity. Casimir effect is the phenomenon wherein a physical force between macroscopic boundaries confining space, such as the ones introduced by placing two parallel plates arise due to the vacuum fluctuation of quantized field. It is shown that vacuum fluctuations of the quantized electromagnetic field, leads to either attraction or repulsion force between the plates depending on the geometry of the plates. Effects of existence of minimal length scale and presence of extra dimensions on the Casimir effect has been studied in recent time. Thus it is of intrinsic interest to study the Casimir effect in Doplicher-Fredenhagen-Roberts (DFR) space-time, a non-commutative space-time that naturally introduces a minimum length scale and also has extra dimensions.

Here we study the Casimir effect by analyzing the vacuum fluctuation of scalar field in lorentz invarient non-commutative space-time, DFR space-time. This is calculated by studying the scalar field when there are two parallel plates, seperated by a distance, and and modeled by two δ-function. We calculate modifications to Casimir force and Casimir energy for both at zero and finite temperature. This is done in two ways; first by treating the extra spatial dimensions introduced in the DFR space-time the same manner as usual spatial dimensions of commutative space-time, and in the second, the extra dimension are treated as a compact dimensions.

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Session

Formal Theory

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Session Classification: Poster - 1