Some quantum optical and information theoretic aspects of relativistic atom-field systems.

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Abstract: In this lecture we will discuss some quantum optical and information theoretic aspects of quantum systems undergoing relativistic motion or subjected to relativistic boundary conditions.

First we consider an atom-mirror system in relative acceleration in presence of single mode scalar quantum vacuum whose canonical operators obey GUP (generalized uncertainty principle). We consider two cases —

(i) The atom undergoing Rindler acceleration and the mirror is static in the Minkowski space-time.

(ii) The mirror undergoing Rindler acceleration and the atom is static in the Minkowski space-time.

We obtained the solution of GUP modified Klein-Gordon equation and using that we calculate spontaneous excitation probability of the atom in both cases. Our work shows that GUP induces violation of equivalence between excitation probability of atom in the two cases mentioned above. GUP introduces damping in both of these cases and modification of Unruh temperature in the case (ii).

In the next part of the lecture we will discuss the Bell nonlocality of photons generated by dynamical Casimir effect simulated in a superconducting-microwave circuit. Employing non-Gaussian pseudospin measurement, we have analytically evaluated the amount of Bell violation and studied their variation with various circuit parameters. We have considered the effects of local noise in the microwave field modes, asymmetry between the field modes, and signal loss. We have identified the appropriate parameter regions, in order to observe Bell violation in this set-up.