Casimir Force and the Expanding Universe without the Zero Point Field

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Abstract. Since 1948, the Casimir force based on the zero point field (ZPF) is thought to exist because of the hypothesis that the field should follow the well verified zero point energy (ZPE) for the ground state of atoms and molecules. However, the ZPF has never been measured in the laboratory. Nevertheless, the ZPF continues to be promoted on the false hope that something can be created from nothing. Instead, forces measured in Casimir experiments are inferred as proof of the existence of the ZPF. But this logic presupposes mechanisms other than the ZPF are not available to produce the said same measured Casimir forces.

In this regard, the blackbody (BB) radiation field produced from the thermal kT energy of atoms in the surfaces of Casimir's plates is available and unlike the speculative ZPF, the existence of BB radiation emitted from atoms is unequivocal. Analysis is presented that shows the force being measured in Casimir experiments finds origin in the thermal kT energy of surface atoms based on the theory of QED induced EM radiation. QED stands for quantum electrodynamics, EM for electromagnetic, k for Boltzmann's constant, and T for absolute temperature. The kT energy of the surface atoms is EM and remains constant as the gap G between the plates is changed. To conserve the kT energy during gap collapse, the low frequency kT energy is up-converted by QED to the frequency f of the instant gap resonance, $f = c/2G$, where c is the speed of light. But the gradient of the constant kT energy of the surface atoms with respect to the gap vanishes, and therefore the force measured in Casimir experiments cannot be explained by BB radiation. Similarly, the force in Casimir theory that assumes the constancy of the ZPF in the gap cannot exist, i.e., Casimir's derivation of the force between parallel plates is unphysical because EM energy was not conserved.

But EM energy density differs from EM energy. Unlike the constancy of EM energy under changes in the gap, the EM energy density changes with the gap. The EM energy density increases as the gap collapses, the gradient of which in combination with the polarizability of the surface atoms is shown to give a BB force that is consistent with the forces measured in Casimir experiments. With the BB force based on polarizability of surface atoms, there is no need to invoke the speculative existence of the ZPF in a Casimir theory that lacks EM energy conservation to explain the forces measured in Casimir experiments.

The BB radiation field also places in question Einstein's notion held since 1929 that the ZPF is the force causing the Universe to expand as suggested by Hubble's finding of redshift in distant galaxy light. In the typical Universe away from galaxies as modeled in the Friedmann equations by a cloud of cosmic dust, the EM energy density of BB radiation from the emission of kT energy of dust atoms at 2.725 K is shown to provide a reasonable estimate of the cosmological constant. For submicron dust, the pair-wise repulsion from BB radiation in the typical Universe at 2.725 K is shown to exceed that of gravitational attraction, and therefore the Universe now thought by astronomers to be expanding because of the ZPF is instead expanding by BB radiation, albeit at a far slower rate than given by Doppler's effect based on Hubble redshift. Like the Casimir force thought to be a force from nothing, the notion that the Universe began from nothing in the Big Bang is therefore placed in question. By this theory, the Big Bang if it occurred at all was likely caused by the collapse of the Universe on itself - certainly not from nothing. The next Universe collapse therefore begins as the dust temperatures in the typical Universe approach absolute zero, although taking eons for the collapse to reach Big Bang temperatures.