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Dissipation of Momenergy to a Bose Gas by An Electromagnetic Propulsion Device

Remi Cornwall
University of London Alumni Society, Malet Street, London WC1E 7HU
http://www,evosci.org http://ulondon.academia.edu/RemiCornwall

Abstract

Theoretical analysis into the energetics of a novel putative electromagnetic field propulsion device by the author, found that it was able to impart momenergy to the ground state of the electromagnetic field; some rest-energy of the craft was converted to kinetic energy of the craft. Electrical analysis showed that the propulsor was always a net electrical load – if the device accelerated from one frame, then deaccelerated to the original frame, both processes would consume electrical work. The aim of this paper is to look further into this sinking of high-grade electrical energy into the field ground state and to show that an even more pernicious form of 2nd Law of Thermodynamics exists.

Keywords: 2nd Law, Thermodynamics, Quantum mechanics, Zero-point.

1. Introduction

The author[1-3] is one of many people[4, 5] who think that the 2nd Law, as it applies to matter, is compromised. Indeed, Sheehan has constructed a device[6] (although working at elevated temperatures) that demonstrates a clear 2nd Law violator with labile chemical bonds (similar to the 1st order phase transition sorting in the appendix[3]). Perhaps, clear to this research community, is that an isolated system can re-sort itself from equilibrium by what Sheehan calls a "Maxwell Zombie" (as opposed to demons) processes; these are akin to sorting on an information theoretic level. Thinking that the matter was settled (obviously for a closed system and not open), it came as a surprise to the author in his researches on electromagnetic propulsion[7, 8], that another insidious form of energy degradation exists involving the zero-point of a field and the harmonic oscillators *themselves* being put into motion.

Research in the fringe energy community on zero-point energy usually looks at ways it might be "cohered" or rectified, for it is well established that although it has zero expectation, its variance is non-zero[9-12]. The author makes no attempt here to either refute or agree with this objective, save to say that, homogeneity, isotropy and Lorentz invariance makes the task extremely difficult. Our different take is to consider it as a potential *sink of energy* rather than a source.

2. Moving a mode of the field

How to begin our claim that the zero-point could be a sink of energy? Let us consider a rather idealised atom of a single electron and proton with linear potentials[†], such that it forms an harmonic oscillator. It consists of leptons, electrons and quarks, with the latter bound to form the proton. Undoubtedly the rest-energy of these constituents, their potential and kinetic energies contribute to the mass of the system (we can define a classical conceptual zero of energy of the system at zero separation in this model with linear potentials). The energy levels of the system would be related to the quantum number thus: $E=\left(n+\frac{1}{2}\right)\hbar\nu$. We can compare this with the rest masses of an electron 0.511MeV and a proton at some 1836 times heavier than this. Inescapably when this hydrogen-like atom is set in wholesale motion, part of the kinetic energy must be ascribed to the zero-point in motion. All is mass-energy; all can be set in motion.

Looking further, each fundamental lepton of the hydrogen atom is an excitation of the fundamental lepton fields – a Fourier sum of modes of the field describing a somewhat localised wavepacket that represents the particle. Whether to say that all the fields describing the atom are moving or that it is a "blip" on the number line moving down it (like sending a wave down a rope tied at one end) is moot, both viewpoints are relativistically correct.

More to the point of this paper, the usual 2nd quantisation procedure for the electromagnetic field (appendix 1[7] and eqn. 27) and a transform of the fields by a Lorentz boost[13] to the electromagnetic tensor thus: $F'^{\alpha\beta}=\Lambda^{\alpha}_{\mu}\Lambda^{\beta}_{\nu}F^{\mu\nu}$ gives different fields; however the zero-point is just the same (not relativistically transformed) but moving with the frame. We can argue that within that moving volume

[†]This avoids the infinite electrostatic energy argument and to just where we'd place our zero of energy. We are interested in absolute energies and not differences in this discussion.

containing those fields, the harmonic oscillator describing them is moving too.

This is the basis of our claim in the putative electromagnetic propulsion system based on the static (zero-frequency) Poynting flow[7]. After the fields have been setup and we tend to the steady-state, the momentum of the photon modes describing the E and B fields of the device is transferred to the zero-point of those modes, as it must for momentum conservation (please consult [7] to see why a unidirectional circulation of energy results and why the zero-point term must be included in the photon's momentum) – the field is set in motion if the craft moves the other way. One may counter that the craft too "is made of fields" but there is no contradiction to say, by linear superposition, that part of the field goes one way whilst the other goes another; it is all one field.

3. Oscillators Coupling and Thermalisation of the Kinetic Energy of movement of the Zero-point

Returning to the hydrogen-like atom (which is just a foil for our field argument, sans rest mass), imagine now that it is part of an ensemble - a cloud of gas or a liquid, each harmonic oscillator describing the atom is coupled to others by short and long range forces. These forces come from the exchange of real photons, as excited atoms lower in energy by emission or virtual photons by dipole (or higher) potential fields, the so-called Van der Waal/London Forces. The process of mixing is inherently random but the upshot is the Equipartition of Energy: if we shoot a molecule of gas into a greater body of gas, its energy and momentum will randomise amongst the ensemble. If the coupling is loose, then the colliding molecule can scatter and cause excited states of other molecules and itself; this could lead to the emission of radiation and reabsorption by the body of gas once again. If the coupling is strong and the molecule sits in a potential well, so that the gas behaves more like a liquid or solid, the whole volume tends to move, without causing excited states, as momentum is transferred from a small group of colliding molecules to the greater body.

If we now strip our hydrogen gas argument foil of mass and concentrate on the zero-point (which we have already agreed translates in space as the atom translates), it is not then to a great a step to see that the zero-point modes of the electromagnetic field would be set in motion by the putative propulsion device and then would exchange the kinetic energy and momentum of their movement with others in the ensemble, leading to thermalisation too.

A similar situation of coupling exists with interaction between the modes of the electromagnetic field. The frequency spectrum of the zero-point goes with the cube in frequency[11, 12, 14] and is Lorentz invariant[12], thus: $\rho(\omega)=\dfrac{\hbar\omega^3}{2\pi^2c^3}$. An electric field present for every mode must mean that these modes experience a mutual interaction term and are coupled. We can model the general bath of zero-point fluctuation from all the oscillators as a mean field and note the effect on an individual mode, which is modelled as an electric dipole $p(E_k)$, such that the Hamiltonian is now:

$$H=\sum_k\left[\hbar\omega_k\left(a^\dagger a+\frac{1}{2}\right)+p\left(E_{k,zpe}\right)\cdot\bar{E}_{zpe}\right] \quad \text{eqn. 1}$$

And suggest that this potential energy term is so "steep", that the oscillators are kept in lock-step so much that it is zero and not normally considered.

Analogously to the hydrogen-like atom, the few modes set in motion by the propulsion device "slam" into the other modes of the field. Since the coupling is strong and the potential energy can always exceed the kinetic energy, the modes affected by the device don't build up sufficient momentum to scatter off the other modes with the emission of real photons (excited states). Thus the device would not produce any rearward going radiation, like a photon rocket. Anyhow momentum resulting from radiation is puny, W/c and the analysis of the device reports the work, W, going directly to the forward kinetic energy of the craft[7, 8].The whole field acts as one and absorbs the momenergy from the propulsion device.

It is quite clear then that, if the initial distribution of kinetic energy of the zero-point of the modes influenced by the propulsion device is non-uniform, the disturbance will evolve, propagate away and thermalize with the other modes. However it is hard to know what distribution it would adopt as *the system is open* and vast (size of the universe), with no certainty to other inputs or what the current state, that is, the average kinetic energy‡ of the modes. A fair guess would be, because the system is bosonic, that the entire modes crowd into the lowest state and this coupled with the immense mass of the zero-point[11, 12], would realistically make the movement infinitesimal. Practically the sink is infinite.

4. Conclusion

This paper carried on looking into the energetics of an electromagnetic propulsion device. The first paper[7] showed that coupling to the zero-point of the field was possible. The second paper[8] showed that work generated by the device was irreversible in a round trip; however, viewed from either reference frame of the trip,

‡ Indeed how physically can the "temperature" from the movement of the zero-point of the field modes be taken? It is homogeneous, isotropic and Lorentz invariant, no physical measurement would reveal it.

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if work W was generated, then the change in kinetic energy of the craft *and* field was (W, 0) or (0, W) respectively and so the system is relativistically invariant. This paper looked into the microscopic nature of this dissipation by showing that modes of the electromagnetic field affected by the propulsion device could move relative to others and that the average zero-point fluctuation field acts as a restoring force coupling all the modes together. The whole field would move together and no real photons would be emitted rearward to the device's forward motion.

The zero-point of the electromagnetic field is not a fiction, despite mathematical methods to remove it, such as normal ordering[12, 15]; physical phenomena exist that confirm it. Even when cancelled by the presumed negative zero-point of fermion fields[12] or an high momentum cut-off/regularisation[12] or not, the electromagnetic zero-point energy density used by the putative device, though not infinite, is exceedingly large and the totality of the field itself is vast - the size of the universe.

We found that the momenergy given to the zero-point of the few modes of the field that the device affects must thermalize and then propagate. Due not least to the enormous magnitude of the energy density of the zero-point of the field but also the vastness of the field, it acts as a practical infinite dump of momenergy. The number of states of this bosonic field is vast, the implied extreme low temperature of the average kinetic energy of the zero-point of the modes *and* the homogeneity, isotropy and Lorentz invariance of electromagnetic phenomenon, would mean that no phenomenon could discern it. The momenergy dumped to it looks unavailable, for sure – the process is not reversible and appears to be an even more insidious form of the 2nd Law.

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