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NOTES ON THE ROLE OF REACTIVE FIELD EFFECTS OF THE PARTICLE ACCELERATION TO THEIR COLLECTIVE MOTION IN PINCHED PLASMAS IN NATURE AND EXPERIMENTS

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Abstract. Reactive field due to particle acceleration is one of the most intriguing and controversial phenomena in classical mechanics and classical electrodynamics (see e.g., [1,2]). The appearance of reactive field is apparently easy to understand within a simple pictures based on the retarding fields of moving particles, and seems to be a very universal one in both sub-atomic and cosmological scales (e.g., [3]). It gives nice interpretations of the magnetic field, which turns out to be just a consequence of potential field sources in the space-time structure [4,5]. The Einstein equivalence between the mass and energy was discovered within this theory well before his work on the mass-energy equivalence (e.g., [1]). This theory is also well aligned with the zero point fluctuating field theory [6]. Unfortunately, the pragmatic success of quantum mechanics, which itself yields excellent results (we may say: too formal, i.e., without a real understanding), somehow damped the further development of this branch of physics during the previous and current centuries. In this lecture we would like to point out the relevance of reactive forces in classical electrodynamics to macroscopic systems with strong particle accelerating fields. The test case we propose here is a system consisting of a spherical shell of charged particles accelerated in radial direction in an external field (in general of arbitrary nature), which generates the stationary reactive electric field $\mathrm{E}_{\mathrm{acc}}$ that we calculate as:

$$E_{acc} = \frac{Q}{4\pi\varepsilon_0}\frac{a}{R}\frac{1}{c^2}I(\frac{r}{R}),$$

where, Q is the total charge within the spherical shell of an instant radius *R*, *a* is the acceleration, ε_0 and *c* are the vacuum permeability and the speed of the light, respectively, and $I(r/R)$ is an integral over the spherical angle, (which is finite in the range $0 < r < \infty$ with a sharp maximum of the order of unity for $r = R$). In the case of a number of *N* particles with elementary charge *e* and mass m_e (e.g., electrons), accelerated in an external electrostatic field E_{ext} the last formula yields the result $E_{acc} = N\frac{r_0}{R}E_{ext}$, where $r_0 = e^2/(4\pi\varepsilon_0 m_e c^2) = 2.8179\times10^{-15}m$ is the classical (or Compton) electron radius. This last expression could have dramatic consequences to plasma systems in nature, laboratory and fusion devices, which are characterized by enough high number of accelerated particles. Namely, the reactive acceleration can strongly compete the external electrostatic force and so could be interpreted as a kind of "electrostatic" confinement mechanism. In addition, consequences of the present approach to subatomic scales should be reinvestigated in a new consistent manner, leading to a reanimation of classical electrodynamics so as to establish the quantum theory only as a special case of the first principles of the nature.

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