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To whom it may concern on the low frequency mode of the E Coli bacteria and the COVD-19 Virus

My friend and research collaborator Yogendra Srivastava has informed me that the low frequency radiation spectra of the E Coli bacteria and the COVID-19 virus are experimentally of similar magnitudes despite the bacteria DNA strand having ~5 mega-base (pairs for the double helix) and while the virus RNA strand having only ~40 kilo base (for the single helix). The smaller size of the virus was expected on the basis of a Landau quasi-particle-hole viewpoint towards electronic one-dimensional Fermi particle hole pair dynamics yielding higher theoretical radiation spectra for the virus than for the bacteria.

Our previous error appears due to not taking into account the gauge symmetry breaking transition for electron-hole pair propagation in one spatial dimension along the helix axis. The Landau quasi particle picture beaks down at the Fermi boundary at $\pm p_F$ in momentum space and must be replaced by the current anomalies of Tomonaga, Schwinger, and Luttinger (references below). While the results are being written up in detail, I will here note the physical principles involved

With the helical axis labeled by x, let $\lambda(x,t)$ denote the electronic charge density per unit length of helix and let $I(x,t)$ denote the electronic current passing along the axis at point x. Local charge conservation in one spatial dimensions dictates that

$$\frac{\partial \lambda(x,t)}{\partial t} + \frac{\partial I(x,t)}{\partial x} = 0 . \tag{1}$$

Local charge conservation is guaranteed by introducing the electron hole pair polarization per unit length $Q(x,t)$ having physical dimensions of charge

$$\lambda(x,t) = -\frac{\partial Q(x,t)}{\partial x} \quad \text{and} \quad I(x,t) = \frac{\partial Q(x,t)}{\partial t} . \tag{2}$$

If we denote positive and negative electronic chirality as being, respectively, the direction of motion in a two-component electron wave function in one spatial dimension and employ the momentum p rate of change in an electric field E via $dp/dt = eE$, then the current will accelerate according to the chiral current anomaly equation of motion

$$\frac{\partial I(x,t)}{\partial t} - v_F^2 \frac{\partial \lambda(x,t)}{\partial x} = \left(\frac{e^2}{2\pi\hbar}\right) v_F E , \tag{3}$$

wherein the Fermi electron velocity is v_F. Finally, we are not here considering charge external to the one-dimensional polarization so that the Maxwell displacement field in Gaussian units vanishes $\mathbf{D} = \mathbf{E} + 4\pi\mathbf{P} = 0$; i.e.

$$E(x,t) + 4\pi \frac{Q(x,t)}{S} = 0\ , \tag{4}$$

wherein S is an effective area for the helix. From Eqs.(1)-(4) we deduce that the electric field along a long linear section of coil obeys

$$\left[\frac{1}{v_F^2}\left(\frac{\partial}{\partial t}\right)^2 - \left(\frac{\partial}{\partial x}\right)^2 + \left(\frac{2e^2}{\hbar v_F S}\right)\right] E(x,t) = 0\ . \tag{5}$$

Eq.(5) a longitudinal massive electric field Boson with a low plasma resonant frequency

$$\omega_\infty{}^2 = 2\left(\frac{e^2}{\hbar c}\right)\left(\frac{v_F}{c}\right)\left(\frac{c^2}{S}\right) \tag{6}$$

independent of the helix length provided that length is long. Associated with a photon mass is a break in gauge symmetry and the entrance of magnetic flux through the helix coil with a transverse field when the electron path is embedded in three-dimensional space.

$$\Phi = \oint \mathbf{A}\cdot d\mathbf{r} = \iint \mathbf{B}\cdot d^2\mathbf{r}$$

wherein the vector potential is **A** and the helix coil is slowly spatially "folded". When the magnetic field energy density $B^2/8\pi$ is added to the electric field energy density $E^2/8\pi$, the resonant photon frequency is considerably lowered since the coil inductance has to be considered along with the kinetic inductance included above Tomonaga- Schwinger-Luttinger model.

References

1. S. Tomonaga, *Prog. Theoret. Phys.* **5**, 544 (1950).
2. J. Schwinger, *Phys. Rev.* **82**, 664 (1951).
3. J.M. Luttinger, *J. Math. Phys.* **4**, 1154 (1963).

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