Coronavirus Disinfection by UVC from Nanoparticles

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1. Abstract

Classical physics allows the atom to have heat capacity at the nanoscale, the conservation of heat proceeding by a change in temperature. However, simple QED based on the Planck law of quantum mechanics denies the atom in nanostructures the heat capacity to conserve heat by a change in temperature, the consequence of which is any heat is conserved by creating standing EM radiation that is released to the surroundings. Unlike electronic quantum states, simple QED is based on size dependent quantum states depending on the dimensions of the nanostructure over which the EM waves stand. UVC radiation is known to disinfect Coronavirus in the air or on surrounding surfaces, but not inside body organs. In this regard, patients diagnosed positive for Covid-19 are proposed disinfected by a single injection of $\sim$ 80 nm lipid nanoparticles that emit UVC radiation powered only by body heat. In the blood stream, the NPs may enter the brain and damage neurons and DNA, but brief NP treatments the risk of brain damage is expected to be minimal. CDC testing to determine acceptable NP doses is required.

Keywords: Covid-19, Quantum Mechanics, Planck law, Nanoparticles.

2. Introduction

The disinfection of viruses by UV radiation [1] has a long history. In 1877, microorganisms in test tubes containing Pasteur's solution, an artificial nutrient fluid for cultivating organisms, upon exposure to sunlight prevented [2] the growth of the organisms for several months. About the same time, Tyndall confirmed [3] sunlight neutralized organisms dependent on intensity, duration, and wavelength, with the UV wavelengths of the solar spectrum being the most effective. However, the specific UV wavelengths of organism disinfection of about 260 nm were not identified [4] until 1944. Thereafter, the production of pyrimidine dimers in DNA that block virus reproduction was demonstrated after exposure to UV radiation, thereby providing the basis for UV disinfection of biological systems.

In 2020, UV disinfection of viruses became of great importance. The Coronavirus known as Covid-19 became a pandemic that changed the economic future of the world, although in severity only comparable to influenza. Nevertheless, there is no vaccine or specific treatment known for Covid-19. In this regard, Coronavirus disinfection by external UV radiation sources would resolve the pandemic research, but only if the virus is still in the air or on the surface of surroundings.

In the usual Covid-19 infection, the virus has infected the blood stream and internal organs. External UV radiation no longer works, but no source of UV radiation is known within the human body.

Recently, the proposal [5] was made to use nanoparticles (NPs) to attach to the virus in combination with IR light to cause a structural change that stops the ability of the virus to survive and reproduce. However, the structural change necessary to produce UV radiation to disinfect the Coronavirus is not identified.

3. Purpose

The purpose of this paper is to present the simple QED theory [6] of nanoscale heat transfer to explain how NPs can produce UV radiation within the human body to disinfect the Covid-19 virus. Developed over the past decade, simple QED can be implemented in vaccinations or specific treatments without long FDA approval.

However, UV radiation may also damage brain neurons and DNA, but may be justified in the brief time necessary to disinfect the Coronavirus. The UVC radiation emitted from lipid NPs powered by heat in blood and tissue at normal body temperature illustrates the ease at which Covid-19 is disinfected as shown in Fig. 1.

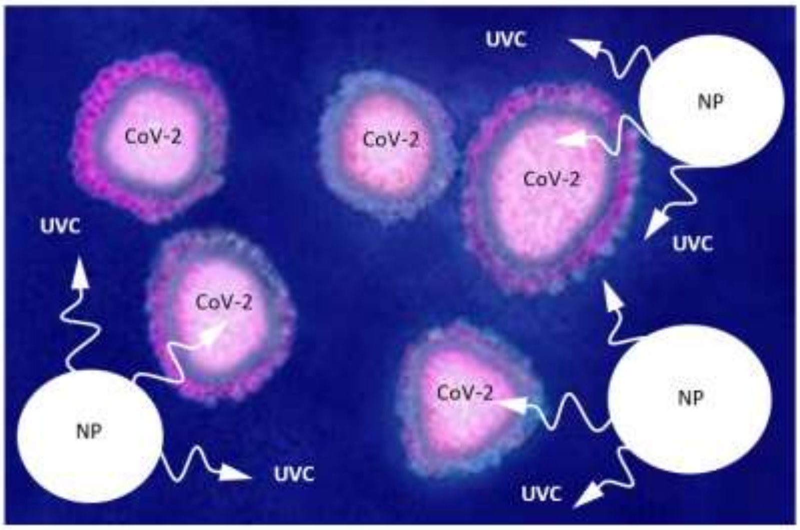

Figure 1. UVC disinfection of Covid-19 by nanoparticles

4. Background

Simple QED is a nanoscale heat transfer process based on the Planck law [7] of quantum mechanics (QM) differing significantly from that of classical physics. Research in nanoscale heat transfer [8-10] has advanced over the past decades, and a large number of interesting phenomena have been reported. But despite the advances in nanotechnology, there are still challenges existing in understanding the mechanism of nanoscale thermal transport. Perhaps, researchers have not appreciated the significant difference between classical physics and the Planck law with regard to the heat capacity of the atom without which nanoscale heat transfer cannot proceed.

In this regard, the Planck law denies atoms in nanostructures the heat capacity to change temperature upon the absorption of heat - a difficult notion to accept because of training in classical physics. Heat transfer without changes in temperature preclude the Fourier law of heat conduction commonly used in nanoscale heat transfer. Similarly, the Stefan-Boltzmann law for radiative heat transfer depending on temperature is not applicable to nanostructures. Although valid at the macroscale, the Fourier law and Stefan-Boltzmann equation are invalid at the nanoscale. Molecular Dynamics (MD) simulations [11] based on classical physics thought to provide an understanding of the atomic response to thermal disturbances assume atoms in nanostructures have temperature. Although MD is valid for periodic boundary conditions, extension to discrete nanostructures is not. Researchers need both new theory and computational procedures to be developed to understand nanoscale heat transfer.

Simple QED is a method of nanoscale heat transfer analysis that conserves heat with EM radiation instead of temperature. QED stands for quantum electrodynamics, a complex theory based on virtual photons advanced by Feynman [12] and others. In contrast, simple QED is a far simpler theory based on the Planck law that requires the heat capacity of the atoms in nanostructures to vanish allowing conservation to proceed by the creation of real photons comprising EM waves that stand within and across the nanostructure. Unlike electron level quantum states, simple QED quantum states are size dependent based on the dimension of the nanostructure over which the EM waves stand.

By classical physics, the kT heat capacity of the atom is independent of the EM confinement wavelength λ, where k is the Boltzmann constant and T absolute temperature. QM differs as the heat capacity of the atom decreases under EM confinement λ < 100 microns, and at the nanoscale for λ < 100 nm, the heat capacity may be said to vanish. The Planck law at 300 K is illustrated in Fig. 2.

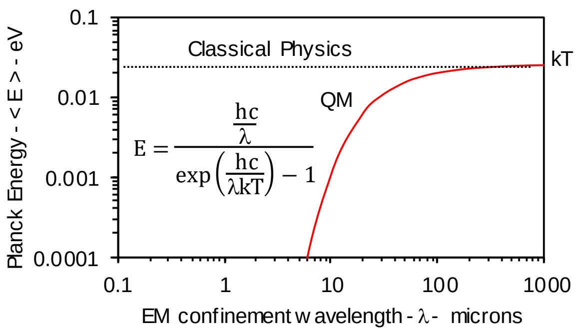

Figure. 2: Planck law of the Atom at 300 °K
In the inset, E is Planck energy, h Planck's constant, c light speed, k Boltzmann's constant, T temperature, and λ the EM confinement wavelength

EM confinement occurs by the high surface-to-volume (S/V) ratio of nanostructures that requires the heat Q to almost totally be confined in the surface, the surface heat itself as EM energy providing the brief EM confinement necessary to create EM waves standing across the internal dimension d of the nanostructure. For heat (or light) having wavelength λ < d, the absorption occurs over the incident face of the particle. However, for small particles d << λ , the light fully immerses the particle to be absorbed uniformly over the full surface. Fig. 3 illustrates λ >> d with light - yellow- immersing the NP and absorbed in penetration depth δ over the full NP surface.

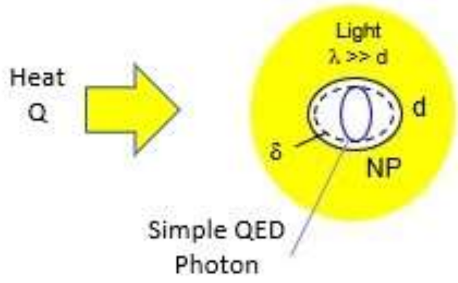

Figure 3. Heat Q (or light) absorbed in full NP surface

Confinement of the light Q while creating the UVC standing wave requires EM confinement at least equal to the Planck energy E of the light. The pressure P acting on the surface is given for bulk modulus B and volume strain $\Delta V/V$ by, $P = B\cdot\Delta V/V = 6\cdot\delta\cdot B/d$. But $P = E / V = 6E/\pi d^3$ giving $\delta = Q/\pi Bd^2$. For an 80 nm NP with bulk modulus $B \sim 2x10^9$ N/m^2, the absorption depth δ of a single UVC photon is $\delta \sim 20$ fm - a small but necessary depth to confine the absorbed heat Q = E to the geometry of the standing wave.

Simple QED absorbs heat Q in the NP surface given by the penetration δ depth. Unable to conserve the surface heat by a change in temperature, conservation requires the creation of simple QED radiation, the time τ to create the standing wave, $\tau = 2d/(c/n)$. The Planck energy $E \sim h/\tau = hc/2nd$ depends on the refractive index n of the NP to correct for the velocity c of light within the NP. The simple QED Planck energy E is quantized by the dimension d of the NP that defines the half-wavelength $\lambda/2$ of the nanostructure. Fig. 4 illustrates the standing EM radiation in a spherical NP of diameter d, but NP atoms still follow their quantized electron energy levels.

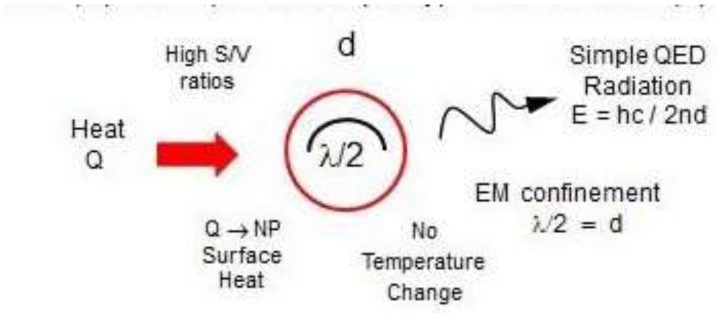

Figure. 4: Planck Energy of EM Radiation

In a rectangular NP with different dimensions of width, thickness, and length there are 3 simple QED quantum states corresponding to the different dimensions of the NP. However, only the minimum dimension is important as by Fermat's principle, the absorbed heat is dissipated in minimum time. Continuous variation in internal nanostructure dimensions produces a broadband spectrum of simple QED dissipated in continuous QED quantum states. Historically, the notion of size dependent quantum states is not found in the literature.

5. Analysis

The simple QED analysis of the thermal response of a single lipid NP in a thermal bath of tissue and blood is illustrated in Fig. 5.

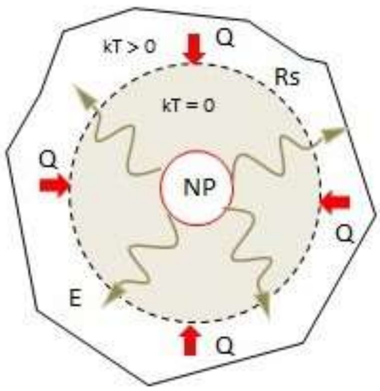

Figure. 5: NP in a Thermal Bath

The NP absorbs heat Q from the thermal bath at absolute temperature T by conduction. Fig. 2 shows Fourier's heat conduction equation at 300 K is only valid in the bath for kT = 0.0254 eV. The radius Rs at which bath atoms at have thermal kT energy is $\lambda > 200$ microns. 1. For body tissue and water having refractive index n = 1.4, the radius Rs = λ/4n ~ 36 μm. What this means is the heat flow Q from the bath at temperature T is converted at Rs to EM radiation in the far IR (λ = 200 microns) and upon being absorbed at by the NP is conserved by emitting simple QED radiation. Small temperature changes occur for R < 10 microns, but clearly vanish for NPs < 100 nm.

Classically, all atoms in the NP at equilibrium have temperature T equal to the bath temperature. In terms of the Boltzmann constant k and the number N of atoms, the total LNP thermal energy U is,

$$U = \frac{3}{2} NkT$$

However, by the Planck law the N atoms do not have kT energy. Instead, simple QED conserves the energy U that otherwise would occupy the 80 nm LNP by creating standing EM radiation across the NP diameter d as shown in Fig. 4.

The molecular weight of the lipid meibomian C44H56O2 is 616 and the number Nm of molecules is, Nm = (ρV/616)·Av, where volume V = $\pi d^3/6 = 2.68 \times 10^{-22}$ m^3, density ρ = 1000 kg/m^3 and Avagadro's number Av = 6.023 x 10^{26} mols/kg-mol. Hence, Nm = 2.62×10^5 and N = 102 Nm = 26.7 million atoms $\rightarrow$ U ~ 1 MeV. For E = hc/λ at λ = 254 nm, E ~ 4.88 eV and the lipid NP creates about 200,000 UVC photons equilibrating with the 300 °K thermal bath temperature. Once created, the emitted UVC photons are absorbed by the Covid-19 virus or water bath, the bath temperature T once again produces the number of ~ 200,000 UVC photons repetitively.

But how rapidly does the NP surface temperature recover?

The simple QED creation of UVC having Planck energy E = 4.88 eV absorbing a pulse of heat from the water changing the temperature ΔT given [14] by,

$$\Delta T = \frac{1.2}{\pi d^2 K}\left(\frac{E}{\Delta t}\right)\sqrt{\frac{\alpha}{\pi}}\left[\sqrt{t+\Delta t}-\sqrt{t}\right]$$

The Planck energy E is spread over the spherical surface area πRs^2. The pulse duration is $\Delta t = 2d / (c /n) \sim 0.85$ fs. The UVC heat $Q = E/\Delta t \sim 900\ \mu W$. For water, thermal diffusivity $\alpha = K/\rho C$, where $\alpha = 1.24 \times 10\text{-}7\ m^2/s$ and K = 0.52 W/m-K. Fig. 6 shows the initial drop in temperature ΔT to be an imperceptible ~ 2 μ°C that recovers in < 1 ps.

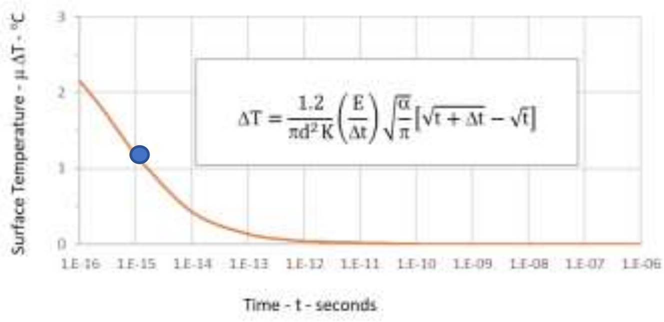

Figure. 6: Single Photon Creation Time

However, the UVC photon must be created promptly, say < 5 fs as noted by the blue circle. What this means is the UVC photon cannot be created from body temperature surroundings. Much higher bath temperatures are required. To create the UVC photon, the required temperature T = E/1.5k ~ 37,000 °K. But high temperatures are not necessary for NPs under high EM confinement. Indeed, once the heat Q is absorbed in the penetration depth δ = 20 fm of the NP, the creation time τ of the UVC photon $\tau = 2d/(c/n)$ ~ 0.85 fs < 5 fs < 5 fs and acceptable.

6. Conclusions

In simple QED, the Planck law allows the lipid NPs to produce UVC radiation that disinfects the Covid-19 from the heat at body temperature, a significant difference with classical physics that predicts the lipid NP only acquires the temperature of the bath.

With regard to Covid-19 disinfection treatments, simple QED produces UVC from lipid NPs using only the thermal energy of the surrounding blood and tissue.

In the manner of an *in vivo* Covid-19 vaccine, the NP treatment of UVC disinfection kills the live virus to produce the inactivated virus that acts as the antigen to elicit immunity to subsequent Covid-19 infection.

The FDA is recommended to approve UVC disinfection of Covid-19 in vaccinations of ~ 80 nm lipid NPs in small quantities. In the blood stream, the disinfection would be rapid. But any NPs entering the brain may damage neurons and DNA. Nevertheless, for patients in a life-threatening condition, the attendant brain damage would appear justified.

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