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THz Rabi Frequency Oscillation for Human Consciousness/Sub-consciousness Detection Probe Use

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Human sub-consciousness information has been the interesting aspect of research and investigation because many convincing challenges remain. We believe that there must be connected information between brain signals and sub-consciousness states, which may be involved and represented during the transition states and useful for A Brain–Computer Interface (BCI) [1]. BCI is often called a mind-machine interface, or sometimes called a direct neural interface or a brain–machine interface, which is a direct communication pathway between the brain and an external device. BCIs are often directed at assisting, augmenting, or repairing human cognitive or sensory-motor functions. Moreover, the use of BCIs can also be useful for humanoid robot applications [2-4]. Till date, humanoid robot has been recognized as the best robotic type in robotic technology, which can be functioned closely to human activities. Such a robotic type requires many components and related technologies for realistic applications, where the main part of such robotic type components is the brain communication and commands. To obtain the realistic robotic brain and its functions, the brains signal and communications are required to manipulate, pattern and test, therefore, the searching of realized technique for brain signal monitoring and encoding remains. Basically, terahertz (THz) pulse generated by laser is the only one that can be used to probe and connect to the brain signals without damage [5-7]. The brain signals can be modulated and demodulated by light via the THz carrier, where in this case the THz Rabi frequency is formed by wave-particle duality of light within the microring resonator [8,9], in which the light probe can be generated by the particle (photon) under the Cerenkov radiation [10,11]. Cerenkov radiation has become the interesting phenomenon which can be occurred in many aspects of natural behaviors, where in this study, a model of space-time paradox concept is proposed to describe the consciousness|sub-consciousness paradox, where the connection between light probe and brain signal can be formed and the mind and mater interfacing information described, which is useful for possible mind and dream investigations. The uncertainty of the paradox pair is also involved and discussed. To form the coupling output of synapse and THz light signals.

The Rabi frequency is the frequency of oscillation for a given atomic transition in a given light field [12-14]. It is associated with the strength of the coupling between light and the transition. Rabi flopping between the levels of a 2-level system illuminated with resonant light, which will be occurred at the Rabi frequency. The Rabi frequency is a semi-classical concept as it is based on a quantum atomic transition and a classical light field. In this study the synapse signal within the human brain is modeled as an electrical pulse, which can be coupled and modulated into the micro-optical circuit by the THz light probe, in which the reflected signals are obtained via the signal direct detection or the drop port output signals, in which the different synapses and signals can be distinguished by using the filtering devices, where the variables such as wavelengths (frequencies), signal amplitudes and signal forms can be investigated. The use of the proposed concept for brain signal monitoring and encoding, sub-consciousness investigation, and human ad hoc networks is modeled and discussed.

In principle, the THz Cerenkov light probe within the system in Figure 1 can be formed and generated by using the nonlinear Schrodinger equation of photon travelling within the system, which is given by Eq. (1), where more details are given by [12].

$$\frac{1}{A}\frac{dA}{dZ} = -\frac{\alpha}{2} - \left(\frac{\beta}{2} - i\gamma\right)|A|^2 - \left(\frac{\xi_r}{2} + i\xi_i\right)|A|^4, \quad (1)$$

Where $E(\mathbf{r}) \approx E(z) = \varpi A(z) e^{i\beta_0 z}$, $\varpi = (\mu_0/\varepsilon_0)^{1/4}(2n_0)^{1/2}$. μ_0 and ε_0 are the permeability and permittivity in vacuum, respectively. n_0 is the linear refractive index, $\beta_0 = n_0 k$ is the propagation constant with $k = \omega/c$, c is the speed of light in vacuum and $A(z)$ is the complex amplitude ($|A|^2$ is the intensity, I). The parameters ξ_r and ξ_i account for free-carrier effects. The parameters entering Eq. (1) are as follows:α and $\gamma=kn_2$ are the linear loss and the Kerr effect constants, where k and n_2 are the wave number and nonlinear refractive index. The solution of Eq. (1) is given by $A(z) = \sqrt{I(z)}\exp[i\phi(z)]$. Then the electric fields on both sides of the point coupler satisfy the following relations.

In simulation, the above calculation was carried out for an silicon ring resonator with radius $R_1=R_2=5$ μm, wavelength, λ=1.55 μm, device length L=10 μm, linear refractive index, $n_0=3.484$, a two-photon

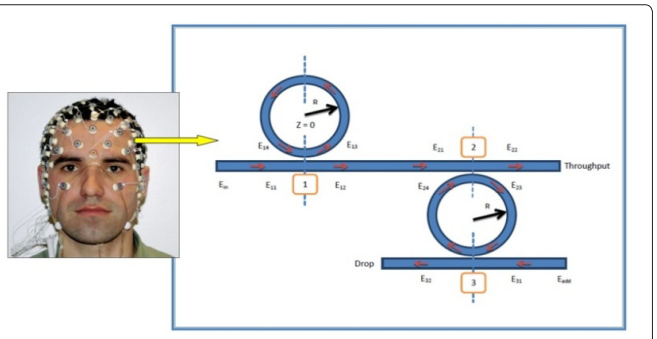

Figure 1: The proposed Rabi oscillation system, where E_i: optical fields, R: ring radius, Drop: drop port, E_{dd}: add port, Throughput: throughput port; 1, 2, 3: coupling coefficients (r) at points 1, 2 and 3 [15].

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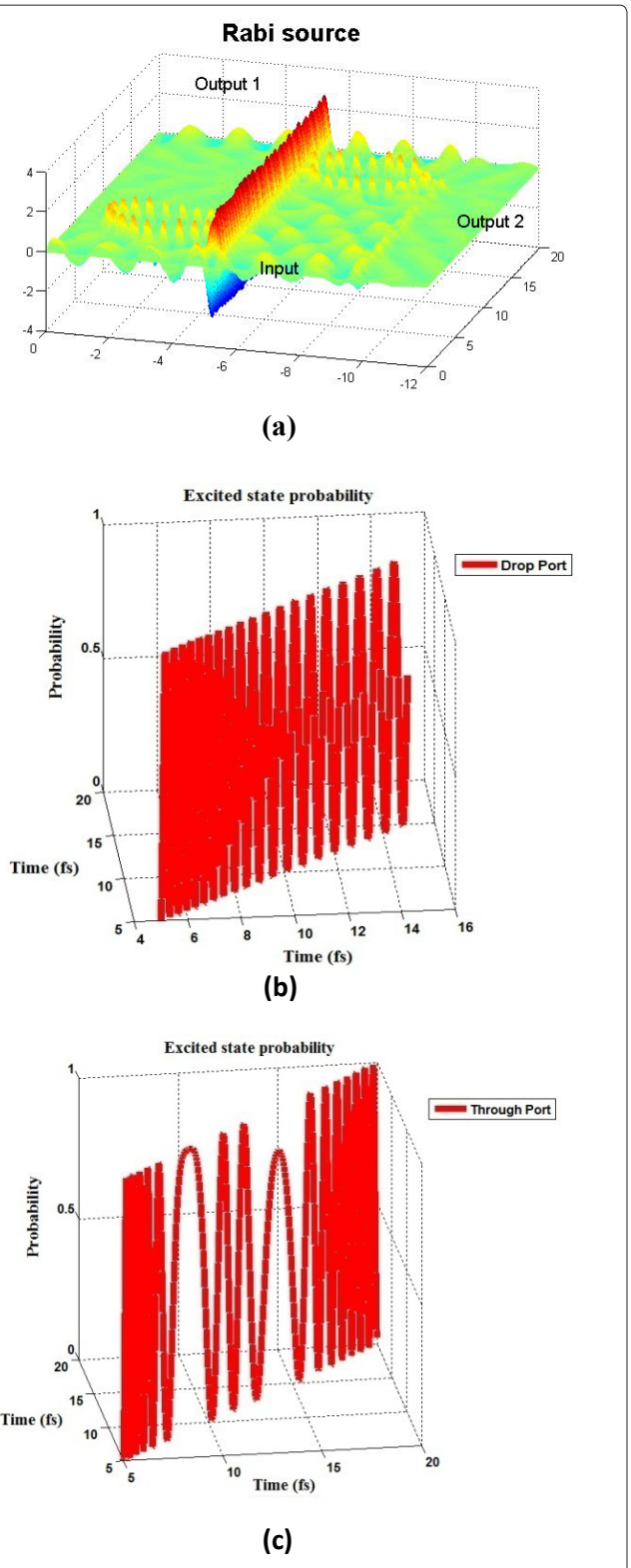

Figure 2: Rabi probability oscillation results (a) results obtained by Opti-wave program, (b) and (c) the two dimension plots of Drop and Through (put) port signals with time in fs.

absorption constant, β=0.5 cm $(GW)^{-1}$, linear loss coefficient, α=1 $dB(cm)^{-1}$. Free carrier life time, τ=1 ns. Nonlinear refractive index $n_2=6\times10^{-5}$ cm^2 $(GW)^{-1}$. Fractional power remaining in the straight waveguide after the coupler, i.e. coupling coefficients are $r_1=0.5$ and $r_2=r_3=0.2$. In applications, after light is input into the system at input port, the light probe is generated and accelerated [8] as shown in Figure 2. The monitoring signals can be detected via the Through (Output 1) and Drop ports (Output 2), respectively. The change in phase of light (particle) can be introduced the change in device output intensities, which can be used to monitor and measure the required physical parameters, especially, within conscious or sub-conscious states, where the link parameters can be seen and interpreted via the drop and through ports. Figure 2 shows the Rabi probability oscillation results, where (a) result is obtained by Opti-wave program, (b) and (c) are the two dimension plots of Drop and through (put) port signals.

Figure 3 shows the Rabi probability oscillation results, where two dimension plots of (a) Drop and (b) Through (put) port signals are as shown. The change in Rabi frequency oscillation in the THz scale

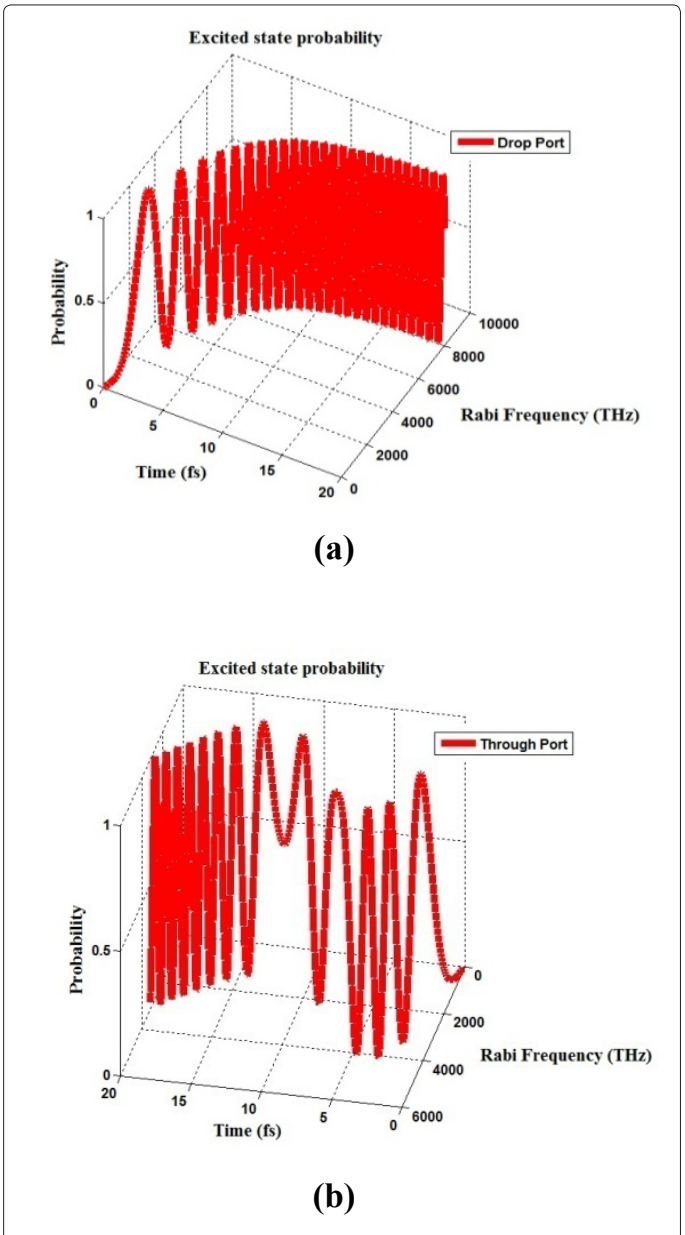

Figure 3: Rabi probability oscillation results where two dimension plots of (a) Drop and (b) Through (put) port signals with frequency in THz.

can be configured to be the relationship between the applied physical parameters and the shift in phase (frequency or time), especially, brain signals and the shift in frequency.

In conclusion, the use of wave-particle duality of light propagation within a micro-optical system is modeled and proposed. The Cerenkov radiation frequency band can be generated and used for sub-consciousness state detection, which can be used to form the measurement and to connect the BCI usage. Moreover, such a proposed technique may be useful for many investigations of human dream and sub-consciousness related activities, which is freely in time due to the Cerenkov radiation. This means that the speed of the particle is greater than the particle group velocity within the interested medium. In this case, the measurement probe is in the gap between shock wave induced by Cerenkov radiation, where the connection between probe and brain signals are within the same Cerenkov radiation situation, in which the measurement can be formed.

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