Mathematical Physics

Classical Optics

We observed that the linear dielectrics and magnetic materials in matter obey a special kind of mathematical property known as Cesàro convergence. Then, we also showed that the analytical continuation of permittivity and permeability to the complex plane in terms of the Riemann zeta (ζ) function. The nontrivial zeros on the half-line of the Riemann zeta (ζ) function correspond to permittivity $\xi_e = 0$ and permeability $\xi_m = 0$. The permittivity $\xi_e = 0$ and permeability $\xi_m = 0$ in the literature are known as zero index materials.

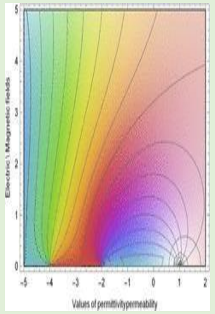
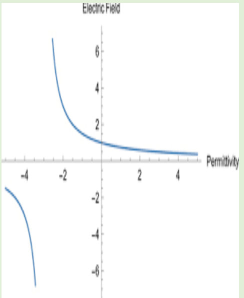
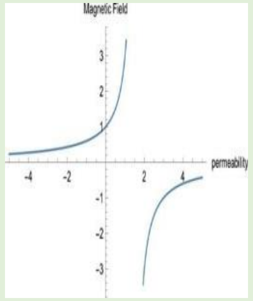


Fig1: In terms of the Riemann zeta function

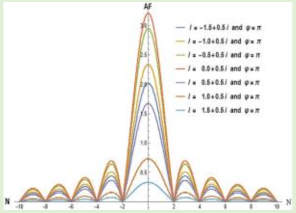


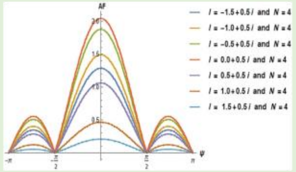
when E_0=1

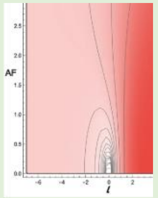


when B_0=1

we study Multiple slit diffraction and n- array linear antennae in negative refractive index material. We show that the evanescent wave plays a vital role in the near-field term. The evanescent wave grows significantly, unlike in conventional materials, and satisfies a novel kind of convergence known as Cesàro convergence. We calculate the intensity of multiple slits and the antenna's amplification factor (AF) in terms of the Riemann zeta function. We further demonstrate that the Riemann zeta function gives rise to additional nulls. We deduce that all the diffraction scenarios in which the traveling wave satisfies the geometric series in the medium of the positive refractive index will enhance the evanescent wave, which satisfies Cesàro convergence in the medium of the negative refractive index.

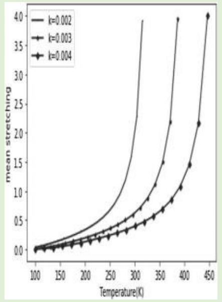




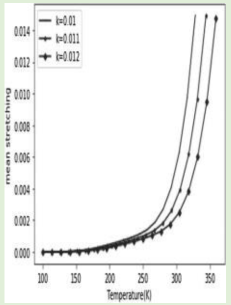


DNA Mutation

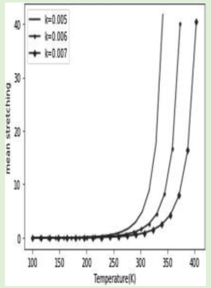
We investigated the deoxyribonucleic acid (DNA) denaturation through statistical mechanics and demonstrates that the exceptional polynomials lead to DNA mutation. A DNA model with two chains connected by the Morse potential representing the H bonds is considered and the partition function for this model is computed. The partition function is converted into a Schrödinger-like equation. The techniques of SUSY quantum mechanics are used to model the DNA mutation. The thermal denaturation of DNA for each mutated state is also computed.



Variation of ⟨*y*⟩ as a function of temperature for three values of coupling constant *K*.



Variation of ⟨*y*⟩ as a function of temperature for three values of coupling constant *K*.



Variation of ⟨*y*⟩ as a function of temperature

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