On the U(1) gauge potential decomposition in geometrical optics

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We propose to apply $U(1)$ gauge potential decomposition in geometrical optics.

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The gauge potential, A_μ, has two sides i.e. global and local[1]. The local side of the gauge potential can be written as $\vec{B} = \vec{\nabla} \times \vec{A}$ and the global side can be written as $\Phi = \oint A_\mu \; dx^\mu$[1]. So, is it possible to decompose the gauge potential, A_μ?[1] The idea of decomposition is[1]

$$\vec{A_\mu} = \Gamma_\mu + b_\mu \tag{1}$$

where Γ_μ is global variables (e.g. topology) and b_μ is local variables (e.g. gauge invariant quantity, observables).

The $U(1)$ gauge potential decomposition had been formulated[2] and we treated the geometrical optics as the $U(1)$ gauge field theory[3].

We propose to apply the $U(1)$ gauge ppotential decomposition in the geometrical optics. To the best of our knowledge, the application of the $U(1)$ gauge potential decomposition in the geometrical optics have not been done[2,4,5].

The $U(1)$ gauge potential in the geometrical optics is[3]

$$\vec{A_\mu} = \vec{a}_\mu \; e^{i \int n \; dr} \tag{2}$$

where $\vec{a}_\mu$ is the amplitude, n is the refractive index, a number.

Roughly speaking, by substituting eq.(1) into eq.(3), we obtain

$$\Gamma_\mu + b_\mu = \vec{a}_\mu \; e^{i \int n \; dr} \tag{3}$$

What is the consequence of the decomposition of the gauge potential to the amplitude and the refractive index?

The work is still in progress.

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