**The Field Combination Mechanism of Photon “Solidification”: Light Speed Control and Static Optical Soliton Formation Based on ABC Theory**

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**Abstract:**  
Based on Li Zhijun’s ABC field combination theory, this paper proposes a theoretical scheme to reduce the speed of photons to zero in a specific control environment. The core argument is that the speed of light in vacuum is not an intrinsic property of photons, but rather the phase velocity exhibited when they, as excited quanta of the A-field (electromagnetic vortex field), propagate in the undisturbed background of the C-field (Higgs field) at the lowest energy state. By drastically altering the local C-field and B-field background along the photon’s propagation path, the resonance conditions for their propagation can be disrupted, forcing the photon’s energy and momentum to become completely localized, forming a static “optical soliton” or “photon Bose-Einstein condensate (BEC)”. Starting from the dynamical equations of ABC field coupling, this paper deduces the conditions required to achieve photon stasis and predicts observable experimental features.

**Keywords:** ABC Field Theory; Light Speed Control; Photon Solidification; Static Optical Soliton; Bose-Einstein Condensation; Field Combination Control

1. **Introduction: Light Speed as an Emergent Property of the Field Background**

In ABC theory, a photon state can be described as:

where is a transverse excitation with wavenumber and angular frequency , is a color singlet (no color charge), and is the ground state coupled to the vacuum expectation value. Its propagation speed is determined by the wave equation of the A-field in the background of the C-field.

The speed of light in vacuum, , corresponds to the propagation speed when the C-field is in its ground state . Any operation that changes the local state of the C-field will alter the effective propagation speed of the photon. “Solidifying” the photon, i.e., setting the group velocity , requires creating an environment where all kinetic energy components of the photon cannot propagate.

1. **Theoretical Model: Achieving Zero Light Speed through Field Combination Control**

**2.1 Disrupting Phase Matching: Introducing a Strongly Dispersive C-field Background**

Photon propagation requires maintaining phase consistency . To achieve “solidification”, it is necessary to introduce an extremely strong dispersion relation that causes the wavenumber to tend towards infinity, thus making the group velocity .

This can be achieved by creating a C-field background on the photon’s path that interacts strongly with the photon. Consider a C-field excited state that resonates with the photon’s frequency; its equivalent potential energy is extremely large. At this point, the effective propagation equation for the photon becomes:

where is the effective mass of the photon (no longer zero under strong interaction), and is the wave function of the photon. When the depth and shape of the potential energy meet specific conditions, eigenstates form where the photon is bound in a local potential well, and its energy levels are discrete. At this point, the photon lacks a continuous energy-momentum dispersion relation , its wave function is a static standing wave, and the group velocity is zero.

Specific Physical Implementation Schemes:  
1. Using Ultracold Atomic Clouds: Cool atoms to a Bose-Einstein condensate (BEC) state, whose collective excitations equate to a highly controllable C-field background. By adjusting atomic density and internal states, an electromagnetically induced transparent (EIT) medium can be created that exhibits extremely strong dispersion (even generating an effective photon mass) for photons of a specific frequency.  
2. Using Photonic Crystals: The periodic structure of photonic crystals can create photonic band gaps. At the edges of these band gaps, the group velocity of photons can drop sharply to near zero. In ABC theory, this corresponds to the C-field background being modulated by an artificial structure (atomic lattice), producing a band structure that prohibits photon propagation.

**2.2 Inducing Topological Confinement: Utilizing the B-field to Produce Photon Confinement**

Although photons are color singlets, they can be coupled to a virtual color charge field (B-field) through nonlinear optical processes.

Consider a medium with strong nonlinear effects (such as a topological insulator or specific metamaterial). When a high-intensity laser beam (photon flow) is incident, its powerful electromagnetic field (A-field) can instantaneously polarize the background B-field, generating a virtual “color charge” distribution. This distribution may possess non-trivial topological structures, such as forming an “optical vortex” or “topological defect”.

This defect can exert an effective topological confinement potential on the incident photon, analogous to the confinement of quarks by the flux tube in chromodynamics. In this scenario, the photon’s wave function is localized at the core of the defect, its energy cannot propagate as a traveling wave, and it can only exist as a static vortex state, i.e., it is “solidified” within the topological defect.

Mathematical Description:  
This process can be described by a nonlinear ABC coupling equation:

where is a nonlinear current that is a function of the A-field, the B-field connection , and the C-field . Under strong fields, this equation allows for soliton solutions, i.e., (a static solution independent of time), which corresponds to the solidification of the photon.

1. **Expected Properties and Detection of “Solidified” Photons**

Once a photon is successfully “solidified”, it will exhibit entirely new properties:

1. Static Energy Localization: The “optical soliton” is stationary in space, and its energy density distribution does not change over time, resembling a “pinned” point of light.
2. Loss of Coherence: Due to the lack of propagation, its phase information may be severely perturbed by the background field, exhibiting decoherence characteristics.
3. Strong Interaction with Matter: The stationary photon field will undergo continuous and intense interactions with the surrounding C-field and B-field background, potentially inducing local matter phase transitions, such as generating local superconductivity or magnetic order.
4. Detection Methods: Ultra-precise near-field optical microscopy (e.g., SNOM) can be used to detect its static electromagnetic field distribution. After turning off the confinement field, if the “solidified” photon thaws, it will release a pulse. By measuring the delay and energy of this pulse, its state during confinement can be inferred.

**4.Conclusion**

Based on ABC field combination theory, this paper demonstrates the theoretical feasibility of reducing the speed of light to zero and achieving photon “solidification” by actively manipulating the C-field and B-field background along the photon’s propagation path to disrupt the resonance conditions for free propagation. This does not change the intrinsic properties of the photon but rather alters the physical “rules of the stage” on which it exists. This scheme provides revolutionary theoretical guidance for preparing and manipulating static optical fields in the laboratory and studying the ultimate interaction between light and matter.

In summary, within the framework of ABC field theory, the “solidification” of a photon is a phase transition process achieved through background field engineering, transitioning it from a traveling wave state (propagation state) to a static soliton state (localized state).

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