Section 2: The Phase Background and Phase Vortices

2.1 The Phase Background:

- **Definition:** At the core of the Geometric Theory of Phase (GPT) lies the Phase Background. It is neither "emptiness" nor a classical "ether." Instead, it is a universal, global field characterized by an equilibrium phase tension (T_0). This background is passive in the sense that it possesses no intrinsic energy source, yet it is dynamic in its capacity to transmit perturbations. The formulation of the background as a dynamic state of subcritical phase fluctuations naturally arises from the theory's basic principles and does not necessitate the introduction of new entities. It is a state where parameters are non-zero but below the threshold required to form any stable particle structure. Perturbations within this background propagate at the speed of light (c) in all directions.
- **Nature:** The background consists of a continuous "sea" of subcritical phase fluctuations ($\delta\phi$). The local energy or tension of these fluctuations is below the critical threshold ($T_{critical}$) necessary for self-organization into stable particles (phase vortices). These fluctuations themselves could be the source of the observed thermal background radiation (e.g., Infrared/Cosmic Microwave Background). Any local energy input, however small, disrupts the background's equilibrium, causing a redistribution in the form of phase waves or, if the energy threshold is met, stable vortices.
- **Properties:**
  - **Passivity:** The background does not actively generate forces on its own but rather serves as a medium for the transmission of phase perturbations. It doesn't resist changes actively; it merely conveys them through wave-like forms.
  - **Conductivity:** Any local disturbances (where local tension $T > T_0$) propagate through the background as phase waves at the speed of light (c). In a linear approximation, this behavior is described by the wave equation $\Box(\delta T) = 0$, where $\Box$ is the D'Alembert operator. The speed c is determined by the background's intrinsic properties, conceptually analogous to permittivity and permeability: $c^2 = 1/(\epsilon_{phase}\mu_{phase})$.
  - **Criticality:** A critical threshold of phase tension, $T_{critical}$, exists. When local phase tension T exceeds $T_{critical}$, the background can locally transition into a state of matter, forming stable phase vortices. For the quiescent background, $T_0 < T_{critical}$.
- **Role:** The phase background serves a dual role: it is the "material" from which particles are "condensed" and the "medium" through which interactions (as waves of phase tension or flow) are propagated. Time and space are considered parameters for integrating phase motion rather than external, pre-existing coordinates.

2.2 Phase Vortices as Quanta of Matter:

- **Definition:** Elementary particles, and potentially more complex structures, are understood in GPT as stable, localized, self-sustaining vortex configurations of the phase field. These are not classical point-like particles but rather closed phase loops capable of maintaining a stable trajectory within the passive background due to their intrinsic coiled tension.
- **Formation:** Vortices "condense" from the background when the local phase tension surpasses the critical threshold ($T > T_{critical}$). This process is driven by the tendency to minimize the local phase energy functional, F.
- **Structure:** The fundamental vortex is a closed (in phase), light-like trajectory. The stability and inherent properties of a vortex are dictated by its topology (the manner of its closure and "twist") and its geometry (such as its characteristic radius R and the distribution of tension within it). The radius of a particle in GPT is a physical dimension of the vortex, determined by the minimal configuration capable of sustaining the internal phase tension. This leads to predictions of a minimum radius for stable particles and an inverse relationship between mass and radius.