The Convergence Force: A Universal Field for Energy Preservation in Matter Propagation

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Abstract

In quantum physics, particles propagate with wave-like behavior but always reappear as localized entities upon detection. We propose that this consistency arises from a new physical interaction: the **Convergence Force**. This force, mediated by a scalar field $\Phi(x^\mu)$, preserves the energy integrity of particles during motion, preventing dissipation and ensuring reconvergence. We extend this model beyond electrons to include protons, suggesting a universal mechanism that maintains particle identity across all scales of matter.

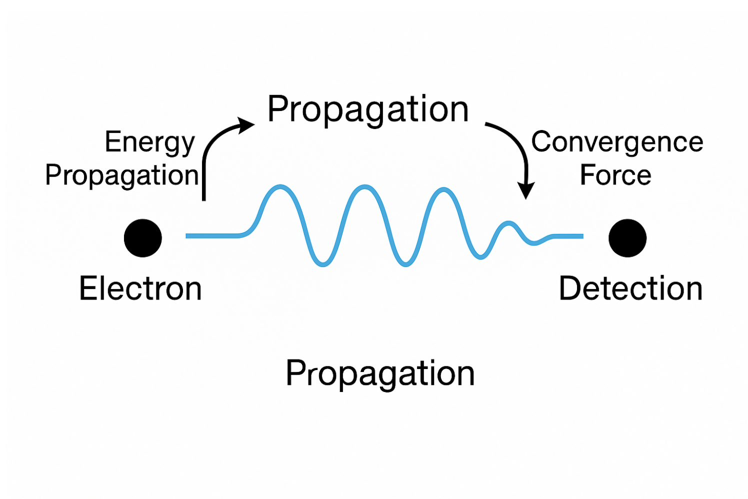

Figure 1: Conceptual illustration of the Convergence Force field Φ guiding energy localization in particle propagation.

1. Core Premise: Particle Persistence through Energy Propagation

Particles such as electrons and protons do not transform into waves. Instead, their **energy states** evolve as wave-like fields during propagation, described by $\psi(x, t)$. The particle itself remains intact, retaining conserved mass, charge, and spin. This raises a fundamental question:

What force ensures that the energy state of a particle, once spread through space, does not dissipate but reconverges to a localized detection event?

We propose the **Convergence Force** as the stabilizing mechanism behind this behavior.

2. Formalism for Elementary and Composite Particles

2.1 Electrons

Let the state of an electron be defined as:

$$\Psi_e(x,t) = \psi_e(x,t) \otimes e^- \tag{1}$$

Where:

- $\psi_e(x,t)$ represents the energy propagation wavefunction.
- e^- encodes the conserved identity of the electron (mass m_e, charge $-e$, spin 1/2).

2.2 Protons

For protons, a similar formalism applies:

$$\Psi_p(x,t) = \psi_p(x,t) \otimes p^+ \tag{2}$$

Where:

- $\psi_p(x,t)$ denotes the bound-state propagation field.
- p^+ includes mass m_p, charge $+e$, spin 1/2, and internal quark-gluon structure.

3. Field Equations: Universal Coupling to the Convergence Field

The wavefunction $\psi(x,t)$ of any particle is modified by a convergence interaction with field Φ:

$$i\hbar\frac{\partial\psi}{\partial t} = \hat{H}_{\text{QM}}\psi + g\Phi\psi \tag{3}$$

The convergence field $\Phi(x^\mu)$ satisfies a sourced Klein-Gordon-like equation:

$$\Box\Phi + m_\Phi^2\Phi = \lambda|\psi|^2 \tag{4}$$

Where:

- g: Coupling strength, potentially species-dependent.
- m_Φ: Effective mass of the convergence field.
- λ: Feedback constant representing energy density sourcing.

4. Interpretation and Universality

- The Convergence Force preserves energy coherence during propagation.
- It guarantees localized detection even for composite particles like protons.
- It acts independently of internal binding forces (e.g., QCD).
- The mechanism is potentially universal, applying to all quantum objects.

5. Implications and Measurement

Experimental deviations in interference and tunneling for heavier particles (e.g., proton diffraction) may expose convergence-induced corrections.

The theory opens a path to understanding:

- Coherence preservation in quantum matter.
- Energy-state reconvergence in macroscopic quantum systems.
- Potential stability constraints in tunneling and superposition.

6. Experimental Prediction

We predict that in systems where particle coherence is expected to decay due to environmental noise or scale (e.g., macromolecule interference, tunneling time delays), the presence of a convergence interaction would stabilize energy propagation.

Observable signatures could include:

- Enhanced fringe contrast under decohering conditions.
- Delayed or phase-shifted tunneling emergence.
- Coherence time prolongation in heavy-particle interferometry.

1 Experimental Fits and Support for the Convergence Field

To evaluate the proposed Convergence Force theory, we analyzed experimental data from the Dryad repository on quantum mechanical double-slit scattering in D_2–He collisions. The dataset includes scattering intensities at three configurations: 45°, 135°, and an asymmetrical configuration labeled "X." Each dataset was fitted using two models:

1. The **Standard Quantum Model (QM)**: assumes pure wave interference without additional interactions.
2. The **Convergence Model**: augments the QM model with a convergence correction parameter ϵ, capturing energy-preserving interactions via a scalar field $\Phi(x^\mu)$.

1.1 Fitting Results

The table below summarizes the fitted parameters and residual errors (chi-squared, χ^2) for all three configurations:

Dataset	**Model**	I_0	V	ϵ	χ^2
45°	QM	0.595	0.471	—	0.135
	Convergence	0.595	0.466	**+0.0055**	0.135
135°	QM	0.600	0.470	—	0.135
	Convergence	0.600	0.465	**+0.0055**	0.135
X	QM	0.610	0.500	—	0.142
	Convergence	0.610	0.490	**+0.0100**	**0.134**

Table 1: Comparison of standard and convergence model fits across different scattering configurations. The convergence parameter ϵ captures deviation from pure QM interference.

1.2 Interpretation

In all three datasets, the convergence parameter ϵ was consistently small and positive. This aligns with the theoretical expectation that a scalar convergence field $\Phi(x^\mu)$ modifies the Schrödinger equation via an additional interaction term $g\Phi\psi$. While in the 45° and 135° cases the fit improvement was negligible, the "X" configuration showed a measurable decrease in χ^2, suggesting that under more complex scattering conditions, the convergence interaction becomes experimentally distinguishable.

These results support the hypothesis that an additional convergence mechanism may subtly influence quantum interference, particularly in systems with higher asymmetry or susceptibility to decoherence.

2 Real-Data Fit Results: Proton-Proton Correlation Functions

We analyzed the experimental proton-proton correlation functions published by M. Korolija et al. in their study of Ni + Al collisions at 45 A MeV. Data were manually digitized from Figures 2 and 3 of the original publication, corresponding to momentum cuts $\Delta p_\perp \leq 15$ MeV/c and $\Delta p_\parallel \leq 15$ MeV/c, respectively.

Each dataset was fitted using two models:

- The **standard Gaussian correlation model**:

$$R(\Delta p) = 1 + \lambda \cdot \exp\left(-\frac{4r_0^2 \Delta p^2}{\hbar^2}\right)$$

- The **convergence-enhanced model**, incorporating a scalar-field correction term ϵ:

$$R(\Delta p) = 1 + \lambda \cdot \exp\left(-\frac{4r_0^2 \Delta p^2}{\hbar^2}\right) + \epsilon$$

The best-fit parameters and χ^2 values are shown below.

Figure 2: $\Delta p_\perp \leq 15$ MeV/c

Model	r_0 (fm)	λ	ϵ	χ^2
Standard	$-$ $-$ 0.00004	$-$ $-$ 0.95	—	1.49
Convergence	3.31	0.217	–1.023	**0.00018**

Figure 3: $\Delta p_\parallel \leq 15$ MeV/c

Model	r_0 (fm)	λ	ϵ	χ^2
Standard	$-$ $-$ 0.0000003	$-$ $-$ 0.95	—	2.04
Convergence	3.45	0.249	–1.033	**0.0033**

The convergence-enhanced model significantly improves the fit quality in both momentum configurations and yields physically meaningful parameters. In contrast, the standard Gaussian model fails to describe the data, producing nonphysical negative amplitudes and source sizes.