Title: Rethinking the Standard Model: Toward a Missing Property Governing Higgs Field Interactions in Pair Production.

Author: Kevin L Crooks, ChatGPT

Abstract: The Standard Model of particle physics elegantly accounts for the conservation of mass, momentum, energy, charge, and spin during high-energy processes such as pair production. However, it falls short in transparently elucidating how massless particles like gamma rays give rise to massive particles such as electrons and positrons through interactions with the Higgs field. This paper speculates on the existence of a yet-unidentified physical property intrinsic to quantum fields, which governs or mediates interactions with the Higgs field during such phenomena. We argue that without this property, our theoretical understanding of mass acquisition during pair production remains incomplete.

---

1. Introduction

Pair production is a well-understood process where a high-energy photon, typically near a nucleus, converts into an electron-positron pair. The Standard Model explains this via conservation laws and the involvement of the Higgs mechanism for mass acquisition. Yet, this framework provides no tangible property that explains why or how mass appears so suddenly from a photon that initially had none.

---

2. The Problem of Massless Origin

The photon is massless and does not interact directly with the Higgs field. In pair production, the resulting electron and positron both possess mass and couple to the Higgs field. Although energy and momentum are conserved, the transformation lacks a descriptive variable or quantum number that accounts for the sudden "turning on" of Higgs coupling.

We propose the existence of a new property ξ (xi), tentatively termed the **Higgs Coupling Potential (HCP)**. This property does not exist in the photon but is somehow induced or transferred through an intermediary condition—possibly the local vacuum geometry, quantum fluctuations, or the influence of nearby massive bodies (e.g., atomic nuclei).

---

3. The Case for Higgs Coupling Potential (HCP)

The Higgs field endows mass via interaction, but the current theory treats this as a static background effect. We posit that HCP is a dynamic property that governs a particle's ability to gain mass through this interaction. HCP would be:

- **Zero for photons and gluons**
- **Non-zero for particles that couple to the Higgs field**
- **Activated or instantiated during transitions involving energy thresholds and symmetry breaking**

---

4. Conservation Laws and the Role of HCP

If HCP is conserved in certain interactions or transforms in a predictable manner, it might be embedded within or correlated with existing quantum numbers.

In pair production, the photon does not initially possess HCP, but the interaction condition—possibly involving virtual particles or the influence of the vacuum—facilitates the bifurcation into particles with non-zero HCP values, allowing Higgs coupling and thus mass acquisition.

---

5. Implications and Further Questions

- Could HCP be quantized or continuous?
- Is it a function of spacetime curvature or quantum vacuum conditions?
- How might experiments detect or infer the presence of HCP?
- Could HCP unify mass acquisition with other symmetry-breaking events?

---

6. Conclusion

The Standard Model remains a powerful tool, but its explanatory scope regarding the genesis of mass during processes like pair production may be incomplete. Introducing a speculative property like Higgs Coupling Potential offers a fresh lens to examine the interactions that give rise to mass. Further theoretical and experimental work is necessary to refine this hypothesis and determine its physical plausibility.

References: [1] Higgs, P. W. (1964). "Broken Symmetries and the Masses of Gauge Bosons." [2] Weinberg, S. (1967). "A Model of Leptons." [3] Peskin, M. E., & Schroeder, D. V. (1995). "An Introduction to Quantum Field Theory." [4] Carroll, S. (2010). "From Eternity to Here." [5] CMS Collaboration. (2012). "Observation of a new boson at a mass of 125 GeV."

[Note: This is a speculative hypothesis and should be treated as an invitation for discussion rather than a definitive theory. This paper was generated using generative AI. This paper was genertaed using ChatGPT.]