Neutron Field Energy

Summary: Neutron Decay as Separation of Balanced Electric Fields in a Potential-Neutral Core

1. Background

In the Standard Model, neutron decay energy (

$$0.782 \text{ MeV}$$

) is attributed to a mass difference between the neutron, proton, and electron, with an additional unobserved particle (the antineutrino) introduced to conserve energy and momentum.

Here, we propose an alternative explanation: The decay energy arises from the separation of two confined electric fields within the neutron — one positive, one negative — which are initially arranged to create no net external potential, despite not fully overlapping.

2. Initial State – Balanced Electric Potential Core

In its stable state, the neutron contains: - A positive field core (proton structure), - A negative field (electron precursor) held nearby at distance

$$R_0 \approx 0.91 \text{ fm}$$

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Though the fields are not spatially overlapping, their potentials are arranged such that: - The net electric potential outside the neutron is approximately zero. - This configuration yields a particle that appears electrically neutral to external observation.

This potential balance is achieved without requiring zero field at every point — only that the total potential field from both sources cancels out on average at larger distances.

3. Decay Process – Field Separation

To break this equilibrium and allow the fields to fully separate (forming a free proton and a free electron), work must be done against their mutual electric attraction.

This work is computed using Coulomb's potential energy formula:

$$E = \frac{1}{4\pi\varepsilon_0}\left(\frac{e^2}{R_0} - \frac{e^2}{R}\right)$$

and using the approximation:

$$E \approx 1.44 \cdot \left(\frac{1}{R_0} - \frac{1}{R}\right) \quad [\text{MeV}]$$

Substituting: -

$$R_0 = 0.91 \text{ fm}$$

(initial equilibrium distance), -

$$R = 1.8 \text{ fm}$$

(separation at which identity splits),

yields:

$$E \approx 1.44 \cdot \left(\frac{1}{0.91} - \frac{1}{1.8}\right) \approx 0.782 \text{ MeV}$$

This matches the measured neutron decay energy.

Once this amount of energy is invested to separate the fields to a distance of

$$1.8\ extfm$$

, the electric binding force is fully overcome. From that point forward, the mutual attraction is not strong enough to reverse the process. The fields continue to move apart, and the system transitions into an open-field configuration. This leads naturally to the formation of a hydrogen atom — a stable, low-energy state at much larger separation.

4. Physical Interpretation

This energy does not arise from mass loss or quantum randomness, but from: - Breaking a confined, balanced electric field system, - Where the initial potential configuration cancels external effects, - And the separation requires work against the internal field equilibrium.

On the nature of the neutron volume: A neutron, while externally neutral, contains internally confined electric fields — a positive and a negative field in near-overlap. Though these fields do not radiate outward, they exist and interact strongly within. The volume of the neutron is determined not by external emission, but by the inner balance of forces: where the internal positive and negative fields reach a dynamic equilibrium. This boundary — where internal compression is halted by counter-field repulsion — defines the neutron's effective spatial extent.

Activation of Confined Field Energy: The neutron's internal energy, measured as 3.86 MeV, is not externally visible and does not manifest as a classical field in space. However, this energy exists within the confined configuration of opposing fields. It becomes physically expressed only when an external electric field interacts with the neutron — such as when a nearby proton's field penetrates its structure. This interaction "activates" the internal potential, producing a real attractive force and leading to stable nuclear configurations. Without external interaction, this field energy remains dormant, yet it is fully real and defines the conditions for stability when combined with surrounding field structures.

Once separated, the system reaches a new stable configuration: - A proton and electron held at a much larger distance, - Forming a hydrogen atom with Bohr radius

$$a_0 = 5.29imes10^{-11}\ extm$$

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5. Significance

Neutron Stability Table:

Structural Context of the Neutron	Stability
Free neutron (isolated)	❌ Unstable
Neutron bound only to another neutron	❌ Unstable
Neutron bound to two neutrons	❌ Unstable
Neutron bound to one proton (PN)	❌ Unstable
Neutron between two protons (PNP)	✔ Stable

Structural Context of the Neutron	Stability
Neutron bound to one proton and a neutron connected to a proton (PNNP)	✔ Stable
Neutron located within the electric field generated by protons (e.g., in a ring)	✔ Stable

This field-based interpretation offers a physical, measurable origin for neutron decay energy: - No need to invoke unobservable particles. - No dependence on weak interaction assumptions. - Replaces probabilistic decay with deterministic field separation.

It supports a broader view in which mass and energy are both emergent from structured, confined electric fields — and decay is a transition between stable field configurations.

Appendix – Constants -

$$e = 1.602 \times 10^{-19}\ \text{C}$$

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$$\frac{1}{4\pi\varepsilon_0} \approx 1.44\ \text{MeV} \cdot \text{fm}$$