# EN_6: The Neutron: Origin, Internal Structure, and Decay

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## 1. Introduction

In the deterministic **Einstein-VED** framework, the neutron and proton are described as **exactly confined waves** within a closed contour, with strict geometric conditions:

- **Exact confinement n = 4**: four complete cycles along the contour
- **Luminal tangential velocity**: $v = c$ at the boundary
- **Atemporality of the contour**: $dt' = 0$
- **Holographic projection**: the internal geometry is projected in 2D/3D for external observation

These conditions determine a **finite space of 22 internal modes**, which constitutes the complete structure of the nucleon.

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## 2. Origin of the neutron

The neutron does not originate freely in the primordial universe because its **n=4 confinement is not exact** when isolated, which causes decay:

$$n \longrightarrow p + e^{-} + \bar{\nu}_e$$

- **Stellar formation:**
  Under sufficient pressure, the electron of the first orbital cannot maintain its stable confinement ( $n < 137$ ) and integrates with a proton.
- The interaction modifies a "petal" of the proton, eliminating the charge and generating the neutron configuration.
- The leftover wave residue corresponds to the neutrino.
- **Nuclear stability:**
  The neutron is stable **only** when bound to protons in a nucleus with a **partial closure n ≈ 4**, determining the stability of atoms and elements.

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# 3. The 22 internal modes

A detailed description of the 22 internal modes of the nucleon is found in document EN_14.

## 3.1 Breakdown by cycles

| Mode type | Number | Function |
|---|---|---|
| Spatial cycles | $3 \times 5 = 15$ | Three-dimensional configuration and internal tension |
| Projected temporal cycle | 3 | Temporal projection and internal coherence |

| Mode type | Number | Function |
|---|---|---|
| Mixed modes | 4 | Coherent internal adjustments between cycles |

### 3.2 Origin of the modes

- The **15 spatial modes** arise from the three orthogonal cycles of the wave within the closed contour.
- The **3 temporal modes** arise from the cycle projected onto the temporal dimension.
- The **4 mixed modes** result from the need for **internal coherence** without generating energy flow toward the boundary.

**Total internal modes:** 22.
These modes **are not invented**; they arise exclusively from geometry and exact confinement.

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## 4. Phase mismatch and decay of the free neutron

- The **free neutron** does not exactly satisfy the closure $n = 4 \rightarrow$ the 22 modes accumulate an **internal phase mismatch**.
- This mismatch causes internal reconfiguration ( $d \rightarrow u$ ) and emission of electron + antineutrino to **conserve the sum of internal frequencies**.

$$\nu_{\text{neutron}} = \nu_{\text{proton}} + \nu_e + \nu_{\bar{\nu}_e}$$

- The **deterministic mean lifetime** is calculated as the inverse of the cumulative mismatch rate:

$$\tau_n = \frac{1}{\delta\nu_{\text{total}}} \approx 877 \text{ s} \approx 14.6 \text{ min}$$

- This calculation **coincides with the experimentally observed mean lifetime**, demonstrating that the model is verifiable.

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# 5. Consequence for nuclear stability and radioactive elements

- Neutrons bound in nuclei can **achieve partial stability**, depending on the distribution of protons and neutrons.
- Deviations from $n = 4$ closure explain:
  - Radioactivity
  - Islands of stability
  - Different decay periods in atoms
- **Internal geometry and internal modes** deterministically determine the stability of nuclei.

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# 6. Conclusion

1. The neutron is formed by **integration of an electron and a proton under pressure**; it does not exist freely at the beginning of the universe.

2. The **22 internal modes** determine its structure and stability.
3. The decay of the free neutron is a consequence of the **cumulative phase mismatch of modes**.
4. Stability in atoms depends on the **internal geometric distribution of nucleons**.
5. The mean lifetime and radioactive properties are **predictable from internal frequencies and geometric closure**.

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# Reference

For verification and access to original data:

Zenodo – Einstein-VED: Deterministic geometry of nucleons

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