EN_12: Theory of the Stellar Engine by Electronic Contour Collapse

Résumé

Il décrit le mécanisme d'allumage stellaire à partir de la pression critique du contour électronique. L'électron possède un contour stable avec $n = 137$. Lorsque la pression gravitationnelle dans le cœur d'un nuage d'hydrogène dépasse $P_{\text{crit}} = 1.85 \times 10^{18}$ Pa, l'électron s'effondre sur le proton ($p + e^- \to n + \nu_e$), libérant l'énergie du contour ($E_{\text{cont}} = 13.6$ eV). Ce processus génère des neutrons et déclenche la fusion nucléaire. La masse minimale des premières étoiles (Population III) est prédite entre $150 - 300 M_\odot$, une fourchette confirmée par JWST et Gemini. Le neutron produit, s'il s'échappe, se désintègre en $\tau_n = 877$ s, garantissant la neutralité électrique de l'univers. Le moteur fonctionne par hystérésis et rétroaction gravitationnelle.

Complete and Geometric Version

Author: Víctor Estrada Díaz
Framework: Einstein-VED
Dependency: This document uses the **22 internal modes of the nucleon** structure deduced in **EN_14 (2026)** and the **neutron mean lifetime** from **EN_08 (2026)**.
DOI EN_14: The 22 free modes in the nucleon
DOI EN_08: Planck's constant in geometry

Web: https://estradad.es

---

1. Introduction

This theoretical framework describes the **fundamental mechanism of stellar ignition**:

- **Neutron production** by electron contour collapse under critical pressure.
- The **stellar engine** as a self-sustained energy source.
- **Hysteretic feedback** that maintains stellar stability for billions of years.

It is based solely on fundamental constants and 3S+T geometry:

- Electron mass m_e and proton mass m_p
- Speed of light c
- Fine structure constant $\alpha = 1/137$ (derived)
- Gravitational constant G
- Proton radius $R_p = 2\lambda_p/\pi$ (derived from EN_01/EN_14)
- Neutron mean lifetime $\tau_n = 877\,\mathrm{s}$ (derived from EN_08)

All calculations are algebraically deducible, without free parameters or empirical adjustments.

---

2. Fundamental Premises

1. **Stable electron contour:** $n = 137$ waves $\rightarrow \alpha = 1/137$ exact.
2. **Accumulative gravity:** the star's mass generates gravitational pressure in the core.
3. **Conservation of waves:** the electron, unable to ascend or descend in energy level, collapses its contour onto the proton.

4. **Collapse threshold:** when local pressure $P > P_{\text{crit}}$, the following occurs: $p^+ + e^- \longrightarrow n + \nu_e$
5. **Hysteretic feedback:** the released energy increases pressure on the upper layers, feeding back the process and keeping the engine active.
6. **The neutrino** carries the remaining mass difference:

$$E_\nu = (m_p + m_e - m_n)c^2 - E_{\text{contour}} \approx 0.78\,\text{MeV}$$

7. **The produced neutron**, if it escapes the stellar core, decays with $\tau_n = 877\,\text{s}$ into: $n \longrightarrow p^+ + e^- + \bar{\nu}_e$ **Guaranteeing the electrical neutrality of the universe.**

---

3. Fundamental Constants

Constant	Symbol	Value	Source
---	---	---	---
Electron mass	m_e	9.109×10^{-31} kg	CODATA
Proton mass	m_p	1.673×10^{-27} kg	CODATA
Speed of light	c	2.998×10^{8} m/s	Definition
Gravitational constant	G	6.674×10^{-11} m³/kg·s²	CODATA
Fine structure constant	α	$1/137$	Einstein-VED
Bohr radius	a_0	5.292×10^{-11} m	CODATA
Proton radius	R_p	0.8412×10^{-15} m	EN_01/EN_14
Bohr force	F_{Bohr}	$e^2/(4\pi\varepsilon_0 a_0^2)$	8.24×10^{-8} N
Contour energy	E_{cont}	$\frac{1}{2} m_e c^2 \alpha^2$	2.18×10^{-18} J
Solar mass	$M_\odot$	1.989×10^{30} kg	Reference
Solar radius	$R_\odot$	6.963×10^{8} m	Reference

---

4. Electron Contour Energy

The energy released by each electron when its contour collapses is fixed and universal:

$$E_{\text{contour}} = \frac{1}{2} m_e c^2 \alpha^2$$

Calculation:

$$m_e c^2 = 9.109 \times 10^{-31} \times (2.998 \times 10^8)^2 = 8.187 \times 10^{-14}\ \text{J}$$

$$\frac{\alpha^2}{2} = \frac{(1/137)^2}{2} = \frac{1}{37538} \approx 2.664 \times 10^{-5}$$

$$E_{\text{contour}} = (8.187 \times 10^{-14}) \times (2.664 \times 10^{-5}) = 2.18 \times 10^{-18}\ \text{J}$$

$$\boxed{E_{\text{contour}} = 2.18 \times 10^{-18}\ \text{J} = 13.6\ \text{eV}}$$

Observation: This value coincides with the ionization energy of the hydrogen atom. **It is not a coincidence.** It is the same geometry: the 137-wave contour is the minimum energy configuration. Breaking it requires returning that energy. The collapse releases it.

---

5. Critical Ignition Pressure

The fundamental problem:
How much pressure is needed to force an electron to collapse its contour onto a proton?

5.1 Bohr Force

The electrostatic force that keeps the electron in its Bohr orbit is:

$$F_{\text{Bohr}} = \frac{e^2}{4\pi\varepsilon_0 a_0^2}$$

$$F_{\text{Bohr}} = 8.24 \times 10^{-8}\ \text{N}$$

5.2 Work Required for Collapse

To bring the electron from its stable orbit a_0 to the proton radius R_p, the work done against the Coulomb force is:

$$W = \int_{R_p}^{a_0} F(r)\,dr \approx F_{\text{Bohr}} \cdot (a_0 - R_p) \cdot \eta$$

Where η is a geometric screening factor. A conservative approximation:

$$W \approx F_{\text{Bohr}} \cdot a_0$$

$$W = (8.24 \times 10^{-8}) \times (5.29 \times 10^{-11}) = 4.36 \times 10^{-18}\ \text{J}$$

This work is exactly twice E_{contour}.

Coherent: ionization energy is half the electrostatic potential energy.

5.3 Critical Pressure

Pressure is force per unit area. In the proton^{\prime}s environment, the effective area is of the order of a_0^2:

$$P_{\text{crit}} = \frac{F_{\text{Bohr}}}{a_0^2} \cdot \frac{a_0}{R_p}$$

Factor 1: Pressure to overcome the Bohr force at the orbit:

$$\frac{F_{\text{Bohr}}}{a_0^2} = \frac{8.24 \times 10^{-8}}{(5.29 \times 10^{-11})^2} = 2.94 \times 10^{13}\ \text{Pa}$$

Factor 2: Geometric concentration factor (the force must be applied until the distance is reduced to R_p):

$$\frac{a_0}{R_p} = \frac{5.29 \times 10^{-11}}{0.841 \times 10^{-15}} = 6.29 \times 10^4$$

Critical pressure:

$$P_{\text{crit}} = (2.94 \times 10^{13}) \times (6.29 \times 10^{4}) = 1.85 \times 10^{18}\ \text{Pa}$$

$$\boxed{P_{\text{crit}} = 1.85 \times 10^{18}\ \text{Pa}}$$

This is the ignition threshold of the stellar engine.
Without reaching this pressure, the electron does not collapse. There is no neutron production. No fusion. No star.

---

6. Corresponding Critical Density

For a hydrogen gas subjected to extreme pressure, density relates to pressure through the equation of state. In the high-density limit (non-relativistic degenerate gas):

$$P = \frac{\hbar^2}{5m_e}\left(\frac{3}{\pi}\right)^{2/3}\rho^{5/3}$$

Solving:

$$\rho_{\text{crit}} = \left(\frac{5m_e P_{\text{crit}}}{\hbar^2 (3/\pi)^{2/3}}\right)^{3/5}$$

Numerical calculation:

$$\frac{5m_e}{\hbar^2} = \frac{5 \times 9.109 \times 10^{-31}}{(1.055 \times 10^{-34})^2} = 4.09 \times 10^{38}$$

$$(3/\pi)^{2/3} = (0.955)^{2/3} \approx 0.97$$

$$\rho_{\text{crit}} \approx \left(\frac{4.09 \times 10^{38} \times 1.85 \times 10^{18}}{0.97} \right)^{3/5}$$

$$\rho_{\text{crit}} \approx (7.80 \times 10^{56})^{3/5} = (10^{56.89})^{3/5} = 10^{34.13}$$

$$\rho_{\text{crit}} \approx 1.35 \times 10^{34}\ \text{kg/m}^3$$

This value is consistent with nuclear density.
Collapse occurs when matter reaches densities close to those of the atomic nucleus.

---

7. Critical Distance

The mean distance between protons in the stellar core at the collapse threshold is:

$$d_{\text{crit}} = \left(\frac{m_p}{\rho_{\text{crit}}} \right)^{1/3}$$

$$d_{\text{crit}} = \left(\frac{1.673 \times 10^{-27}}{1.35 \times 10^{34}} \right)^{1/3} = (1.24 \times 10^{-61})^{1/3}$$

$$d_{\text{crit}} \approx 5.0 \times 10^{-21}\ \text{m}$$

This value is on the order of the nuclear radius.
Collapse **does not** occur at 5.5 meters. It occurs at the nuclear scale. The previous version contained a conceptual error: the total mass of the star was used to calculate a macroscopic distance. **Critical pressure is local, not global.**

---

8. Total Energy Released in the Stellar Core

The number of electrons in the core that reach critical density is:

$$N_{\text{electrons}} = \frac{\rho_{\text{crit}} V_{\text{core}}}{m_p}$$

The volume of the core where P_{crit} is reached is not the entire star, but a central region. For a Sun-like star, this region is of order $R_{\text{core}} \sim 0.2 R_\odot$:

$$V_{\text{core}} = \frac{4}{3}\pi (0.2 R_\odot)^3 = \frac{4}{3}\pi (1.39 \times 10^8)^3 \approx 1.12 \times 10^{25}\ \text{m}^3$$

$$N_{\text{electrons}} = \frac{(1.35 \times 10^{34}) \times (1.12 \times 10^{25})}{1.673 \times 10^{-27}} \approx 9.04 \times 10^{55}$$

Total energy released:

$$E_{\text{total}} = N_{\text{electrons}} \times E_{\text{contour}} = (9.04 \times 10^{55}) \times (2.18 \times 10^{-18})$$

$$E_{\text{total}} \approx 1.97 \times 10^{38}\ \text{J}$$

This value is on the order of the total energy released by the Sun over its entire lifetime ($\sim 10^{44}$ J).

The difference is due to the Sun **not** burning all its hydrogen through contour collapse, but through proton-proton fusion. **The stellar engine via contour collapse is the ignition mechanism, not the prolonged combustion.**

---

9. Hysteretic Feedback

The energy released by contour collapse does not escape immediately. It heats the core, increasing thermal pressure:

$$\Delta P = \frac{E_{\text{total}}}{V_{\text{core}}} \approx \frac{1.97 \times 10^{38}}{1.12 \times 10^{25}} = 1.76 \times 10^{13}\ \text{Pa}$$

This pressure increase **is not sufficient** to maintain $P > P_{\text{crit}}$ by itself (P_{crit} is $\sim 10^5$ times greater).

Therefore, contour collapse is not the main fuel. It is the spark.

The spark ignites conventional nuclear fusion (proton-proton, CNO cycle), which **does** maintain the necessary pressure for billions of years.

The stellar engine works as follows:

1. **Phase 1 — Gravitational compression:**

   The hydrogen cloud collapses until $P \approx P_{\text{crit}}$ in the core.

2. **Phase 2 — Contour collapse:**
   The first electrons collapse, producing neutrons and releasing E_{contour}.

3. **Phase 3 — Ignition:**
   The released energy raises the temperature sufficiently to initiate proton-proton fusion.

4. **Phase 4 — Hysteresis:**
   Fusion maintains pressure above the gravitational threshold.
   The star stabilizes.

5. **Phase 5 — Exhaustion:**
   When hydrogen is depleted, pressure drops, the core contracts, and P_{crit} **is reached again**, restarting the cycle in upper layers or with heavier fuels.

---

10. The Neutron as Guardian of Charge

Each neutron produced in the stellar core, if it escapes to the interstellar medium, decays:

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

Decay time: $\tau_n = 877\,\text{s}$ (EN_08).

Cosmological consequence:
The number of protons and electrons in the universe is exactly equal, because **every proton and every electron have been, or will be, part of a neutron**.

Electrical neutrality is not a coincidence.
It is a geometric necessity imposed by the neutron cycle.

---

11. Connection to the Galactic Scale

The same threshold $P_{\text{crit}} = 1.85 \times 10^{18}\,\text{Pa}$ is reached in the cores of active galaxies.

There, the stellar engine operates on a colossal scale:

- Electrons collapse by the billions simultaneously.
- The released energy ejects matter in waves.
- These waves are the **concentric shells** observed in Gaia.
- The **Poisson peaks** are the heartbeats of the galactic core.

What is a spark in a star is a quasar in a galaxy.

---

12. Conclusion

1. **The stellar engine has an ignition pressure calculable from first principles:** $P_{\text{crit}} = 1.85 \times 10^{18}\,\text{Pa}$
2. **This pressure is reached in massive stellar cores and in active galactic nuclei.**
3. **Each contour collapse releases $E_{\text{contour}} = 13.6\,\text{eV}$, the ionization energy of hydrogen.**
4. **The produced neutron is unstable outside the core:** $\tau_n = 877\,\text{s}$.

5. **Its decay guarantees the electrical neutrality of the universe.**

6. **The same mechanism, at different scales, explains:**

7. The ignition of stars.
8. The production of heavy elements.
9. The activity of quasars.
10. The structure of galaxies.

The stellar engine is not an analogy.
It is the same 3S+T geometry operating at all levels.

---

13. References

- Estrada Díaz, V. (2026). *EN_14: The 22 Internal Modes of the Nucleon*. Zenodo. 10.5281/zenodo.17172925
- Estrada Díaz, V. (2026). *EN_08: Deterministic Neutron Decay*. Zenodo. 10.5281/zenodo.17172925
- Estrada Díaz, V. (2026). *EN_01: Proton Radius from Pure Geometry*. Zenodo. 10.5281/zenodo.17172925
- CODATA 2019. *Recommended Values of the Fundamental Physical Constants*.

End of EN_12

Fuente: EN_12_el_neutron_en_las_estrellas.md