EN_12: Theory of the Stellar Engine by Electronic Contour Collapse

Complete and Geometric Version

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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_8 (2026)**.
DOI EN_14: The 22 free modes in the nucleon
DOI EN_8: Planck's constant in geometry
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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_1/EN_14)
- Neutron mean lifetime $\tau_n = 877$ s (derived from EN_8)

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

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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.

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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} $\text{m}^3/\text{kg} \cdot \text{s}^2$	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_1/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

Constant	Symbol	Value	Source
Solar radius	$R_\odot$	6.963×10^8 m	Reference

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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:

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

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

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

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

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.

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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'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:

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

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

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.

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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):

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

Solving:

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

Numerical calculation:

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

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

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

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

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

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

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7. Critical Distance

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

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

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

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

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.**

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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.**

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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.

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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: $\tau_n = 877$ s (EN_8).

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.

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11. Connection to the Galactic Scale

The same threshold $P_{\text{crit}} = 1.85 \times 10^{18}$ 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.

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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:**
    - The ignition of stars.
    - The production of heavy elements.
    - The activity of quasars.
    - The structure of galaxies.

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

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13. References

- Estrada Díaz, V. (2026). *EN_14: The 22 Internal Modes of the Nucleon*. Zenodo. 10.5281/zenodo.17172925
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- CODATA 2019. *Recommended Values of the Fundamental Physical Constants*.

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