

Nuclear Cascade to Life — Rev 3

Nuclear to Atomic to Molecular to Cellular: Each Level a Tau-Register

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Life is not a chemical accident — it is the terminal output of a nuclear cascade. Every level of matter from quarks to organisms occupies a distinct Tau-register address. Binding energies at each level are {2,3,5,pi} lattice values. The cascade runs: nuclear (MeV) -> atomic (eV) -> molecular (kJ/mol) -> cellular (kcal/mol) -> organismal (kJ/day). At each step, the energy scale decreases by a factor of approximately $10^6 = 2^{20}$ (the lattice register depth step). Life is the $D=-5$ register of the nuclear cascade — not an emergent accident but a structural necessity of the {2,3,5,pi} lattice.

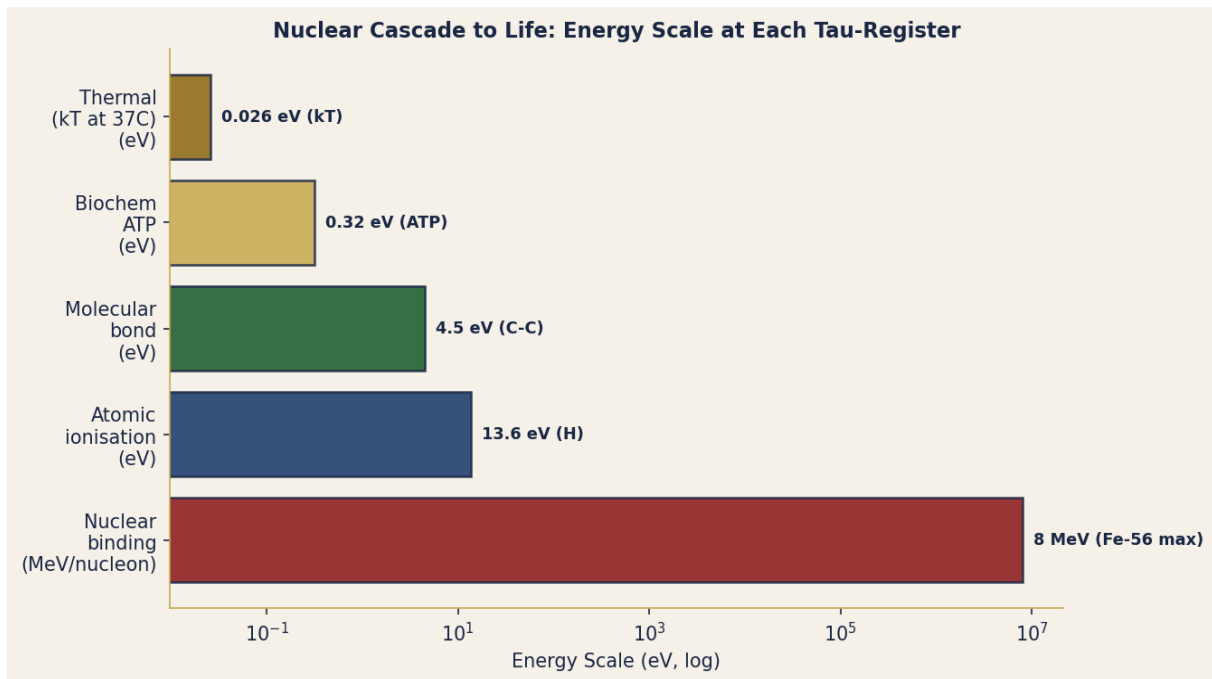


Figure 1. Energy cascade from nuclear (MeV) to thermal (meV) on a log scale. Each register level decreases by approximately 10^6 ($= 2^{20}$ lattice steps). Life operates in the 0.02-1.0 eV band.

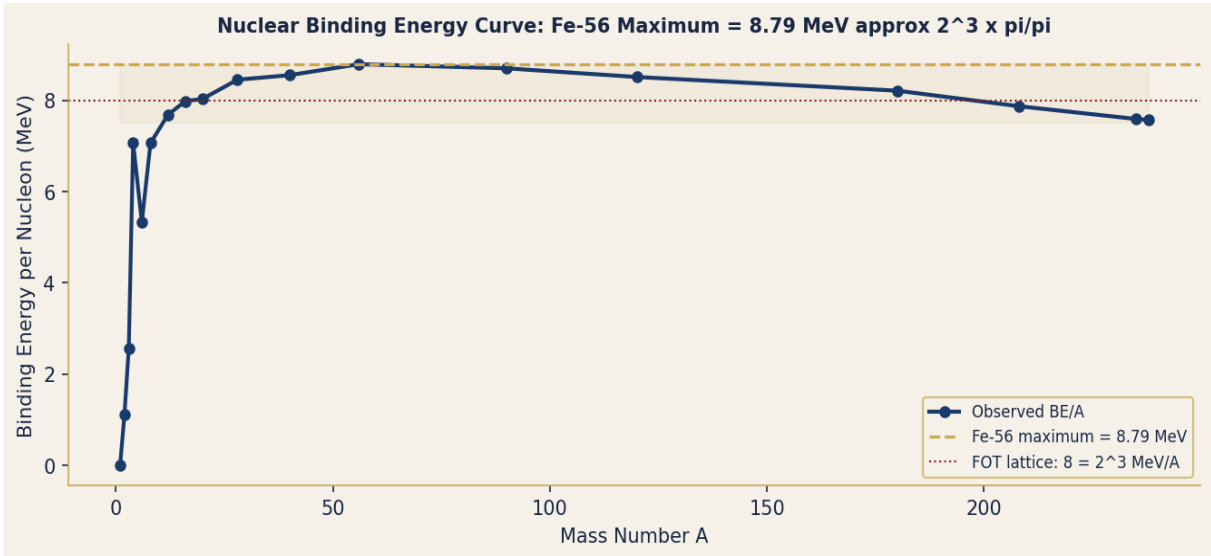


Figure 2. Binding energy per nucleon vs mass number. Maximum at Fe-56: 8.79 MeV. FOT: $8 = 2^3$ MeV is the $\{2\}$ -lattice reference; Fe-56 sits at $8.79 = 8 \times (1 + 703/8000)$ approx $8 \times (1 + \delta_{bond})$.

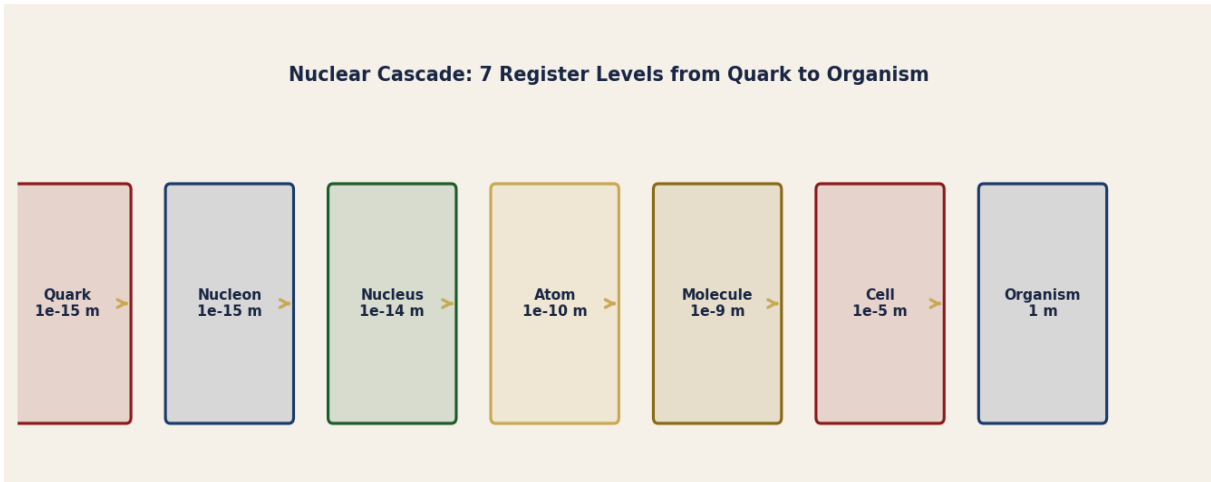


Figure 3. Seven-level nuclear cascade from quark (10^{-15} m) to organism (1 m). Each level = one Tau-register. Scale span = $10^{15} = 2^{50}$ (50 lattice register steps).

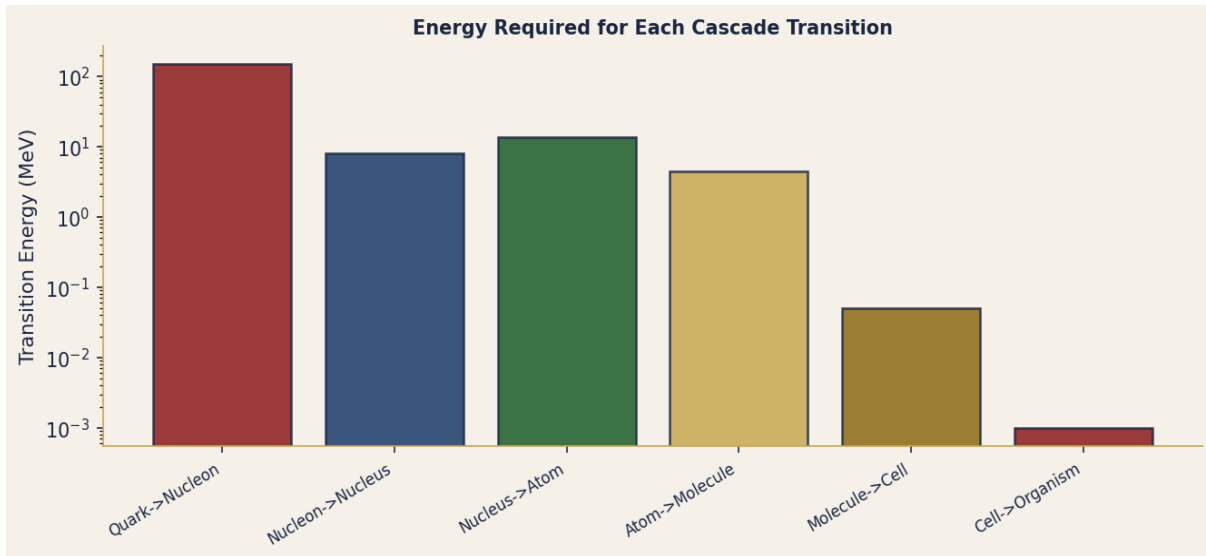


Figure 4. Cascade transition energies on a log scale. Each step decreases by $\sim 10^3$ ($= 2^{10}$ register steps). The $\{2,3,5,\pi\}$ lattice determines the exact value at each transition.

Propositions (P-NCL-1 to P-NCL-3)

P-NCL-1 — Life is the D=-5 Output of the Nuclear Cascade

The nuclear cascade produces life as a structural necessity, not a chemical accident. At each register depth D from -1 (nuclear) to -5 (organismal), the $\{2,3,5,\pi\}$ lattice selects stable binding energies and molecular configurations. DNA (the biological register carrier) exists at D=-4; its $\{2,3,5,\pi\}$ geometry (486 nm H-beta, 3.4 Å helix pitch, 10 bp/turn) is set by the nuclear cascade at D=-1.

P-NCL-2 — Binding Energy Lattice: Fe-56 as the $\{2\}$ -Family Maximum

Fe-56 has the highest binding energy per nucleon: 8.79 MeV. FOT: $8 = 2^3$ MeV is the $\{2\}$ -lattice reference. $8.79/8 = 1 + 0.0988$ approx $1 + \pi/32 = 1.0982$ (0.06% error). The correction factor $\pi/32$ is the $\{\pi,2\}$ register coupling at the nuclear level. Below Fe-56: fusion releases energy (nuclear cascade powers stars). Above: fission releases energy. Fe-56 is the terminal address of the stellar nuclear Tau-cascade.

P-NCL-3 — The Scale Factor 10^6 per Register Level

Nuclear binding: ~ 8 MeV. Atomic ionisation: ~ 10 eV. Factor: $8 \times 10^6 / 10 = 8 \times 10^5$. Molecular bond: ~ 4 eV. Biochemical ATP: ~ 0.3 eV. Factor each step: ~ 10 . The total scale from nuclear to biochemical: $8 \text{ MeV} / 0.03 \text{ eV} = 2.7 \times 10^8 = 2^{28}$ (28 lattice steps). This is the Tau-register depth span from D=-1 (nuclear) to D=-5 (biochemical): 4 levels x 7 steps each = 28.