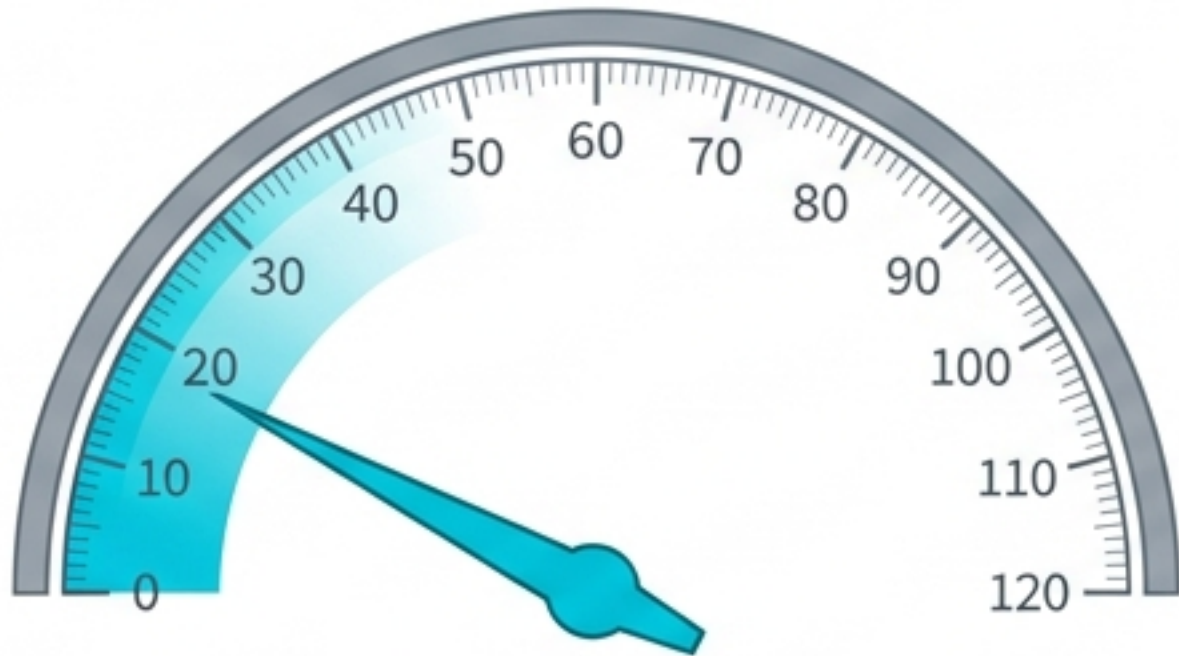


# Resolving the Cosmological Lithium and Missing Baryon Anomalies



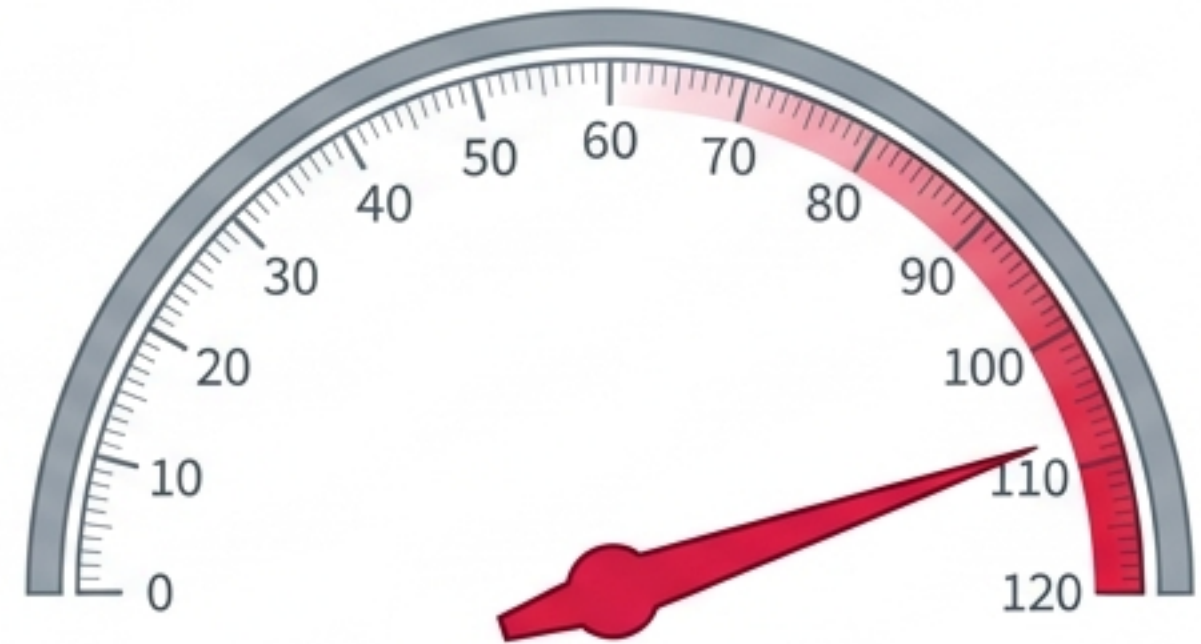
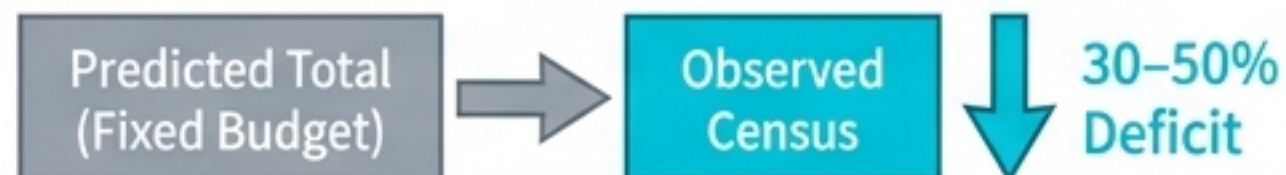
A steady-state nucleosynthesis and open-budget framework derived from continuous substrate physics.

# Two Enduring Empirical Failures of the Standard Model



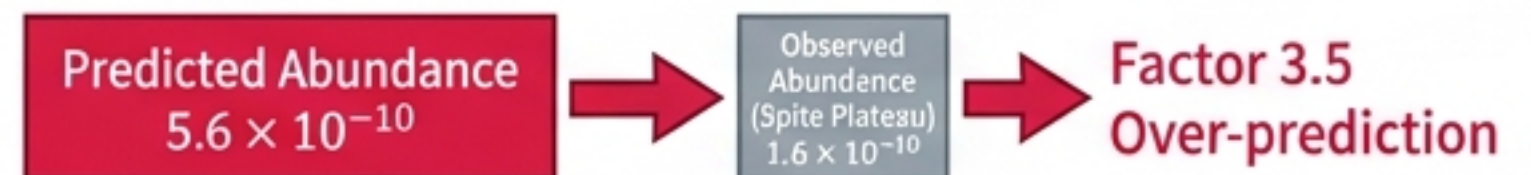
## The Direct Census Shortfall

Standard cosmology assumes a fixed, closed hydrogen budget from the first three minutes. Direct observational census consistently falls 30–50% short of this predicted total.

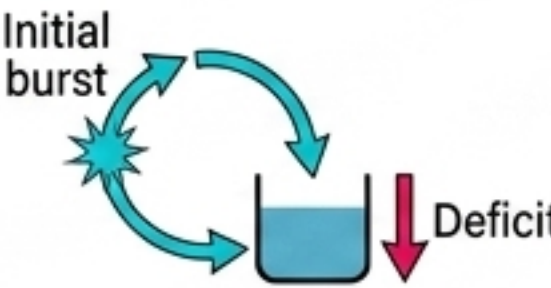
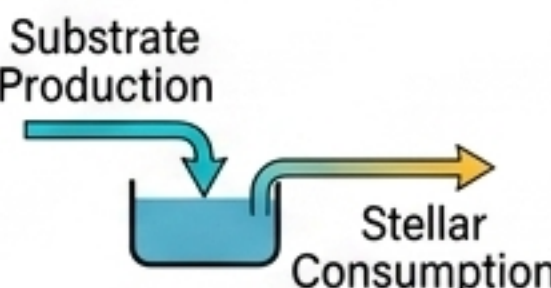
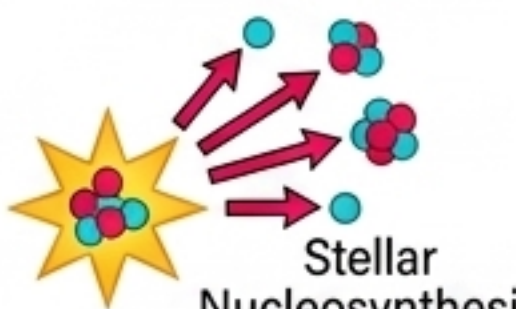
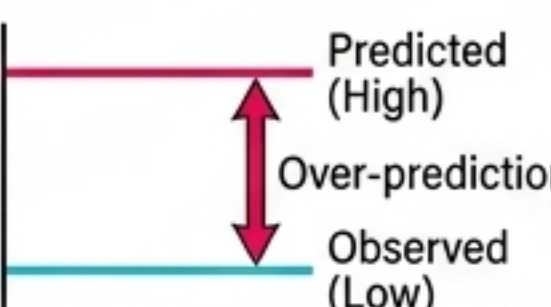
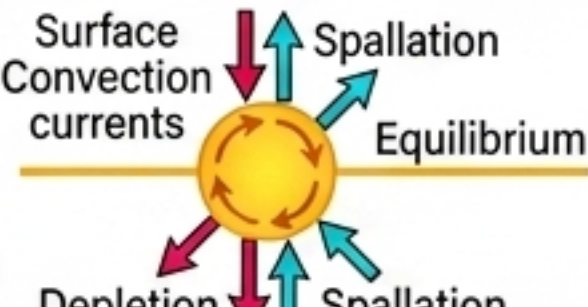


## The Factor-3.5 Discrepancy

Predicted primordial Lithium-7 abundance is  $5.6 \times 10^{-10}$ .  
Observed Spite plateau abundance in old halo stars is precisely  $1.6 \times 10^{-10}$ .



# The Diagnostic Shift from Frozen Relics to Dynamic Equilibrium

|                      | Standard Model (BBN)                                                                                                                                                                                                                                                                                                                                                                                         | Steady-State Framework                                                                                                                                                                                                                                                                                                                          |
|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Hydrogen Budget      | <p><b>Closed</b><br/>(Fixed in first 3 mins, causing missing baryon deficit)</p>  <p>The diagram shows a blue container with a blue arrow labeled 'Initial burst' entering from the top and a red arrow labeled 'Deficit' exiting from the bottom.</p>                                                                    | <p><b>Open</b><br/>(Continuous substrate production)</p>  <p>The diagram shows a blue container with a blue arrow labeled 'Substrate Production' entering from the top and a yellow arrow labeled 'Stellar Consumption' exiting from the bottom.</p>         |
| Heavy Element Origin | <p><b>Primordial</b><br/>(Formed before stars)</p>  <p>The diagram shows a grey cloud with blue dots inside, labeled 'Primordial Nucleosynthesis'.</p>                                                                                                                                                                  | <p><b>Post-Collapse</b><br/>(Formed exclusively via stellar fusion)</p>  <p>The diagram shows a yellow star with red arrows pointing outwards, labeled 'Stellar Nucleosynthesis'.</p>                                                                      |
| Lithium-7 State      | <p><b>Frozen Relic</b><br/>(Irreconcilable over-prediction)</p>  <p>The diagram shows a horizontal line with a red arrow pointing up to a higher line labeled 'Predicted (High)' and a blue arrow pointing down to a lower line labeled 'Observed (Low)'. The space between the lines is labeled 'Over-prediction'.</p> | <p><b>Regulated Surface Abundance</b><br/>(Dynamic equilibrium)</p>  <p>The diagram shows a yellow circle with arrows pointing in and out, labeled 'Equilibrium'. The arrows are labeled 'Surface Convection currents', 'Spallation', and 'Depletion'.</p> |

# The Logical Flaw in Primordial Inference

Stars destroy Lithium

Observed Lithium must therefore be a depleted primordial remnant.

Animals consume Oxygen

Observed Oxygen must therefore be primordial.

Active destruction does not imply a higher primordial starting value when ongoing production is simultaneously present.

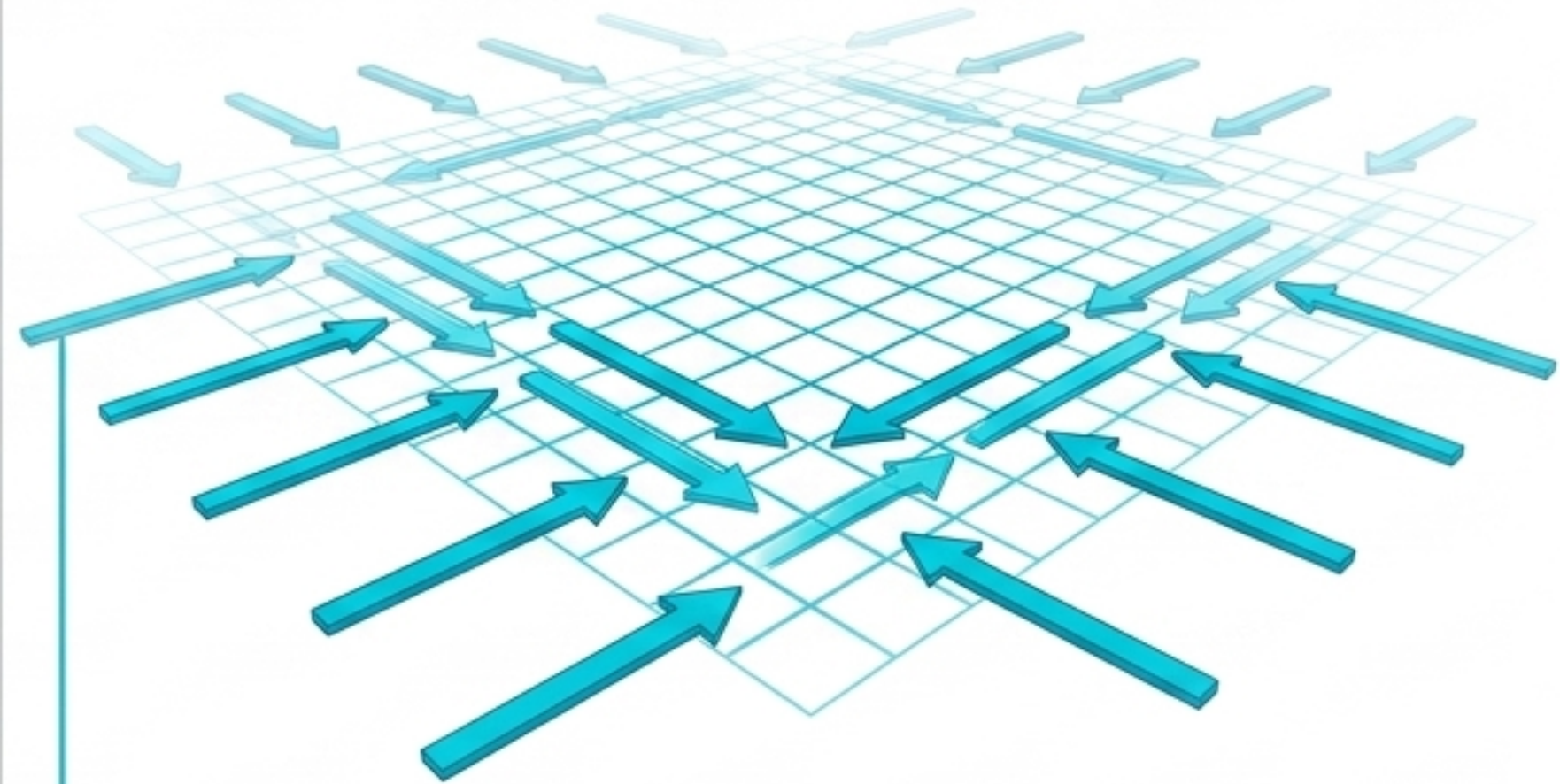
# Resolving the Missing Baryon Problem via an Open Budget

The Closed Budget



**Closed System:** Fixed primordial budget, permanently short.

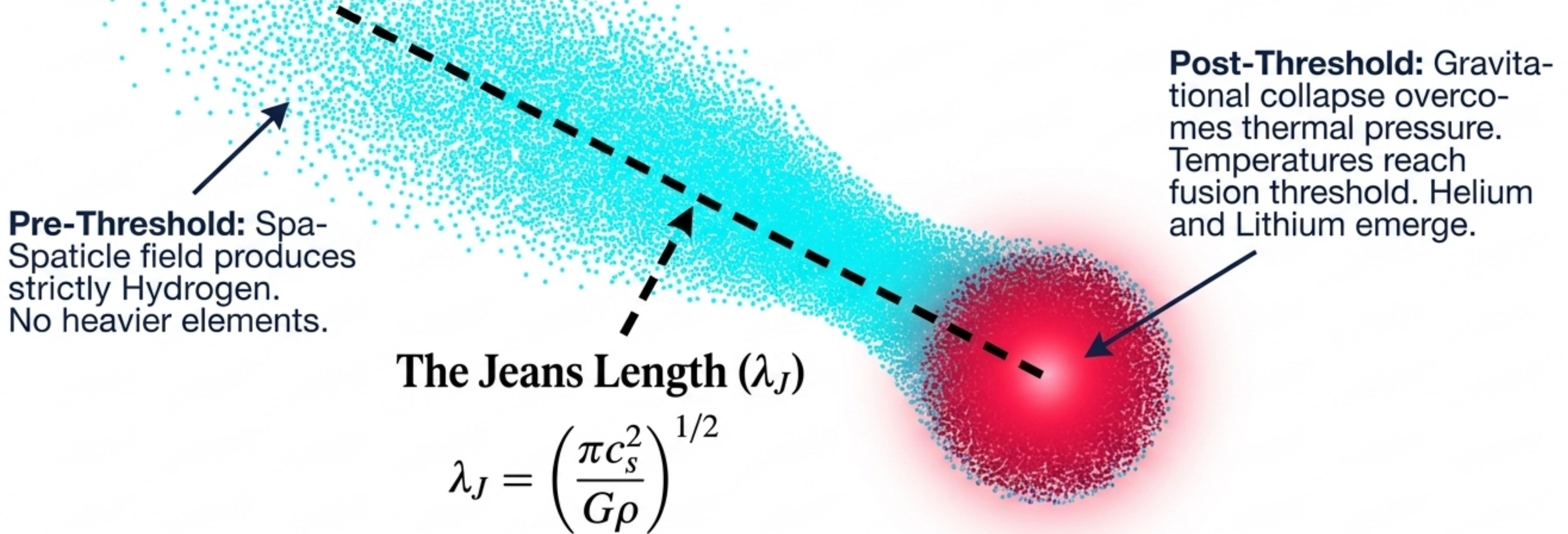
The Open Budget



**Open System:** Continuous substrate hydrogen production across all cosmic time ( $\rho_s = 5.9 \times 10^{-27} \text{ kg/m}^3$ ).

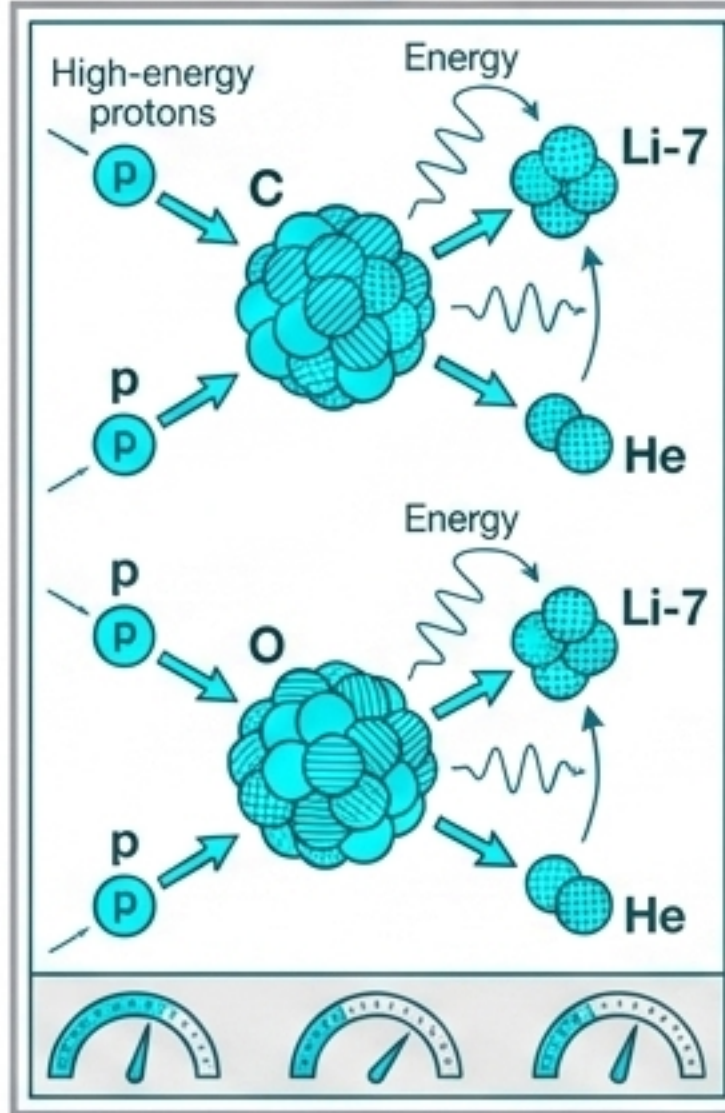
# The Strict Physical Boundary for Heavy Element Formation

## Heavy Element Formation



# The Physics of Regulated Surface Abundance

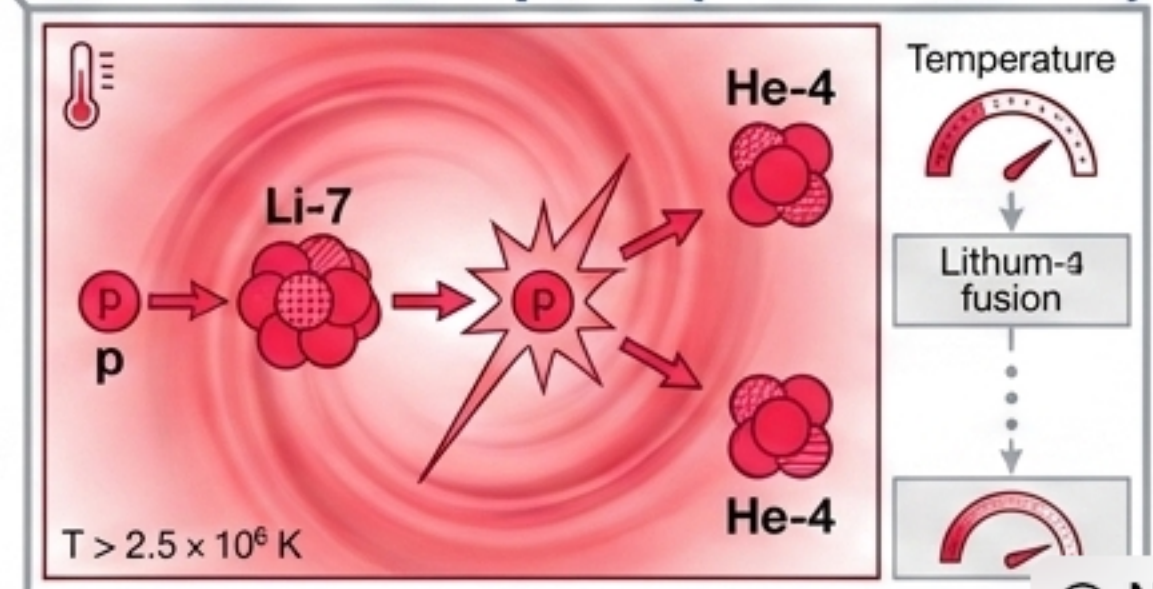
## Cosmic-Ray Spallation



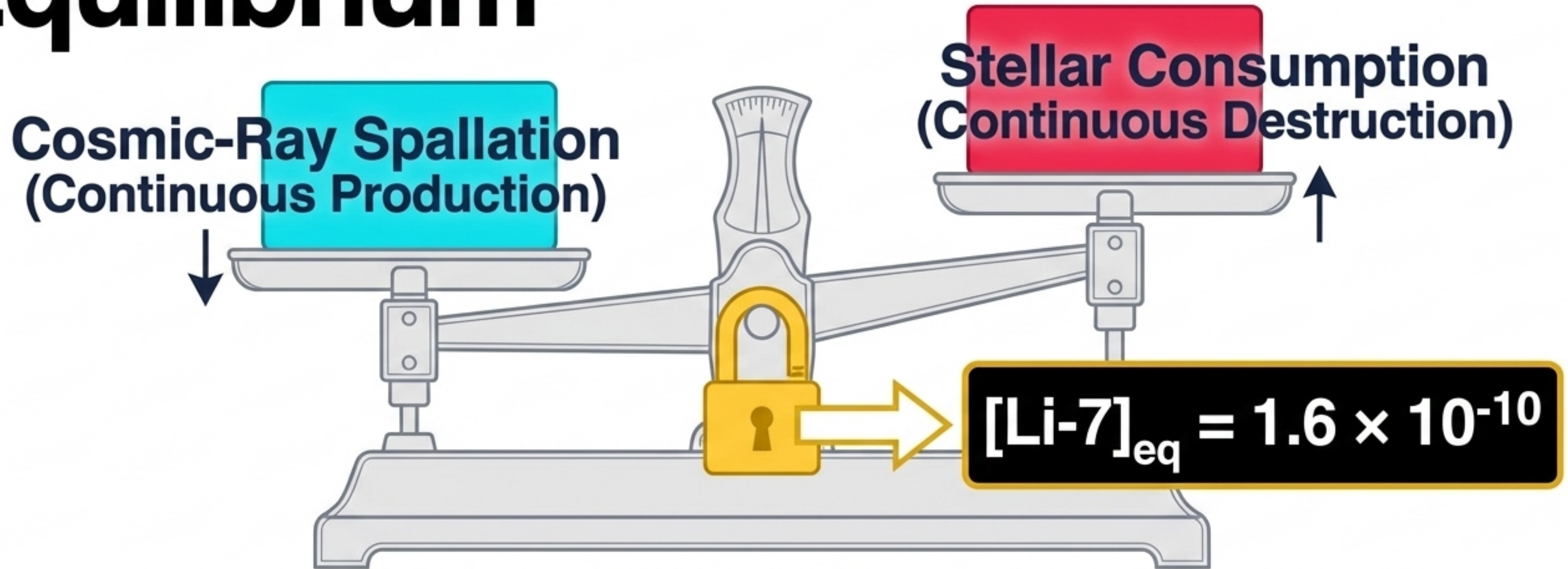
$$\frac{d[\text{Li-7}]}{dt} = R_{\text{production}} - k_{\text{dest}} \times [\text{Li-7}] \times [p] = 0$$

Steady-State Equilibrium

## Stellar Consumption ( $T > 2.5 \times 10^6 \text{ K}$ )



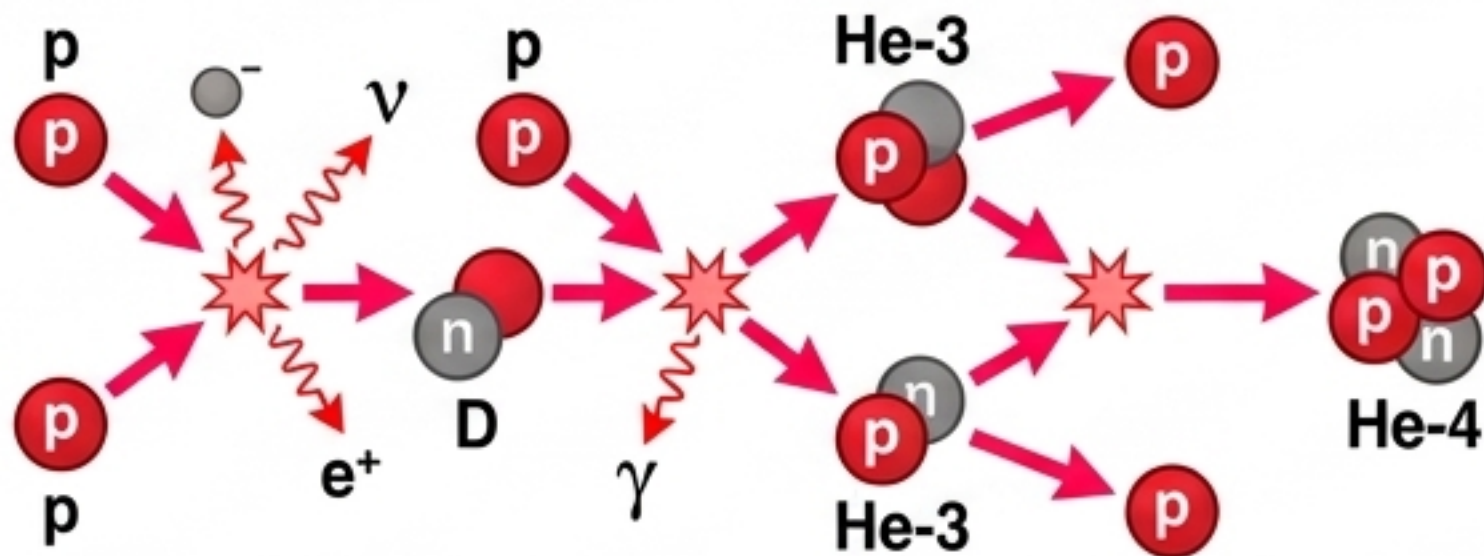
# The Spite Plateau as a Dynamic Equilibrium



By balancing observed interstellar production with measured stellar envelope processing, the equilibrium settles precisely at the observed plateau, requiring no new nuclear physics and no ad hoc universal depletion patches.

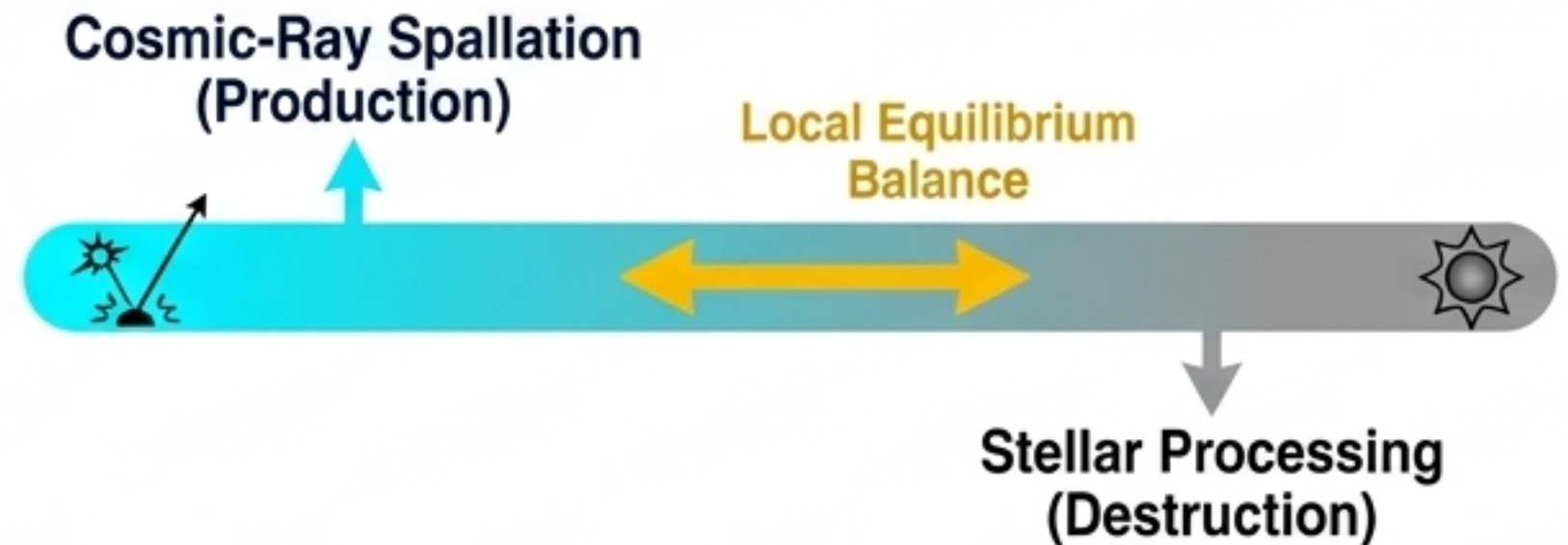
# Equilibrium Dynamics of Helium-4 and Deuterium

## Helium-4 (He-4) Accumulation



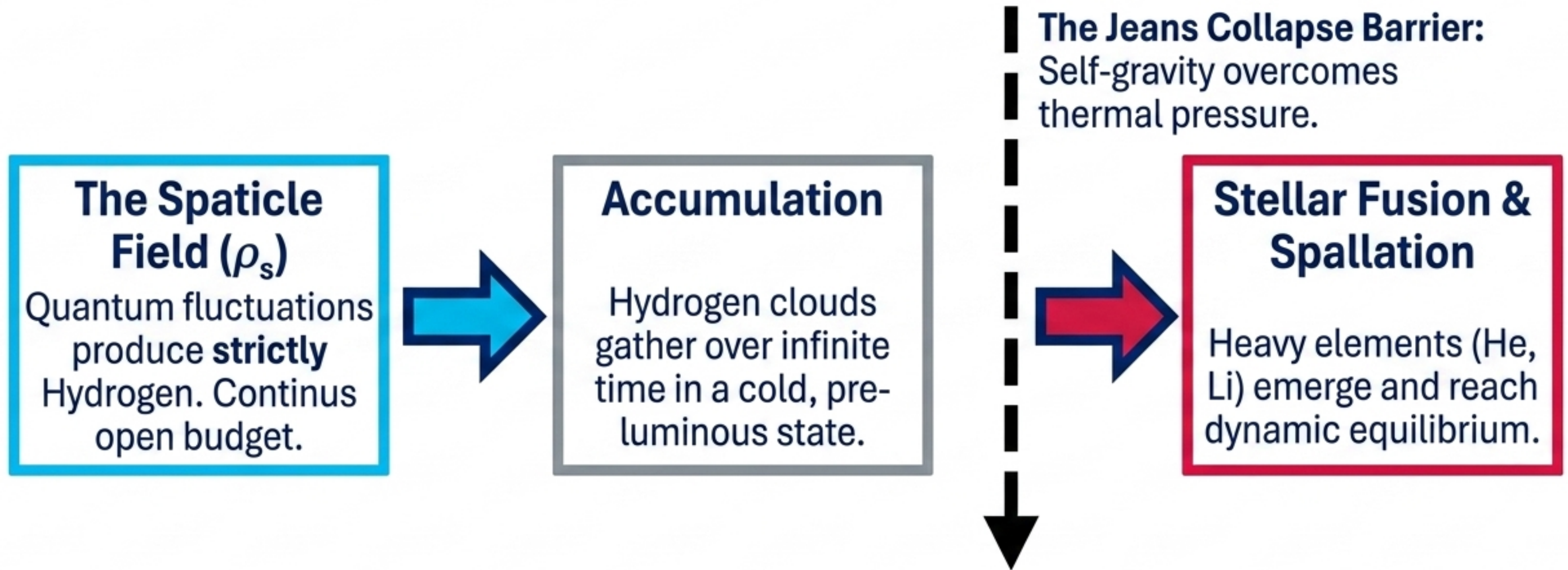
The 75:25 ratio is not a primordial constraint. It is the natural accumulation equilibrium of ordinary stellar hydrogen burning, governed entirely by the nuclear binding energy of He-4 and standard stellar temperatures.

## Deuterium (D) Balance



Observed Deuterium is the balance of cosmic ray spallation (production) and stellar processing (destruction). The observed gradient (higher in pristine clouds, lower near activity) reflects local equilibrium balances, not varying preservation of a frozen relic.

# The Unified Sequence of Matter Formation



Matter formation is not a one-time historical event. It is an ongoing, continuous sequence operating everywhere in the infinite universe today.

# Falsifiable Predictions and Observational Tests

## Test 1: Spite Plateau Stability

Environments of genuinely zero prior stellar processing will show Lithium-7 values at or below  $1.6 \times 10^{-10}$ , rather than approaching the BBN prediction of  $5.6 \times 10^{-10}$ .

## Test 2: Deuterium Gradient Correlation

High-resolution surveys (CMB-S4) will show deuterium abundance quantitatively correlates with local cosmic ray flux (production) and local stellar density (destruction), rather than merely stellar processing history.

## Test 3: No Universal Depletion Rescue

No ad-hoc, fine-tuned universal depletion mechanism will be found that forces the  $5.6 \times 10^{-10}$  BBN prediction down to the Spite plateau identically across all stellar masses and metallicities.