Big Bang as a Detonation: A Hypothesis of Matter-Antimatter Annihilation in Analogy to Explosive Material

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Abstract

We propose a model in which the Big Bang (BB) is analogous to the detonation of an explosive material. In our hypothesis:

- The process of **matter (M) and antimatter (A) annihilation** is the engine driving expansion.

- **Baryogenesis was always conserved** – the amount of A remains equal to the amount of M, but they are geometrically separated due to differences in gravitational interaction, with A accumulated at the hypothetical "edge" of the Universe.

- The initial energy, resulting from Einstein's relation $E = Mc^2$, underwent a transformation. A significant part of it transformed into **energy associated with spacetime**, manifesting as **dark energy** with density ρ_V, which drives the expansion.

- The volume of spacetime (V) is a consequence of this expansion, "powered" by dark energy.

The properties of the edge W and antimatter are the subject of a separate hypothesis.

1 Foundations and Analogy

1.1 Fundamental Energetic Principle

The total energy available in the Big Bang process results from Einstein's relation:

$$E_{\text{total}} = Mc^2 \tag{1}$$

where M is the total mass of matter and antimatter before annihilation.

1.2 Analogy to Explosive Material (EM)

We propose the following analogy:

- **Explosive Material (EM):** A condensed mixture of fuel and oxidizer (e.g., $H_2 + O_2$). Energy is stored in chemical bonds.

- **Detonation of EM:** A chemical reaction converting liquid into gases at high temperature and pressure. The gas expands, performing work.

- **Initial State of BB:** A "condensate" of matter and antimatter, maintained in a metastable state by a barrier preventing immediate annihilation. Energy is stored in rest mass.

- **Ignition/BB:** The collapse of the separating barrier, initiating a chain reaction of annihilation.

- **Annihilation:** A process "converting" mass into pure energy. This energy, according to our hypothesis, not only creates photons and residual matter but also **creates spacetime and endows it with the property of expansion**, identified with dark energy.

2 Model of the Hypothesis: Energy Distribution

The hypothesis postulates that the initial energy $E = Mc^2$ was distributed into two main components:

1. Traditional **released energy** (E_{released}): kinetic energy, radiation (photons).

2. **Energy associated with spacetime** (E_{SP}): energy that created spacetime and endowed it with the property of expansion, described by a constant density ρ_V.

This can be written as an energy balance equation:

$$Mc^2 = E_{\text{released}} + E_{\text{SP}} \tag{2}$$

A key assumption is the identification of spacetime energy with the dark energy content in volume V:

$$E_{\text{SP}} = \rho_V V \tag{3}$$

where:

- $\rho_V = 6 \times 10^{-10}\,\text{J/m}^3$ – vacuum energy density (dark energy),

- V – volume of the observable Universe associated with expansion driven by ρ_V.

Combining equations (2) and (3), we obtain a phenomenological description of the distribution:

$$Mc^2 = E_{\text{released}} + \rho_V V \tag{4}$$

This equation does not create new energy – it only describes **how** the initial energy Mc^2 was distributed.

2.1 Inflation Phase as Detonation

Within the analogy:

- The **Inflation phase** corresponds to the instantaneous detonation of the main charge.

- **Annihilation** $A + M$ generates "gases" – i.e., endows spacetime with the property of expansion ($E_{\text{SP}} = \rho_V V$) – and "explosion energy" (E_{released}).

- The **End of inflation** is the cessation of the annihilation reaction due to the separation of A from M.

3 Computational Example

Electron-Positron Annihilation

Energy of annihilation for an $e^- e^+$ pair:

$$E_{\text{annihilation}} = 2m_e c^2 \approx 1.64 \times 10^{-13}\,\text{J}$$

According to the hypothesis, part of this energy could have been transferred to the "creation" of spacetime volume. Assuming all annihilation energy went to this purpose (approximation):

$$\Delta V = \frac{E_{\text{annihilation}}}{\rho_V} = \frac{1.64 \times 10^{-13}\,\text{J}}{6 \times 10^{-10}\,\text{J/m}^3} \approx \boxed{2.7 \times 10^{-4}\,\text{m}^3} \quad (\approx 273 \text{ cm}^3)$$

This volume is close to that of a tennis ball. This example illustrates the scale of the effect postulated by the hypothesis.

4 Discussion and Conclusions

- The hypothesis presents the Big Bang not as a creation from nothing, but as a phase of instantaneous "detonation" of a precursor state of matter and antimatter.

- The **Separation of A and M** at the edge of the Universe explains the conservation of symmetry $A = M$ and ends the phase of violent annihilation.

- **Dark energy** is not a mysterious addition but a direct energetic product of the annihilation process, "powering" the expansion of spacetime. It is analogous to post-explosion gases which expand under high pressure and temperature, occupying a large volume.

- Equation (4) is **phenomenological** and describes an energy balance, not a fundamental law of nature. Its purpose is to quantitatively relate observed quantities (ρ_V, V) to the initial energy of the process.

The hypothesis opens the way for further consideration of the mechanism of matter-antimatter separation and the nature of the Universe's "edge".

5 Estimates and Consequences of the Hypothesis

The hypothesis generates testable predictions regarding the amount of spacetime "created" by various processes. The following estimates are illustrative and show the scale of the phenomenon.

5.1 Spacetime Production by Stars

Example: The Sun

The Sun, through thermonuclear reactions, converts about $\Delta M = 4.3 \times 10^9$ kg of matter per second into energy (mainly radiation). Assuming for illustrative purposes that all this energy is converted into spacetime according to the model, we get:

$$\Delta V_{\odot} = \frac{\Delta M \cdot c^2}{\rho_V} = \frac{(4.3 \times 10^9 \,\text{kg}) \cdot (9 \times 10^{16} \,\text{m}^2/\text{s}^2)}{6 \times 10^{-10} \,\text{J/m}^3}$$
$$= \frac{3.87 \times 10^{26} \,\text{J}}{6 \times 10^{-10} \,\text{J/m}^3} \approx \boxed{6.45 \times 10^{35} \,\text{m}^3} \quad \text{per second}$$

This is a huge volume. However, if it were added locally (e.g., within the volume of the Solar System), it would cause observable effects, such as a systematic increase in the astronomical unit (AU), which has not been observed.

Proposed Explanation: "Leakage" into a Higher Dimensionality

To resolve this apparent contradiction, it is postulated that spacetime "generated" by astrophysical processes is not added to our 4-dimensional spacetime (SP4D) in a local manner. Instead, it **"leaks"** or "percolates" into a hypothetical, higher dimensionality (SP5D), perhaps fueling the expansion of the **Entire Universe (EU)** beyond our observational horizon.

In this interpretation, the local geometry of SP4D remains stable (stable planetary orbits), while the global geometry of the EU undergoes expansion driven by the cumulative effect of all such processes.

6 Critique of the Hypothesis and Challenges

Although the presented model offers an intriguing and illustrative analogy, it faces serious theoretical and observational challenges that must be openly discussed.

6.1 Vagueness of the Separation Mechanism

A primary challenge is the lack of a precise **physical mechanism** responsible for the initial separation of matter and antimatter and for maintaining them in a metastable state. The postulated "differences in gravitational interaction" or the existence of a "barrier" remain speculative. Modern particle physics (the Standard Model) does not predict differences in the gravitational interaction between a particle and an antiparticle. Introducing such a mechanism would require significant modifications to established theories, which have not been observed to date.

6.2 The Problem of the Universe's "Edge"

The concept of a hypothetical "edge" to which antimatter adheres is **inconsistent with the modern understanding of cosmology**. According to the cosmological principle and the Friedmann-Lemaître-Robertson-Walker model, the Universe is unbounded and has no edges or center. Introducing an absolute "edge" would constitute a radical departure from this paradigm and would generate a host of new questions about the nature of such a boundary and its interaction with spacetime.

6.3 Phenomenological Nature of the Main Equation

The energy balance equation $Mc^2 = E_{\text{released}} + \rho_V V$ is **purely phenomenological**. It describes a correlation between quantities but is not derived from any first principles of physics (e.g., from gravitational field equations). It also does not specify **exactly how** the annihilation energy is to be "transferred" to spacetime to endow it with the property of expansion. It is more of a metaphorical description than a theory with concrete dynamical rules.

6.4 The Issue of Local Energy Conservation

The process of spacetime "leakage" into a higher dimensionality, while elegant, **challenges the local conservation of energy** in our 4-dimensional spacetime. Energy produced in the nuclear process within the Sun disappears from our universe (SP4D), only to appear in another (SP5D). Such a process would be extremely difficult to reconcile with the vast body of existing observations confirming local energy conservation in all studied physical processes.

6.5 Lack of New Quantitative Predictions

For the hypothesis to be taken seriously, it should generate **new, falsifiable predictions** that differ from those of the standard ΛCDM cosmological model. In its current form, the model mainly reinterprets existing elements (dark energy as an annihilation product) using a new analogy, but does not lead to quantitatively different forecasts regarding, for example, the expansion rate, fluctuations in the cosmic microwave background, or large-scale structure.

6.6 Summary of Critique

It must be stated that the current form of the hypothesis is more of an **interesting metaphor** than a complete scientific theory. Its main value is the heuristic linking of several major puzzles of cosmology (antimatter, dark energy, inflation) into a narratively coherent whole. To become a credible alternative, the model would require: (1) Formulation of a mathematical description of the separation and "barrier" mechanism, (2) Reconciliation with, or modification of, the cosmological principle, (3) Derivation of dynamical equations from first principles, (4) Formulation of specific, falsifiable observational predictions.

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