Redefining Mass in a Space-Only Physical Ontology

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Abstract

This paper proposes a redefinition of SI units based on a foundational ontology in which only space exists. Time is not treated as an independent entity but rather as a measure of change in spatial configuration. Consequently, the only fundamental units are [meter] and [second], denoted as [m] and [s]. All other units, including mass, must be derived from these. We explore the dimensional formulation of mass within this framework as $[m^x][s^y]$, analyze candidate values of x and y, and conclude that the best fit for mass is $[m][s^{-2}]$.

1. Introduction

In standard physics, the SI unit system treats mass, length, time, electric current, temperature, and others as fundamental dimensions. However, from a foundational perspective that treats **space as the only ontological substance**, this multiplicity of fundamental units is conceptually redundant.

In the ontology proposed here, **time is not a separate dimension but the measure of spatial change**. That is, time exists only as a parameter indexing the reconfiguration of space. Therefore, all physical quantities must be re-expressed solely using units of length ([m]) and time ([s]).

This framework mandates the redefinition of all SI units using only [m] and [s]. The present paper focuses specifically on one of the most essential quantities: **mass**.

2. Reserved Units: Charge and Time

To avoid confusion in dimensional analysis, some dimensional placeholders are reserved. For example:

- **Charge** is assigned the dimension $[m^0][s^0]$, a dimensionless placeholder in this model.
- **Time** is understood purely as change in spatial configuration, and thus is not fundamental in itself.

3. Redefining Mass: The Task

We assume that mass must take a dimensional form:

$$[M] = [m^x][s^y]$$

Our goal is to determine the best-fitting values of x and y such that mass:

- Behaves correctly in fundamental equations such as $F = ma$, $E = mc^2$, and $KE = \frac{1}{2}mv^2$
- Aligns with the interpretation of mass as **resistance to spatial change**
- Stays consistent with a universe in which only space exists

4. Evaluated Combinations of $[m^x][s^y]$

x	y	Dimensions	Score	Comment
1	-2	$[m \cdot s^{-2}]$	10	Perfect match to $F = ma$, KE, $E = mc^2$
2	-2	$[m^2 \cdot s^{-2}]$	7	Same as energy; overstates mass
1	-1	$[m \cdot s^{-1}]$	6	Like momentum per velocity
3	-2	$[m^3 \cdot s^{-2}]$	6	Suggests volumetric mass field
2	-1	$[m^2 \cdot s^{-1}]$	5	Like surface flow; mismatches key laws
3	0	$[m^3]$	5	Volume only; lacks temporal resistance
3	-1	$[m^3 \cdot s^{-1}]$	4	Volume flow rate; doesn't fit F or E
2	0	$[m^2]$	4	Area only; geometrically weak
0	-1	$[s^{-1}]$	3	Mass as frequency; doesn't generalize
1	0	$[m]$	3	Too simple; no dynamic aspect
3	-4	$[m^3 \cdot s^{-4}]$	3	Excessively steep; no equation fit
3	-6	$[m^3 \cdot s^{-6}]$	2	Overpowerful dimensionally
0.5	-1	$[m^{0.5} \cdot s^{-1}]$	2	Weak; no clear physical meaning
0.5	-2	$[m^{0.5} \cdot s^{-2}]$	2	Half-area inertia? Incoherent
0	-2	$[s^{-2}]$	2	Mass with no space? Breaks ontology
-1	2	$[m^{-1} \cdot s^2]$	1	Inverse space; totally inconsistent
0	0	dimensionless	1	Reserved for charge

5. Conclusion

From the above evaluation, the dimensional form:

$$\boxed{[M] = [m][s^{-2}]}$$

is the best candidate for mass in a space-only ontological framework. This form:

- Preserves physical behavior in core equations
- Encodes mass as resistance to spatial acceleration
- Aligns with a geometry-driven model of the universe

Future work will involve redefining other SI units (force, energy, pressure, etc.) within this reduced ontology and exploring the implications for cosmology and field theories.

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References

[1] Bureau International des Poids et Mesures (BIPM). "The International System of Units (SI)," 9th edition, 2019. `https://www.bipm.org/en/publications/si-brochure`