

Proposal: The H-Kilogram — A Universal, Hydrogen-Based Definition of Mass

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Abstract

This paper proposes the H-kilogram, a new definition of mass based directly on the atomic mass unit of hydrogen-1. One H-kilogram is defined as exactly 6×10^{26} atomic mass units of hydrogen. This yields a unit of approximately 1.004 kg, maintaining close compatibility with the current kilogram while removing all historical ties to physical artifacts and Earth-derived time units.

The H-kilogram completes the H-Units framework by providing a truly universal standard of mass independent of the International Prototype Kilogram and Planck's constant as currently defined in SI.

1 Motivation

The current kilogram, even after the 2019 redefinition, still carries significant historical baggage. Its scale was originally set by a physical artifact (the 1889 International Prototype Kilogram), and its modern definition through Planck's constant remains indirectly tied to the Earth-based SI second. This creates a double dependency — both on a historical object and on Earth-based time.

A cleaner approach is possible: define mass directly from the most abundant element in the universe — hydrogen.

2 The H-Kilogram Definition

Definition: One H-kilogram is defined as exactly 6×10^{26} atomic mass units (u) of hydrogen-1 (^1H), the unbound protium atom at rest in its ground state.

This definition is independent of:

- Any physical artifact
- Planck's constant
- The SI second

Result: Using the accepted atomic mass of hydrogen-1 (1.007825 u) and the definition of the atomic mass unit, this yields an H-kilogram of approximately **1.004 kg**.

The exponent 6×10^{26} was chosen to keep the H-kilogram very close to the familiar scale of one kilogram while producing a simple, memorable definition.

3 Advantages

- **Universality:** Based solely on hydrogen, the most common element in the cosmos.
- **Independence:** Completely free from Earth-based artifacts and time units.
- **Practicality:** The resulting unit is only 0.4% heavier than the current kilogram, allowing easy conversion and compatibility with existing engineering practices.
- **Conceptual Clarity:** Mass is defined directly from atomic mass units rather than through indirect constants.

4 Conclusion

The H-kilogram provides a clean, universal definition of mass that aligns with the H-Units philosophy: start with hydrogen, derive everything else from first principles.

Together with the H-second and H-meter, it forms part of a coherent, Earth-independent measurement system suitable for the multi-planetary era.