H-Units in the Quantum Domain (Planck's Constant & Scales)

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Abstract

We extend H-units to quantum phenomena by expressing Planck's constant in cycles per H-second. The H-Planck choice sets $\hbar \equiv 1$ (exact), which fixes the unit of action. The H-kilogram is then defined such that Newton's constant $G \equiv 1$ (exact). The resulting system yields the mathematically purest form of black-hole thermodynamics: $T_{\mathrm{H}} = 1/(8\pi M)$ and $S_{\mathrm{BH}} = 4\pi M^2$.

1 Introduction

The H-second and H-meter eliminate Earth-based bias in classical metrology. This paper extends the framework to quantum scales and shows that two simple unit choices restore maximal mathematical elegance to quantum gravity.

2 H-Second and H-Meter Recap

The H-second (H-s) is exactly 1.5×10^9 cycles of the hydrogen hyperfine transition ($f_{\mathrm{H}} = 1.420405751768 \times 10^9\,\mathrm{Hz}$ [1]). The H-meter (H-m) is defined such that $c \equiv 3 \times 10^8$ H-m/H-s (exact).

3 Planck's Constant in H-Units

Frequency in H-units is measured in cycles per H-second (H-Hz). Planck's constant is therefore

$$h_{\mathrm{H}} = \frac{h}{t_{\mathrm{H}}} = 6.2744721019 \times 10^{-34}\ \mathrm{J \cdot cycle^{-1}}.$$

The reduced constant is $\hbar_{\mathrm{H}} = h_{\mathrm{H}}/(2\pi)$.

4 The H-Planck Choice

We adopt the natural H-Planck convention:

$$\hbar \equiv 1 \quad \text{(exact — fixes the unit of action)}.$$

The H-kilogram is then defined such that

$$G \equiv 1 \quad \text{(exact — fixes the unit of mass)}.$$

5 Black-Hole Thermodynamics in H-Planck Units

With $\hbar = c = G = k_{\mathrm{B}} = 1$, the Hawking temperature and Bekenstein–Hawking entropy become

$$T_{\mathrm{H}} = \frac{1}{8\pi M}, \tag{1}$$

$$S_{\mathrm{BH}} = 4\pi M^2, \tag{2}$$

containing *no additional constants*.

This is the pristine form celebrated in conventional Planck units, but now realised in a system any radio telescope can build from the 21-cm line.

6 Practical Realisation

Laboratory hydrogen masers realise the H-second to $\leq 10^{-15}$. With the exact choices $\hbar \equiv 1$ and $G \equiv 1$, the full quantum-gravity unit system is reproducible at the highest level of modern metrology.

7 Conclusion

Two simple, natural unit choices — hydrogen for time, light for length, $\hbar = 1$ for action, $G = 1$ for mass — give us a measurement system that is cosmically reproducible, practically realisable, and mathematically perfect. Earth keeps SI. The cosmos inherits H-units.

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References

[1] P. J. Mohr et al., "CODATA Recommended Values of the Fundamental Physical Constants: 2022," *Rev. Mod. Phys.* **97**, 025002 (2025).