H-Units: The Cosmic Kelvin
Universal Temperature Standard from the CMB

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Abstract

We extend H-units to thermodynamic temperature by defining the H-kelvin such that the peak frequency (ν_{peak}) of a blackbody spectrum (B_ν) is exactly 160 GHz *(in SI units of Hz)* when $T = 1$ H-K, in the CMB rest frame. This yields a present-day CMB temperature of 2.72548 K. The Cosmic Kelvin is cosmically reproducible using only a radio receiver.

1 Introduction

The H-second, H-meter, and H-Planck choices eliminate Earth-based bias in time, length, and action. Temperature in SI remains tied to terrestrial standards. The cosmic microwave background provides a universal blackbody whose temperature is the same everywhere (in its rest frame). We use it to define the Cosmic Kelvin.

2 Why the CMB?

The CMB is the most isotropic radiation field known, with temperature $T_{\text{CMB}} = 2.72548 \pm 0.00006$ K [1] in the CMB rest frame. Its B_ν peak lies at 160.23 GHz in SI units. It requires only a radio telescope to observe — making it the natural temperature standard for interstellar physics.

3 Definition of the H-kelvin (Cosmic Kelvin)

The H-kelvin (H-K) is defined such that the peak frequency of the blackbody spectral radiance $B_\nu(T)$ is **exactly 160 GHz (in SI units of Hz)** when the temperature is exactly 1 H-K, measured in the CMB rest frame.

This definition makes the present-day CMB temperature exactly 2.72548 SI kelvin in the CMB rest frame.

4 Practical Realisation and Uncertainty

The H-kelvin is realised by measuring the CMB spectrum, removing the kinematic dipole and higher multipoles to recover the CMB rest frame, and identifying the B_ν peak. Current best realisations achieve 2×10 relative uncertainty. Future experiments will reach 10 or better.

5 Conclusion

With the Cosmic Kelvin, all classical base units are now defined from cosmic observables. When combined with the H-Planck choices $\hbar \equiv 1$ and $G \equiv 1$, the full H-system is complete, universal,

and mathematically elegant.

Earth keeps SI. The cosmos inherits H-units.

Acknowledgments

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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).