The 18 Energy Levels in Lockyer's Proton Model. A Thermodynamic Constraint?

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Abstract

In Lockyer's model, the proton incorporates 18 nested energy levels, akin to Russian dolls. The strength of this model lies in its precise alignment with the CODATA proton-to-electron mass ratio (1836.15267389), matching the first seven significant figures, surpassing the approximate estimates (1836) of standard theories. This model relies on two unexplained constants: the geometric growth factor of energy levels and the total number of levels. This paper focuses exclusively on the latter, exploring why the structure stabilizes at exactly 18 nested energy layers. We propose a thermodynamic interpretation based on blackbody radiation limits in the early universe, suggesting that the energy density during the hadronization phase, via wavelength constraints, naturally favors 18 shells over other values.

Keywords: proton structure, early universe, blackbody radiation, energy shells, Lockyer model, hadronization, symmetry

1 Introduction

The Lockyer model [1] proposes that a proton is a positron incorporating 18 nested, increasing energy levels, structured like Russian dolls. Two free parameters were required to match observed data: (1) a geometric factor between energy levels, and (2) the total number of embedded shells. The first parameter will be addressed in a separate article. Here we concentrate on the second: why the number of energy nested levels is precisely 18.

2 Proton Structure and Energy Levels

Postulating that the 18 levels of Lockyer's proton model correspond to two series of 9 levels on perpendicular planes coupled together, we observe that 2×9 levels provide enhanced stability in our 3D world compared to 2×6 or 2×12 levels. We will compare the energies required to construct three proton structures—12, 18, and 24 nested levels within the zeroth level—using Lockyer's model, and contrast these with theoretical QGP temperatures during hadronization. The wavelengths of the highest energy levels for these structures are calculated as 5.75×10^{-15} m, 7.2×10^{-16} m, and 9×10^{-17} m for 12, 18, and 24 levels, respectively. These are depicted as vertical red lines on the spectral graph below.

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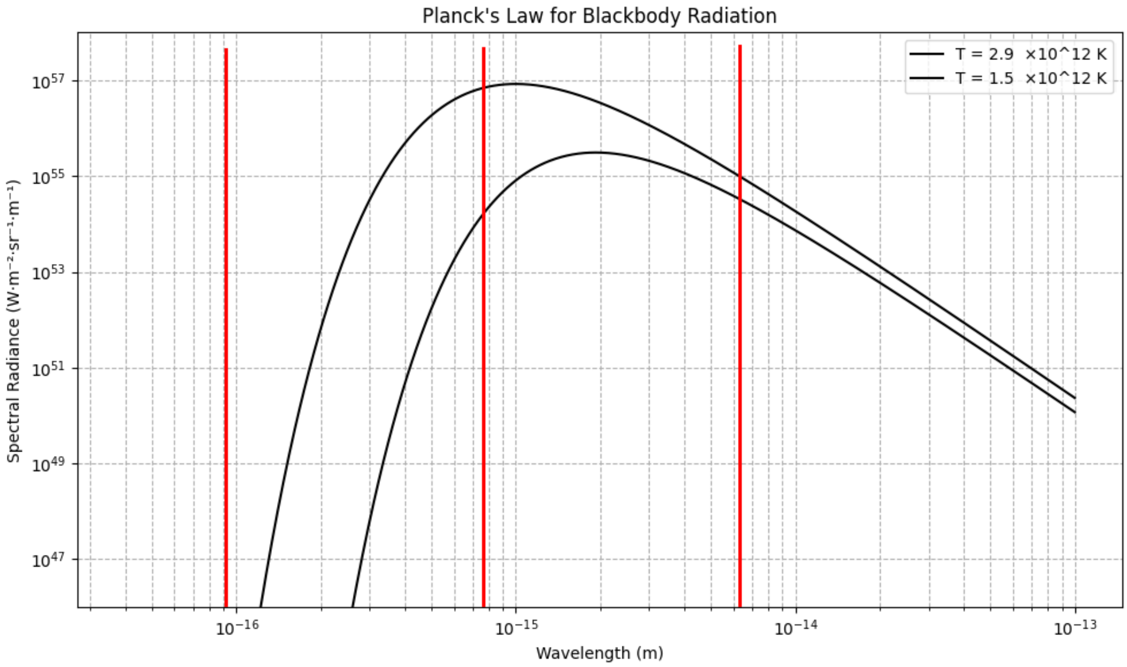

Figure 1: Planck spectrum at high and low temperature estimates corresponding to the hadronization epoch. Vertical lines indicate the shortest wavelength required for a proton with 12, 18, and 24 levels, respectively.

3 Spectral Analysis and Hadronization Temperatures

The temperature of the quark-gluon plasma (QGP) at the hadronization epoch, marking the transition to hadron formation in the early universe, is estimated through theoretical models and experimental data.
Lattice quantum chromodynamics (QCD) calculations predict a critical temperature of 150 to 170 MeV (approximately 1.8×10^{12} to 2.0×10^{12} K) for this transition, as reported by Aoki et al. (2006) [5]. Experiments involving heavy-ion collisions at RHIC and LHC corroborate these estimates, with effective temperatures measured between 150 and 220 MeV (approximately 1.8 $\times 10^{12}$ to 2.6×10^{12} K), derived from particle spectra and jet quenching phenomena (Adams et al., 2005 [6]; Aad et al., 2010 [7]). Some cosmological models and experimental analyses, such as those by the ALICE Collaboration (2012) [8], suggest temperatures reaching up to 250 MeV (approximately 2.9×10^{12} K) under extreme conditions. These estimates combine rigorous theoretical approaches and experimental observations, providing a consistent range for the QGP temperature at hadronization.

The shape of the blackbody radiation spectrum, governed by Planck's law [3], depends on temperature. Using high and low estimates of the plasma temperature during hadronization—ranging from 1.5×10^{12} K to 2.9×10^{12} K—we compute the spectral radiance for both temperatures.
The shortest wavelengths of Lockyer's proton are derived from the rationalized Compton wavelength of the electron ($\lambda_{C,\text{rationalised}} \approx 3.861 \times 10^{-13}$ m), divided by a geometric correction factor of approximately 1.05 (deduced from the proton's magnetic moment and the fine-structure constant), and further scaled by $\sqrt{2}^n$, where n is the level number. We found: for $n = 12$, $\lambda = 3.861 \times 10^{-13}/(1.05 \times (\sqrt{2})^{12}) \approx 5.75 \times 10^{-15}$ m; for $n = 18$, $\lambda \approx 7.2 \times 10^{-16}$ m; and for $n = 24$, $\lambda \approx 9 \times 10^{-17}$ m, Those wavelengths are showned in the graphic with vertical lines.

4 Analysis of the Spectral Density

The figure shows blackbody spectra for high and low estimates of temperatures at the time of hadronization ($T = 2.9\times10^{12}$ K and $T = 1.5\times10^{12}$). The three vertical red lines correspond to the shortest wavelengths for three Lockyer protons with 24, 18, and 12 indented levels, respectively.

We observe:

- For 24 levels, the required wavelength lies completely outside the estimated temperatures prevailing during hadronization (theoretically and experimentally confirmed).
- For 18 levels, as predicted in the Lockyer model, we are right in the hadronization temperature range.
- For 12 levels, the spectrum supports these wavelengths, but when the temperature reached these levels, the protons constructed with 18 levels already existed and dominated the matter.

We do not have a rigorous explanation for the stability of the proton with 18 levels, but we have verified that it is in agreement with the temperatures estimated for the epoch of hadronization. In the figure, two blackbody spectra are plotted for $T = 1.5 \times 10^{12}$ K and $T = 2.0 \times 10^{12}$ K. The central blue line corresponds to the shortest wavelength necessary to build a proton with 18 levels. The red lines represent hypothetical protons with 12 and 24 energy levels.

5 Conclusion

The figure of 18 levels was the only ad hoc parameter in Lockyer's theory. We have justified this number by starting from the theoretical temperatures prevailing during hadronization, bringing it closer to the values derived from experimental data. This study adds another stone to M. Lockyer's theory [1] [2], though further research is needed to elucidate the underlying stability mechanism.

References

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