Report on the Evaluation of Chapter 24 Statistical Mechanics in "The Grand Unified Theory of Classical Physics" by Dr. Randell L. Mills

Prepared by

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Executive Summary

In my analysis, I verified calculations and equations involving Maxwell-Boltzmann, Bose-Einstein, and Fermi-Dirac Statistics found in Chapter 24 Statistical Mechanics of the book "The Grand Unified Theory of Classical Physics" (January 2020 edition) by Dr. Randell L. Mills. I verified equations and calculations to a high degree of accuracy that are associated with these statistical systems. There is a remarkable agreement between the GUTCP calculated equations and the equations I get from my calculations. I verified all the equations from 24.1 through 24.68. Plus I verified all the entries in Table 24.1.

Purpose

In Chapter 24, three different kinds of statistical distributions are described, namely Maxwell-Boltzmann statistics, Bose-Einstein statistics, and Fermi-Dirac statistics. They are thoroughly discussed, as well as when they are to be used. The differences in the three distributions are summed up in the three graphs shown in Figure 24.1 and in the entries in Table 24.1.

Next, the chapter applies Maxwell-Boltzmann statistics to molecules moving in an Ideal Gas. $n(\varepsilon)d\varepsilon$ and $g(\varepsilon)$ are derived in order to find the Energy of a Gas using the Maxwell-Boltzmann statistics. This energy is found to be equal to $E=(3/2)NkT$, which is the known result for this case. So we see that Maxwell-Boltzmann statistics are valid to use for molecules moving in an Ideal Gas.

The Maxwell-Boltzmann speed distribution of molecules in a gas is derived and plotted in Figure 24.5. Equations for v(rms), v(avg), and v(most probable) are derived from the speed distribution, and these three values are compared to each other.

Next, Bose-Einstein statistics is applied to Blackbody Radiation, Blackbody Spectra, and Planck's Blackbody Radiation Law. A discussion of Wien's Displacement Law and the Stefan-Boltzmann Law is included, as well as how both of these laws are a direct result of the Planck Blackbody Radiation Law.

Bose-Einstein statistics are also applied to the Heat Capacities of Solids, C_V. This results in the derivation of Einstein's Heat Capacities of Solids formula and a discussion of Debye's more accurate Heat Capacities of Solids theory at low temperatures.

Next, Fermi-Dirac statistics is applied to Free Electrons in Metals. The Fermi Energy of electrons in metals is derived, as well as the electrons' energy distribution. The chapter ends with a discussion of Fermi-Dirac statistics applied to the specific heat of the conduction electrons in a metal.

Calculation

I have verified that Equations 24.1-24.9 are true.

Every entry in Table 24.1 is correct and has been verified by myself.

I have verified that Equations 24.10-24.15 are also correct.

I have verified that Equations 24.18, and 24.20-24.22 are correct as listed.

I have verified that Equations 24.24-25.35 are correct.

I have verified that Equations 24.36-24.42 are correct as listed.

I have verified as correct the Equations 24.43-24.53.

I have also verified as correct the Equations 24.54-24.60.

I have verified that Equations 24.61-24.68 are correct.

Conclusion

I was able to verify the GUTCP results of Chapter 24 in excellent agreement with my own calculations and derivations of equations. I successfully reproduced all of the equations found in Chapter 24. I verified that all of the entries in Table 24.1 were correct. This chapter demonstrates that the GUTCP theory is successful at describing Maxwell-Boltzmann Statistics, Bose-Einstein Statistics, and Fermi-Dirac Statistics, to a high degree of accuracy.

I find my results and calculations to be confirmation that the derivations and equations of Chapter 24 are indeed reproducible, accurate, and valid.