Plasma Characterization Applied to an Understanding of Ion Acoustic Waves

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Plasmas, such as an aurora borealis or a lightning strike, are a fundamental state of matter that can provide solutions to Earth's greatest challenges. However, this growing field of physics and engineering is barely touched in the modern high school curriculum. Using an Ion Acoustic Wave, we established an analogy to classical physics to help integrate plasma physics into the classroom and ground a complex topic onto a field students already understand. Additionally, the analysis and characterization of a steady-state, filament generated argon plasma are investigated. A vacuum chamber was filled with argon gas before a tungsten filament undergoing thermionic emission ionized the argon atoms and created the steady-state plasma. Ion Acoustic Waves were produced by a biased grid and received by a mounted probe. Data including ion sound speed, plasma temperature, plasma density, and damping were analysis using wave signals and MATLAB. Calculated ion sound speed, plasma temperature, density, and damping range were 1940 +/- 29.6 m/s, 1.62 +/- 0.047 eV, 4.09E+15 +/- 4.84E+14 m-3, 5.3 cm, respectively. This study began to illustrate a connection or analogy between plasma physics and classical physics through the use of Ion Acoustic Waves to characterize a plasma. Further experiments will expand on this connection through non-collisional/Landau damping in a multi-species plasma.

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