

Abstract Submitted
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Adiabatic expansion of electron gas interacting with a magnetic nozzle KAZUNORI TAKAHASHI, Tohoku University, CHRISTINE CHARLES, ROD BOSWELL, The Australian National University, AKIRA ANDO, Tohoku University — A specially constructed experiment shows the near perfect adiabatic expansion of an ideal electron gas resulting in a polytropic index greater than 1.4, approaching the adiabatic value of $5/3$, when removing electric fields from the system, while the polytropic index close to unity is observed when the electrons are trapped by the electric fields. The measurements were made on collisionless electrons in an argon plasma expanding in a magnetic nozzle. The collision lengths of all electron collision processes are greater than the scale length of the expansion meaning the system cannot be in thermodynamic equilibrium, yet thermodynamic concepts can be used, with caution, in explaining the results. In particular, a Lorentz force, created by inhomogeneities in the radial plasma density, does work on the expanding magnetic field reducing the internal energy of the electron gas which behaves as an adiabatically expanding ideal gas.

Kazunori Takahashi
Tohoku Univ

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