

Abstract Submitted
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Laboratory plasma with cold electron temperature of the lower ionosphere SHANNON DICKSON, SCOTT ROBERTSON, University of Colorado at Boulder — For the first time, plasma with cold electron temperatures less than 300K has been created continuously in the laboratory. The plasma is created in a cylindrical double-walled vacuum chamber in which the inner chamber (18cm in diameter and 30cm long) is wrapped in copper tubing through which vapor from liquid nitrogen flows, providing a cooling mechanism for the neutral gas. The inner chamber has two negatively-biased filaments for plasma generation and a platinum wire Langmuir probe for diagnostic measurements. Neutral gas pressures of 1.6mTorr and a total filament emission current of 2mA are used to obtain plasma densities near $4 \times 10^8 \text{ cm}^{-3}$. When carbon monoxide is used as the working gas, decreasing the neutral gas temperature also decreases the cold electron temperatures, yielding cold electrons with 21meV (240K) when the neutral CO is at 150K. The same experiment conducted with H₂, He, or Ar results in a doubling of the cold electron temperatures, yielding 80meV (930K) when the neutral gas is at 150K. The lower electron temperature with CO is attributed to the asymmetric CO molecule having a nonzero electric dipole moment which increases the cross section for electron energy exchange. Nitric oxide, a dominant constituent of the ionosphere, has a similar dipole moment and collision cross section as carbon monoxide and is likely to be equally effective at cooling electrons.

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