Abstract Submitted
for the GEC06 Meeting of
The American Physical Society

Probe diagnostics in low pressure dc discharge. Does the Langmuir Paradox exist? VALERY GODYAK, BEN ALEXANDROVICH, ABDUR RAHMAN, Osram Sylvania — Maxwellian electron energy distributions in a highly non-equilibrium plasma of low pressure dc discharges is one the oldest and fascinating mysteries of gas discharge physics. There is extensive literature and many hypotheses attempting to explain this paradox, but the problem still remains unsolved. In this report we present results on the EEDF measurement in the positive column of a dc discharge in mercury vapor with differently oriented probes placed along the positive column over a wide range of discharge current showed that: a) - the EEDF is not Maxwellian, b) - is essentially anisotropic, c) - is not in equilibrium with discharge current (i.e. EEDF changes along the positive column), d) - the electron temperature inferred from the measured EEDF and that determined by the slope of the probe characteristic in semi-log scale are essentially different, e) - the linearity of the probe characteristic in semi-log scale (the sign of a Maxwellian EEDF) may occurs at essentially nonlinear dependence of the second derivative of the probe characteristic on the probe voltage in semi-log scale. The main conclusions of this study are: a) - the absence of Maxwellian EEDF in the low pressure dc discharge and b) - the Druyvesteyn method is not applicable for measurement of highly anisotropic EEDF typical for the Langmuir Paradox condition.

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Date submitted: 15 Jun 2006 Electronic form version 1.4