Abstract Submitted
for the DPP16 Meeting of
The American Physical Society

Effects of temperature dependence of electrical and thermal conductivities on the heating of a one dimensional conductor[1] FOIVOS ANTOULINAKIS, PENG ZHANG, Y. Y. LAU, University of Michigan, DAVID CHERNIN, Leidos, Inc — Dependence of electrical conductivity on temperature gives rise to electrotheramal instability, an important instability for Z-pinches [1]. In other areas, ohmic heating limits the operation of nanoscale circuits such as graphene electronics, carbon nanofiber based field emitters, and nanolasers [2]. For many applications, it is important to consider the temperature dependence of the thermal and electrical conductivities when calculating the effects of ohmic heating. We examine the effects of linear temperature dependence of the electrical and thermal conductivities on the heating of a one-dimensional conductor by solving the coupled non-linear steady state electrical and thermal conduction equations. We find that there are conditions under which no steady state solution exists. In the special case in which the temperature dependence of the electrical conductivity may be neglected, we have obtained explicit expressions for these conditions. The maximum temperature and its location within the conductor are examined for various boundary conditions. We note that the absence of a steady state solution may indicate the possibility of thermal runaway. [1] K. J. Peterson, et al., Phys. Plasmas, 20, 056305 (2012). [2] P. Zhang, et al., IEEE J. Quantum Electronics, 52, 2000207 (2016).

[1]Work supported by AFOSR No. FA9550-14-1-0309, and by L-3 Communications.

Peng Zhang
Univ of Michigan - Ann Arbor

Date submitted: 14 Jul 2016 Electronic form version 1.4