**Consistent matching of plasma and sheath** KARL-ULRICH RIE-
MANN, Ruhr-University, D 44780 Bochum, Germany — Due to the sheath edge
singularity, the asymptotic ($\epsilon \sim \lambda_D/L \to 0$) plasma- and sheath solutions cannot
be matched smoothly. The sheath edge singularity, however, can be bridged by an
intermediate scale analysis accounting in lowest order both for plasma processes (e.g.
collisions, ionization, and non-planar geometry) and space charge. The possibility
to construct a uniformly valid matched asymptotic expression from the plasma -
, intermediate -, and sheath solutions was questioned in the literature. Problems
arise from the asymptotic singularities and from the ionization eigenvalue problem
of bounded plasmas (plasma balance). To clarify the topic we analyze the plasma-
sheath problem both analytically and numerically. We show that the validity of
the intermediate scale analysis is limited to a very narrow vicinity ($|\Delta\varphi| \leq 0.1$)
of the sheath edge and formulate a matched asymptotic expression uniformly valid
from the plasma core to the wall. The approximations obtained by matching are
compared with exact solutions and discontinuities in the derivatives are investigated
analytically.

Karl-Ulrich Riemann
Ruhr-University, D 44780 Bochum, Germany