

Modeling of Langmuir probe effects locally induced in tokamak edge plasma*

M.V. Umansky¹, D. Brunner², B. LaBombard², T.D. Rognlien¹

¹Lawrence Livermore National Laboratory,
Livermore, CA 94550

²MIT Plasma Science and Fusion Center,
Cambridge, MA 02139

In tokamak divertor studies, a so-called “death-ray” regime is sometimes observed where the electron pressure, as measured by Langmuir probes at the plate, exceeds the upstream values over a narrow radial region [1,2]. However recent studies on Alcator C-Mod indicate that at high SOL collisionality Langmuir probes overestimate plasma pressure and heat flux on the target plate, possibly due to the probe perturbing the plasma locally, and the death-ray over-pressure may be a result of local plasma perturbation by the probe [3]. We use the tokamak edge fluid code UEDGE for investigating the effects of probe perturbation of the plasma. The code is set up in a 2D slab-like configuration roughly matching the basic dimensions and characteristics of edge plasma in Alcator C-Mod in the regimes where the death-ray is observed. The code obtains numerical solutions when a small segment of target plate is biased, which mimics the plate-mounted probe. In the numerical solutions it is observed that at certain levels of the bias voltage, the probe substantially modifies the local plasma characteristics. Detailed mechanisms of this perturbation are investigated, and the implications are discussed.

*Work performed for USDoE at UC LLNL under Contract DE-AC52-07NA27344 and supported by USDoE Coop. Agreement DE-FC02-99ER54512

[1] B. LaBombard et al., Journal of Nuclear Materials, 241-243, p. 149-166 (1997)

[2] A. Loarte et al., Nuclear Fusion 38 (1998) 331.

[3] D. Brunner et al., APS DPP 2010, poster TP9.00069