Two-point model analysis of SOL plasma in EAST

Jie Huang[1], Yasuhiro Suzuki[1,2], Kunpei Nojiri[3], Naoko Ashikawa[1,2] and EAST team[4]

[1]National Institute for Fusion Science, National Institutes of Natural Sciences, Oroshi-cho, 322-6, Toki 509-5292, Japan

[2]Department of Fusion Science, Graduate University for Advanced Studies, SOKENDAI, Oroshi-cho, 322-6, Toki 509-5292, Japan

[3]Plasma Research Center, University of Tsukuba, 1-1-1 Tennodai, Tsukuba 305-8577, Japan

[4]Institute of Plasma Physics, Chinese Academy of Sciences, Hefei 230031, People's Republic of China

*E-mail: huang.jie@nifs.ac.jp

The plasma parameters in the scrape-off layer (SOL) are very important for characterization of both the plasma behavior in confined volume and the plasma wall interaction. Normally sophisticated two-dimensional or three-dimensional code like SOLPS [1] or EMC3-EIRENE [2,3] are used to analyze the parameter profiles of plasma boundary for magnetic fusion devices. Nevertheless, the reduced analytical models can also be applied for rough estimate of the characteristics of plasma boundary, which can give a qualitative insight into physics of transport process in SOL and save the computation time. One simplest and useful analytical model is the two-point model, which is based on the three basic equations, i.e. the heat conduction, the pressure balance and the power balance equations. The basic two points are referred to the upstream and target, hence it is also called as the zero-dimensional divertor model.

In this work a refined two-point model is proposed to investigate the equilibrium influence on the divertor plasma in EAST tokamak. To extend the model to the main SOL region, a series of the upstream points are set on the midplane from separatrix to the wall and the reciprocal target points are searched by the field line tracing method in the cylindrical coordinate. Given the appropriate upstream density and power decay length and other control parameters, the density, temperature and particle flux profile on the divertor target can be calculated by the model, which are compared with the experimental observation as shown in Figure 1. The modeling result agrees well with the experimental observation. In addition, these profiles on the divertor target strongly depend on the SOL magnetic topology or the equilibrium configuration from the modeling.
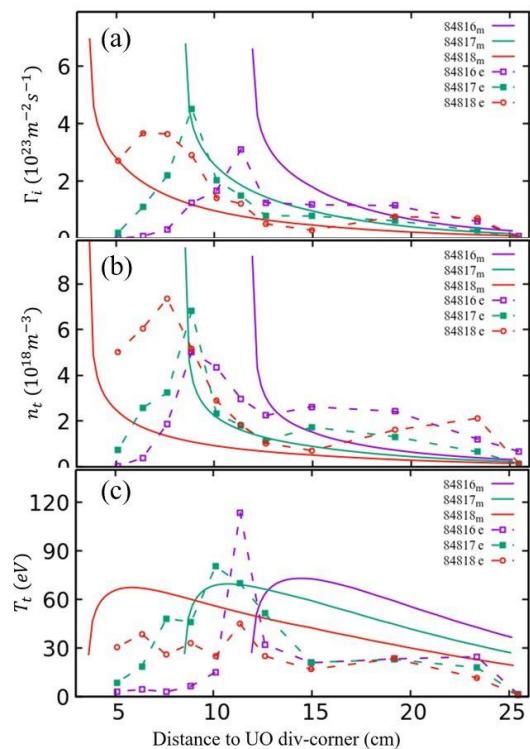

Figure 1. Profiles of (a) particle flux, (b) plasma density and (c) plasma temperature at the upper outboard for EAST shots #84816-84818 with different equilibrium configurations. The symbols with dotted line are experimental data, and the solid curves are the 2-point modeling results.

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[2] Y. Feng et al., Contrib. Plasma Phys. **44**, 57 (2004)

[3] D. Reiter et al., Fusion Sci. Technol. **47**, 172 (2005)