§41. 2-dimensional Code Development to Estimate the Environment in Laser Fusion Liquid Wall Reactor Chamber

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One of the critical issue of a laser fusion reactor with a liquid wall is the chamber clearance[1]. After micro explosion with 100 MJ nuclear yield, about 10 kg of liquid metal evaporates from the surface due to heating by α particles, ions and debris from the target. The evaporated plume makes, then, mist and clusters by collisions between plumes near the center of the liquid wall chamber. To prevent such phenomena, the structure of the first wall of the chamber is like tiles as shown in Fig. 1.

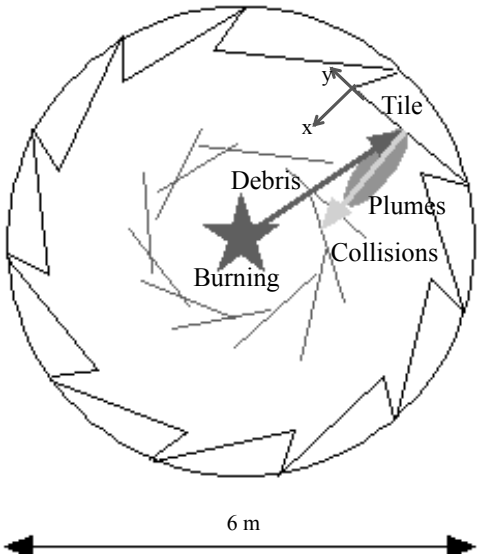

Fig. 1 The structure of the first wall of the chamber.

To experimentally simulate the ablation process, laser irradiation is often used. We, however, found that ablation process by ions is quite different from that by lasers. The range of α particles in liquid Pb is about 10 μm. As the result, superficial liquid Pb evaporates as a high density, low temperature, plasma with low ionization rate. In this study, we have developed an integrated ablation simulation code DECORE (Design Code for Reactor) to clarify the ability of the chamber clearance[2].

2-dimensional simulation is performed. Fig. 2 shows particle number density profiles obtained by 2-dimensional simulation. As shown in Fig. 2, the top of the plume at time = 9.8 μs is not spread to y-direction. If this result is true, the probability of collisions between plumes near the chamber is low.

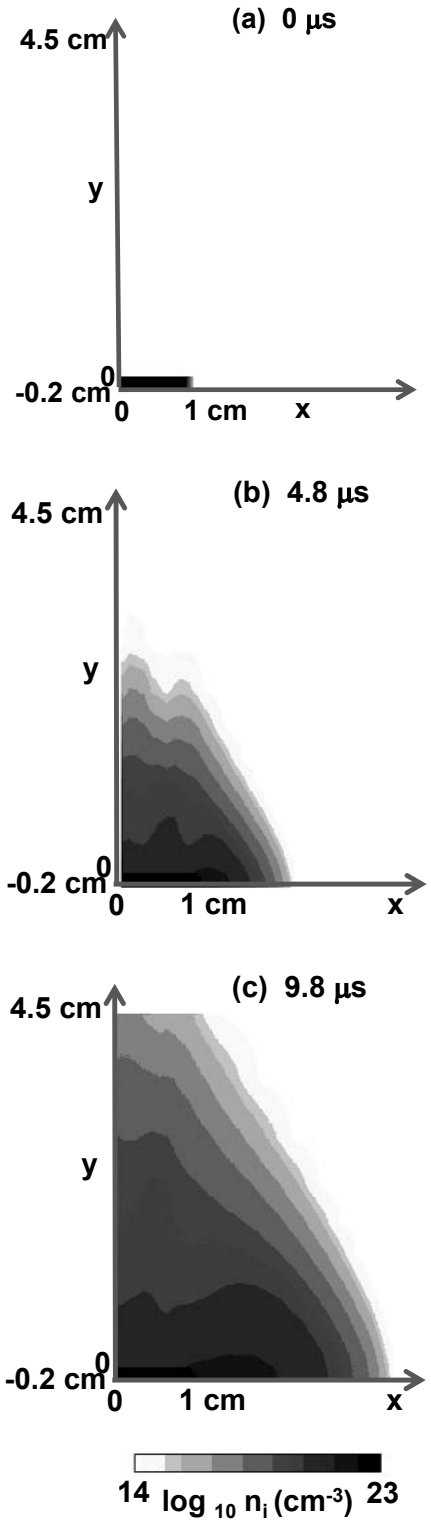

Fig. 2 Particle number density profiles obtained by 2-dimensional simulation

[1] Y. Kozaki: Fusion Science and Technology **49** (2006) 542-552.
[2] H. Furukawa, and T. Norimatsu: J. Plasma and Fusion Research **87** (2011) 51-55 (in Japanese).