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NUMERICAL STUDY ON SPLASH CONDITIONS OF AN INTEGRATED DROPLET-TYPE DIVERTOR

Xiao-Yong Luo, Ming-Jiu Ni, Alice Ying, M. A. Abdou
Mechanical and Aerospace Engineering Department, UCLA, Los Angeles, CA 90095
xyluo@ucla.edu

There are many liquid wall conceptions that have been designed for the magnetic fusion energy plant, such as CliFF, the Convective Liquid Flow First-Wall concept. The idea behind the CliFF is to eliminate the presence of a solid FW facing the plasma through which the surface heat load must conduct. This goal is accomplished by means of a fast moving thin liquid layer flowing on the FW surface. The main issue of the liquid wall concept in this design is the compatibility of a free surface liquid with the plasma. Plasma compatibility will likely set a limit on the amount of material allowed to evaporate or sputter from the surface. This evaporation limit will in turn give a surface temperature limit to the flowing liquid layer**.** Strategies to minimize evaporation from the liquid wall will need to minimize the surface temperature. An integrated droplet-type divertor has been considered in the CLiFF design in order to create higher heat removal capability. One idea is to inject droplets so they strike the liquid surface at an acute angle and merge with the flow to enhance the heat transfer of the liquid walls. However, there has not been much research about critical issues relative to this approach.

In this paper, a level set method combined with the second-order RKCN projection method for the multiphase incompressible flow was developed and applied to a free surface flow divertor concept. Crank-Nicholson method for the diffusion term was used to eliminate the numerical viscous stability restriction. The high order ENO scheme was used for the convective term to guarantee the accuracy of the method. The results show the numerical methodology is successful in modeling the hydrodynamics of the multiphase flow even if severe surface deformation occurs. Through performing the different conditions of the droplets like size, velocity, inject angle, we give a detail description on the splash conditions of the integrated droplet-type divertor. The versatility of the numerical methodology shows the work can handle complex physical phenomena encountered in fusion engineering sciences.