

RESEARCH TOPIC FOR THE PARISTECH/CSC PHD PROGRAM

Field: *Materials Science, Mechanics, Fluids*

Subfield: Mechanical Engineering / Energy Engineering

Title: Numerical Simulation of Droplet Impingement for Chip Cooling Process

ParisTech School: Arts et Métiers Sciences et Technologies

Advisor(s) Name: Antoine Dazin, Francesco Romano

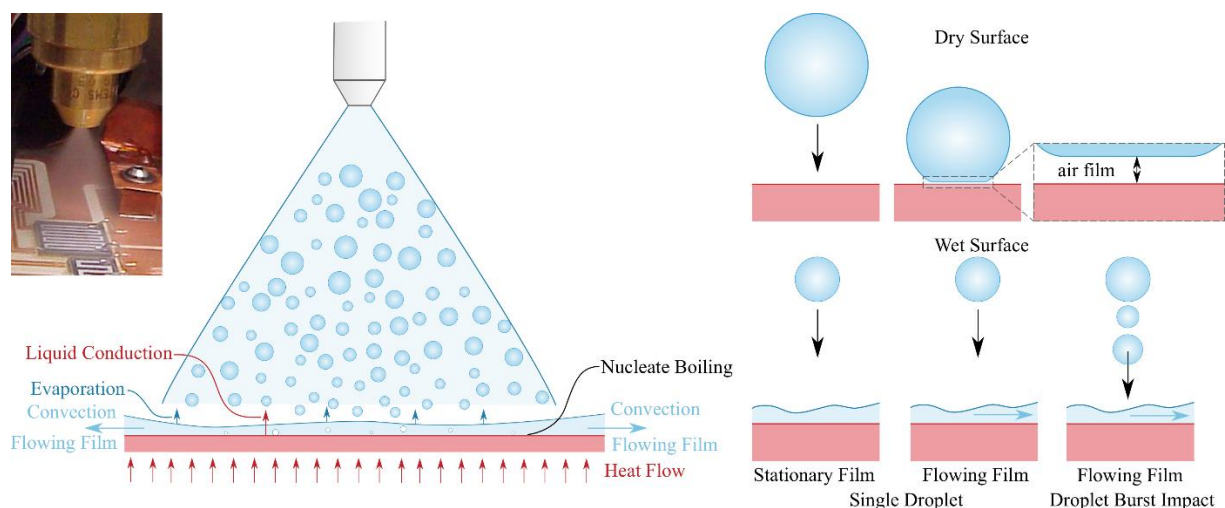
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Research group/Lab: Laboratoire de Mécanique des Fluides de Lille (LMFL)

Lab location: 8 bd Louis XIV - 59046 LILLE Cedex

(Lab/Advisor website): <http://lmfl.cnrs.fr/en/home/>

Short description of possible research topics for a PhD: Liquid spray cooling is widely employed as a high-heat-flux-removal method for electronic components generating an intense thermal load. The optimization of spraying technology is strongly related to the challenging fluid mechanics phenomena involving droplet-wall and droplet-liquid film interactions, heat transfer and phase changes (see figure). The aim of this project is to simulate the complex physics related to several configurations occurring in the spray dynamics. The first phases of the cooling process will involve the impingement of a droplet on a dry surface. Thereafter, when a thin film of liquid formed on the chip, the droplets will impact on a stationary liquid film coating the hot wall. Finally, for heavier coolant flow rates, the liquid film on the wall will start flowing and the droplet(s) will impinge on a moving liquid surface. The droplet(s) dynamics will be simulated using a scale-matching technique based on multiphase numerical simulations (CFD) carried out with the in-house solver developed at LMFL [1]. Capillary and Marangoni stresses, heat transfer and phase change will be considered.



Required background of the student: Fluid Mechanics or Applied Mathematics

A list of 5 (max.) representative publications of the group:

1. M. Muradoglu, F. Romano, H. Fujioka, J. B. Grotberg, J. Fluid Mech., 872 (2019) 407–437.
2. F. Romano, H. Fujioka, M. Muradoglu, J. B. Grotberg, Phys. Rev. Fluids, 4 (2019) 093103.