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Liquid Metal Flow Control Simulation at Liquid Metal Experiment

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Successful design of liquid metal wall or divertors for nuclear fusion reactors require the understanding of the behavior of liquid metal flows. The Liquid Metal eXperiment (LMX) at PPPL has been designed in a form of a rectangular channel allowing investigation of major issues of heat transfer and magnetic field influence relevant to tokamak divertor operation. We present the numerical simulations of heat transfer in liquid metal flow and the comparison with the experimental data obtained on the LMX. Experiments with Reynolds number within 103-104 show temperature flux quadratic decay while laminar flow simulations predict exponential behavior. This difference indicates that the boundary layer physics is dominant over the heat conduction mechanism in the studied liquid metal flow. When the Hartmann layer is formed in addition to viscous boundary layer, this may become more prominent. Also, the effects of various obstacles in the flow to enhance the advection of heat were simulated and show quantitative agreement with experiments.

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Primary author: Dr MODESTOV, Mikhail (Princeton University/Nordita)

Co-authors: Prof. KOLEMEN, Egemen (Princeton University/PPPL); Mr GILSON, Erik P (Princeton Plasma Physics Laboratory); Prof. JI, Hantao (PPPL/Princeton University); Mr HINOJOSA, Jesus A. (Princeton University); Mr MAJESKI, Richard P. (Princeton Plasma Physics Laboratory); Mr KUNUGI, Tomoaki (Princeton Plasma Physics Laboratory)

Presenter: Dr MODESTOV, Mikhail (Princeton University/Nordita)

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