Abstract Submitted
for the DFD11 Meeting of
The American Physical Society

Numerical study of instability in a laminar plane wall jet LARS-UVE SCHRADER, CATHERINE MAVRIPLIS, University of Ottawa, Canada, LUCA BRANDT, KTH Mechanics, Stockholm, Sweden, UNIVERSITY OF OTTAWA, CANADA COLLABORATION, KTH MECHANICS, STOCKHOLM, SWEDEN COLLABORATION — A two-dimensional jet released parallel to a wall is called a plane wall jet. This flow type plays an important role in cooling of surfaces, e.g. in laptop processors. Developed laminar wall jets are nearly self-similar in the streamwise direction. Their instability was investigated by linear stability theory (LST) in previous studies. In this presentation, we report a direct numerical simulation (DNS) study of the linear spatial evolution of the wall jet instabilities and compare our DNS results with findings from LST. We find large discrepancies of the linear disturbance growth rates and attribute this to the incompatibility of the parallel flow assumption of LST with the rapidly evolving plane wall jet. A correction to the instability map is suggested, where especially the "stable hole" (a patch of stable conditions within the unstable region) turns out to be significantly larger than known so far. We also computed optimal initial disturbances using a method based on the adjoint Navier-Stokes equations. These disturbances evolve into traveling wave packets with maximum possible disturbance kinetic energy.

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Date submitted: 05 Aug 2011 Electronic form version 1.4