Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Travelling waves in the asymptotic suction boundary layer[1]
MATTHIAS ENGEL, MORITZ LINKMANN, School of Mathematics and Maxwell Institute for Mathematical Sciences, University of Edinburgh, Edinburgh, EH9 3FD, United Kingdom , HANNA KNAHL, ERIC JELLI, BRUNO ECKHARDT, Department of Physics, Philipps-University of Marburg, D-35032, Germany — The asymptotic suction boundary layer (ASBL) is a flow that develops over a flat bottom plate in the presence of suction through that plate, resulting in a constant boundary layer thickness. As such, it shares certain properties with parallel shear flows and spatially developing boundary layers. Travelling-wave solutions with large-scale low-speed areas that extend into the free stream, reminiscent of large-scale low-momentum zones that influence mixing and extreme events in turbulent boundary layers, have been found in the ASBL. Here, we continue such a solution with respect to Reynolds number and domain size up to domains of size $(L_x/\delta, H/\delta, L_z/\delta) = (14.5\pi, 20, 7.25\pi)$. It appears through a saddle-node bifurcation in Reynolds number and generally disappears through saddle-node bifurcations in domain size. In short domains, the structure is known to localise in spanwise direction, we find that it does not do so in the streamwise direction. We study the spatial structure of its dominant instabilities as a function of domain size, leading to a phenomenological description of breakdown scenarios of travelling-wave type free-stream coherent structures in the ASBL.

[1]This work is supported by the Priority Programme SPP 1881 "Turbulent Superstructures" of the Deutsche Forschungsgemeinschaft (DFG) under grant LI3694/1

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Date submitted: 02 Aug 2020 Electronic form version 1.4