Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Direct numerical simulation of a turbulent thermal boundary layer spatially evolving on an isothermal wall from a fully turbulent adiabatic flow MATTEO GELAIN, Safran Aircraft Engines; Laboratoire EM2C (CNRS - CentraleSupelec), OLIVIER GICQUEL, Laboratoire EM2C (CNRS - CentraleSupelec), ALEXANDRE COUILLEAUX, Safran Aircraft Engines, RONAN VICQUELIN, Laboratoire EM2C (CNRS - CentraleSupelec) — A direct numerical simulation of a spatially evolving turbulent thermal boundary layer is performed in a channel flow at $Re\tau = 395$. The domain is made of two parts in the streamwise direction. Upstream, the flow is turbulent, homogeneous in temperature and the channel walls are adiabatic. The inflow conditions are extracted from a recycling plane located further downstream so that a fully developed turbulent adiabatic flow reaches the second part. In the domain located downstream, isothermal boundary conditions are prescribed at the walls. The boundary layer, initially at equilibrium, is perturbed by the abrupt change of boundary conditions and a non-equilibrium transient phase is observed until, further downstream, the flow reaches a new equilibrium state presenting a fully developed thermal boundary layer. The study focuses on the spatial transient phase, identifies different zones in terms of active physical phenomena and contrasts these results with usual assumptions in wall-modelled large-eddy simulations. Mean and root-mean-square profiles of temperature and velocity are presented and discussed along with budgets of first- and second-order moments balance equations for the enthalpy and momentum turbulent fields.

Matteo Gelain
Safran Aircraft Engines; Laboratoire EM2C (CNRS - CentraleSupelec)

Date submitted: 29 Jul 2019 Electronic form version 1.4