Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

Rotating channel flows over rough and smooth surfaces[1] UGO PIOMELLI, WEN WU, Queen's University, JUNLIN YUAN, Michigan State University, TURBULENCE SIMULATION AND MODELLING LABORATORY TEAM
— In wall-bounded flows rotating about the spanwise axis, if the signs of the rotation and mean vorticity vectors are the same, the flow tends to be de-stabilized; if they are opposite it may become more stable. In a channel, in which the vorticity has opposite signs near the two walls, one side is unstable and the other one stable. To investigate how roughness can change these dynamics, we performed DNS of channel flows with two rotation rates ($Ro_b = 2\Omega\delta/U_b = 0.42$ and 1.0), over both smooth and rough surfaces. The roughness is modelled using an immersed-boundary method. At the high Rotation number, in the smooth case the Reynolds stresses vanish on the stable side, and the flow approaches 2D turbulence in the $x - z$ plane. When the wall is rough, the increased momentum transfer due to the roughness results in significant $\langle u'v' \rangle$ and much more isotropic turbulent fluctuations. On the unstable side both rotation and roughness tend to de-stabilize the flow. Even at mild rotation rates Townsend's similarity hypothesis does not apply on the stable side, and only approximately on the unstable one. The role of production and redistribution due to rotation in the turbulent kinetic energy budget will be discussed.

[1]The authors acknowledge the support from Hydro-Québec and the NSERC Collaborative Research Development program (CRDPJ 418786-11). The simulations were performed at CAC Queent site. UP also thanks the support of Canada Research Chair Program

Wen Wu
Queen's University

Date submitted: 28 Jul 2017 Electronic form version 1.4