Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Exact relations between Rayleigh-Bénard and rotating plane Couette flow in 2D[1] JARED WHITEHEAD, Brigham Young University, CHARLES DOERING, University of Michigan, BRUNO ECKHARDT, Universitat Marburg — Relying on an exact relationship between Rayleigh-Bénard Convection (RBC) and Rotating Plane Couette Flow (RPC) restricted to two spatial independent variables, we deduce several relations between both flows: (i) Heat and angular momentum transport differ by $(1 - R_\Omega)$, explaining why angular momentum transport is not symmetric around $R_\Omega = 1/2$ even though the relation between Ra and R_Ω has this symmetry. This relationship leads to a predicted value of R_Ω that maximizes the angular momentum transport that agrees remarkably well with existing numerical simulations of the full 3D system. (ii) One variable in both flows satisfy a maximum principle i.e., the fields' extrema occur at the walls. Accordingly, backflow events in shear flow *cannot* occur in this quasi two-dimensional setting. (iii) For free slip boundary conditions on the axial and radial velocity components, previous rigorous analysis for RBC implies that the azimuthal momentum transport in RPC is bounded from above by $Re_S^{5/6}$ with a scaling exponent smaller than the anticipated Re_S^1.

[1]This work was supported in part by the US National Science Foundation via awards DMS-1515161 and DMS-1813003, and the Simons Foundation through award number 586788. This work was initiated at the Institute for Pure & Applied Mathematics *Mathematics of Turbulence* program during the fall of 2014.

Jared Whitehead
Brigham Young University

Date submitted: 03 Aug 2020 Electronic form version 1.4