

Abstract Submitted  
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**Physics of a dynamic free-slip boundary**<sup>1</sup> CONG WANG, MORTEZA GHARIB, Caltech — Recently we demonstrate that a dynamically modulated air-water interface can reduce the wall shear stress of a turbulent boundary layer (TBL) for more than 40% (Wang & Gharib 2020). In addition, a pumping effect which increases the momentum flux of TBL was observed. Here we present the physics of modulated air-water interface. With modulation frequencies above certain cut-off criterion, the air-water interface exhibits instability features of an elastic film. The periodically oscillating air-water interface produces a mean streaming jet in the water phase. Results of DPIV measurement indicate that the streaming jet is connected to the vorticity production and transportation at the air-water interface. The current findings support our claim of significant wall skin friction reduction effect in Wang & Gharib 2020, as the streaming jet could push the near-wall vortical structures away from the wall.

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