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A theory for coupled uniform momentum zones and vortical fissures in turbulent wall flows[1] BRANDON MONTEMURO, JOE KLEWICKI, CHRIS WHITE, GREG CHINI, Univ of New Hampshire — Both field observations and laboratory experiments suggest that at high Reynolds numbers Re the outer region of incompressible turbulent wall flows self-organizes into uniform momentum zones (UMZs) separated by internal shear layers called 'vortical fissures' (VFs). In this investigation, a candidate flow configuration is identified that has the potential to generate a self-sustaining interaction between a single VF and adjacent UMZs. Large-Re asymptotic analysis is used to derive coupled, reduced sets of equations that elucidate the dominant physical processes operative in the different regions of the flow. The results indicate that large-scale, streamwise roll modes can act as a homogenizing agent that leads to the formation of the UMZs while simultaneously producing a concentrated region of spanwise vorticity that comprises the VF. The analysis also highlights possible feedback mechanisms between the VF and UMZs that may enable their self-sustenance.

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