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Transition to turbulence in reciprocating channel flow CHRISTOPHER WHITE, ALIREZA EBADI, University of New Hampshire, IAN POND, YVES DUBIEF, University of Vermont, UNH TEAM, UVM TEAM — Direct numerical simulation of reciprocating channel flow is used to study transition to turbulence in periodic flows. The simulations are performed at two Stokes Reynolds numbers: $Re_s = 648$ and 1019, representing type III (self-sustaining transition) and type IV (intermittently turbulent) flow regimes, respectively. It is found that the underlying mechanism of transition to turbulence is the emergence of an internal layer that first develops during the phases just prior to the onset of turbulence. In the absence of this internal layer (i.e., at $Re_s = 648$), the flow remains transitional over the entire cycle. An analysis of instantaneous spanwise vorticity contours suggests that the internal layer is likely formed from the concatenation of strong opposite sign (relative to the mean) vorticity concentrated in the near-wall region. This concentrated region of near-wall opposite sign vorticity leads to the rapid production of Reynolds stress and Reynolds stress divergence that underlie transition to turbulence. The flow moves towards relaminarization during the late phases in the decelerating portion of the cycle when the concentrated region of opposite sign vorticity moves toward the center of the channel and the near-wall production of Reynolds stress is diminished.

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