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Hibernating turbulence, edge states and the Virk asymptote in channel flow of Newtonian and polymeric fluids MICHAEL GRAHAM, Univ. of Wisconsin-Madison, LI XI, MIT — Turbulent channel flow of Newtonian and drag-reducing polymer solutions is studied computationally. Simulations in the minimal channel geometry reveal that, even in the Newtonian limit, there are intervals of "hibernating" turbulence that display many features of the universal maximum drag reduction (MDR) asymptote observed in polymer solutions: weak streamwise vortices, nearly nonexistent streamwise variations and a mean velocity gradient that quantitatively matches experiments (i.e. the Virk log-law). As viscoelasticity increases, the frequency of these intervals also increases, while the intervals themselves are unchanged, leading to flows that increasingly resemble MDR. Simulations in larger channel flow domains as well as turbulent boundary layers reveal spatiotemporally localized regions of active and hibernating turbulence, with hibernating turbulence becoming dominant as the level of viscoelasticity (and drag reduction) increases. Simulations of "edge states", dynamical trajectories that lie on the basin boundary between turbulent and laminar flow, display characteristics that are similar to those of hibernating turbulence and thus to the Virk asymptote, again even in the Newtonian limit.

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