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Low-drag exact coherent states in Newtonian channel flow[1] JAE SUNG PARK, MICHAEL GRAHAM, University of Wisconsin-Madison — Exact coherent states have been known to nicely capture the main features of turbulent flows such as near-wall coherent structures and streak spacing. In this study, we numerically calculate new classes of exact coherent states, specifically nonlinear traveling wave solutions, for Newtonian channel flow, which display low-drag flow features such as weak streamwise vortices and nearly nonexistent streamwise variations like those observed in polymer solutions and in Newtonian hibernating turbulence. Traveling wave solutions with various symmetries are found. While some of the structures clearly display nonlinear critical layer dynamics, in others this connection is not as clear. Dynamical trajectories are computed and some of the solutions are shown to lie on the basin boundary between laminar and turbulent flows and are thus edge-states of the flow. Lastly, the dependence of Reynolds number for the solutions is investigated. We find one intriguing family whose mean velocity profile appears to approach the so-called maximum drag reduction asymptote found in polymer solutions, despite the fact that fluid studied here is Newtonian. Our results suggest that these traveling wave solutions may play a role as promising targets for turbulence control strategies for drag reduction.

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