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On the connection between Maximum Drag Reduction and Newtonian fluid flow RICHARD WHALLEY, University of Liverpool, JAE-SUNG PARK, ANUBHAV KUSHWAHA, University of Wisconsin-Madison, DAVID DENNIS, University of Liverpool, MICHAEL GRAHAM, University of Wisconsin-Madison, ROBERT POOLE, University of Liverpool — To date, the most successful turbulence control technique is the dissolution of certain rheology-modifying additives in liquid flows, which results in a universal maximum drag reduction (MDR) asymptote. The MDR asymptote is a well-known phenomenon in the turbulent flow of complex fluids; yet recent direct numerical simulations of Newtonian fluid flow have identified time intervals showing key features of MDR. These intervals have been termed "hibernating turbulence" and are a weak turbulence state which is characterised by low wall-shear stress and weak vortical flow structures. Here, in this experimental investigation, we monitor the instantaneous wall-shear stress in a fully-developed turbulent channel flow of a Newtonian fluid with a hot-film probe whilst simultaneously measuring the streamwise velocity at various distances above the wall with laser Doppler velocimetry. We show, by conditionally sampling the streamwise velocity during low wall-shear stress events, that the MDR velocity profile is approached in an additive-free, Newtonian fluid flow. This result corroborates recent numerical investigations, which suggest that the MDR asymptote in polymer solutions is closely connected to weak, transient Newtonian flow structures.

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