Abstract Submitted
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de Gennes's theory of polymer drag reduction revisited[1] DONGHYUN LEE, RAYHANEH AKHAVAN, University of Michigan — The original theory of polymer drag reduction proposed by de Gennes [1] and its re-interpretation for wall-bounded flows proposed by Sreenivasan & White [2] give predictions which are orders of magnitude off from both DNS results and available experimental data. A revised version of this theory is developed, in which the effect of the mean shear on polymer stretching is included, and the polymer is assumed to affect the dynamics of a turbulent scale when a small fraction, on the order of $\sim 3\%$, of the turbulence kinetic energy at that scale is redirected into the elastic energy of polymer. The revised theory gives predictions in quantitative agreement with DNS and experimental results for a number of polymer drag reduction features, including the criteria for onset of drag reduction, saturation of drag reduction, MDR, and the range of turbulent scales affected by the polymer. A complete theory of polymer drag reduction is proposed to show how this minimal exchange of energy between the polymer and turbulence can lead to the dramatic drag reductions observed with polymers.

[1] de Gennes, Physica **140A**, p.9 (1986).
[2] Sreenivasan & White, J. Fluid Mech. **409**, p.149 (2000)

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