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Superhydrophobic and polymer drag reduction in turbulent Taylor-Couette flow[1] ANOOP RAJAPPAN, GARETH H. MCKINLEY, Massachusetts Institute of Technology — We use a custom-built Taylor-Couette apparatus (radius ratio $\eta = 0.75$) to study frictional drag reduction by dilute polymer solutions and superhydrophobic (SH) surfaces in turbulent flows for $15000 < \mathrm{Re} < 86000$. By monitoring the torque-speed scaling we show that the swirling flow becomes fully turbulent above $\mathrm{Re} = 15000$ and we focus on measurements in this regime. By applying SH coatings on the inner cylinder, we can evaluate the drag reducing performance of the coating and calculate the effective slip length in turbulent flow using a suitably modified Prandtl–von Kármán analysis [1]. We also investigate drag reduction by dilute polymer solutions, and show that natural biopolymers from plant mucilage can be an inexpensive and effective alternative to synthetic polymers in drag reduction applications, approaching the same maximum drag reduction asymptote. Finally we explore combinations of the two methods – one arising from wall slip and the other due to changes in turbulence dynamics in the bulk flow – and find that the two effects are not additive; interestingly, the effectiveness of polymer drag reduction is drastically reduced in the presence of an SH coating on the wall.
[1] S. Srinivasan et al., Phys. Rev. Lett. 114, 014501 (2015).

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