

Abstract Submitted  
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**Bubbly Turbulent Drag Reduction Is a Boundary Layer Effect<sup>1</sup>**

DENNIS P.M. VAN GILS, THOMAS H. VAN DEN BERG, University of Twente, DANIEL P. LATHROP, University of Maryland, DETLEF LOHSE, University of Twente — In turbulent Taylor-Couette flow, the injection of bubbles reduces the overall drag. On the other hand, rough walls enhance the overall drag. In this work, we inject bubbles into turbulent Taylor-Couette flow with rough walls (with a Reynolds number up to  $4 \cdot 10^5$ ), finding an enhancement of the dimensionless drag as compared to the case without bubbles. The dimensional drag is unchanged. As in the rough-wall case no smooth boundary layers can develop, the results demonstrate that bubbly drag reduction is a pure boundary layer effect.

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