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Non-unique frictional drag in turbulent plane Couette flows DONGRONG ZHANG, GUSTAVO GIOIA, PINAKI CHAKRABORTY, Okinawa Institute of Science and Technology — There is a long standing mystery concerning frictional drag in fully developed turbulent plane Couette flows. In manifest defiance to the predictions from dimensional analysis, experiments have consistently shown that the frictional drag, f, is not a unique function of the Reynolds number, Re. In fact, the f vs. Re data fall on two distinct curves. The origin of these two curves dates back to the 1950s when Reichardt and Robertson independently performed their classical experiments. Subsequent works have found f vs. Re data to be in accord with the Reichardt curve or with the Robertson curve. Here we examine this problem from the perspective of the spectral link, the link between macroscopic properties (like f and the mean velocity profile, MVP) and the turbulent energy spectrum. We argue that since the flow is driven by moving boundaries, the boundaries affect the large length scales of the spectrum differently in the different setups. Using the spectral link we predict that the Reichardt and Robertson curves correspond to disparate features in the MVP: the presence or absence of an overshooting wake, respectively. Whilst the different experiments and simulations did not report the spectrum, we verify our predictions by comparing the f vs. Re curves with the attendant MVPs.

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