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Determination of the Reynolds stress in canonical flow geometries. T.-W. LEE, Arizona State University — We present a new theoretical result for solving for the Reynolds stress in turbulent flows, and show how it works for canonical flow geometries: flow over a flat plate, channel flow, and axi-symmetric jets. The theory is based on fundamental physics of turbulence transport. Comparison of the current theoretical result with experimental and DNS (direct numerical simulation) data show good agreement, and various considerations of the results indicate that this is not a fortuitous coincidence, and point to radically new solutions for Reynolds stress. The theory leads to a closed-form formula for the Reynolds stress in terms of the root variables, such as the mean velocity, velocity gradient, turbulence kinetic energy and a viscous term. The form of the solution also provides insight on how the Reynolds stress is generated and distributed. This is *not* a modeling study, but a theoretical one based on physical principles although some of the nuances are still being examined. Details of the theory are submitted elsewhere, and also will be presented at the conference. The theoretical result for the Reynolds stress is compared with various experimental and DNS data. The agreement is nearly perfect at low Reynolds numbers, which gives some confidence that we have captured the true physics of turbulent transport, and that the results are not a fortuitous coincidence.

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