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Inertial-layer Mean Velocity Profiles for extreme Reynolds number flows FABIO RAMOS, HAMIDREZA ANBARLOOEI, DANIEL CRUZ, Federal University of Rio de janeiro — For fully developed statistically stationary channel and pipe flows with smooth walls, any averaged quantity of the flow at a distance y from the wall can be specified by the control parameters ρ, μ, u_τ and y itself. By the Pi theorem, there exist only three non-dimensional groups that can be formed from the combination of $\langle u\rangle(y)$ or $\frac{d\langle u\rangle}{dy}(y)$, and those quantities. In an earlier work, by observing that center of the log-law scales as the geometric mean $\sqrt{\delta\delta_\nu}$, we have proposed an attached eddy framework, which results on a new friction factor formula for extreme Reynolds number, namely $f \sim \frac{1}{Re^{2/13}}$. In this work, by assuming incomplete self-similarity, we show that the new friction factor is compatible with a new MVP formula, namely $\langle u\rangle(y) = u_\tau\Phi(\frac{y}{\delta}, \frac{y}{\sqrt{\delta\delta_\nu}})$, which in wall units result in the new expression $u^+ = A(y^+)^{1/12} + \frac{B}{Re_\tau^{1/12}}(y^+)^{1/6}$. This formula, with only two free parameters, results in a very good fit for the MVP data obtained from Princeton superpipe experiments, for a large range of extreme Reynolds number, $Re > 10^7$, and for a large radial extension above the log-law range.

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