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Physics of the Logarithmic Velocity Mean Profile<sup>1</sup> JOE KLEWICKI, University of New Hampshire, Department of Mechanical Engineering — A physical interpretation of the mathematical conditions necessary for a logarithmic (or nearly logarithmic) mean profile is presented. The basis for this interpretation is the analysis of Fife et al., (2005 JFM 532, 165) which reveals that the mean momentum balance rigorously admits a hierarchy of scaling layers each having their own characteristic length. These analyses also show that the condition for exact logarithmic dependence exists when the normalized equations of motion (normalized using the local characteristic length) attain a self-similar structure. The physics underlying this are shown to be directly associated with gradient of the turbulent force associated with the Reynolds shear stress gradient, or equivalently the axial component of the Lamb vector. These physics also indicate that the von Karman constant will only truly be invariant when an exact self-similar structure in the gradient of the turbulent force is attained across an interior range of layers comprising the hierarchy. These results are discussed relative to the physics of boundary layer Reynolds number dependence and recent data indicating that the von Karman constant varies for varying mean momentum balance.

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Joe Klewicki University of New Hampshire

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