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New DNS and modeling results for turbulent pipe flow ARNE JOHANSSON, GEORGE EL KHOURY, OLOF GRUNDESTAM, PHILIPP SCHLATTER, GEERT BRETHOUWER, KTH, LINNE FLOW CENTRE TEAM — The near-wall region of turbulent pipe and channel flows (as well as zero-pressure gradient boundary layers) have been shown to exhibit a very high degree of similarity in terms of all statistical moments and many other features, while even the mean velocity profile in the two cases exhibits significant differences between in the outer region. The wake part of the profile, i.e. the deviation from the log-law, in the outer region is of substantially larger amplitude in pipe flow as compared to channel flow (although weaker than in boundary layer flow). This intriguing feature has been well known but has no simple explanation. Model predictions typically give identical results for the two flows. We have analyzed a new set of DNS for pipe and channel flows (el Khoury et al. 2013, Flow, Turbulence and Combustion) for friction Reynolds numbers up to 1000 and made comparing calculations with differential Reynolds stress models (DRSM). We have strong indications that the key factor behind the difference in mean velocity in the outer region can be coupled to differences in the turbulent diffusion in this region. This is also supported by DRSM results, where interesting differences are seen depending on the sophistication of modeling the turbulent diffusion coefficient.

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