Abstract Submitted
for the DFD13 Meeting of
The American Physical Society

Direct numerical simulation of turbulence in a bent pipe PHILIPP SCHLATTER, AZAD NOORANI, KTH Mechanics, Stockholm, Sweden — A series of direct numerical simulations of turbulent flow in a bent pipe is presented. The setup employs periodic (cyclic) boundary conditions in the axial direction, leading to a nominally infinitely long pipe. The discretisation is based on the high-order spectral element method, using the code Nek5000. Four different curvatures, defined as the ratio between pipe radius and coil radius, are considered: $\kappa = 0$ (straight), 0.01 (mild curvature), 0.1 and 0.3 (strong curvature), at bulk Reynolds numbers of up to 11700 (corresponding to $Re_\tau = 360$ in the straight pipe case). The result show the turbulence-reducing effect of the curvature (similar to rotation), leading close to relaminarisation in the inner side; the outer side, however, remains fully turbulent. Prpoer orthogonal decomposition (POD) is used to extract the dominant modes, in an effort to explain low-frequency switching of sides inside the pipe. A number of additional interesting features are explored, which include sub-straight and sub-laminar drag for specific choices of curvature and Reynolds number: In particular the case with sub-laminar drag is investigated further, and our analysis shows the existence of a spanwise wave in the bent pipe, which in fact leads to lower overall pressure drop.

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Date submitted: 04 Aug 2013

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