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Minimal Requirements for Self-Sustained Turbulence in a Square Duct: a Numerical Investigation ALFREDO PINELLI, MARKUS UHLMANN, CIEMAT, Combustion & Gasification Division, Madrid-Spain, GENTA KAWAHARA, University of Kyoto, Kyoto-Japan — Direct Numerical Simulations of unsteady square channel flows are performed at low to moderate Reynolds numbers diminishing in a systematic way the streamwise length of the computational domain. The basic motivation of the present study is twofold. On one hand we want to determine the minimal requirements for the self-sustainment of a turbulent flow (J. Jiménez & P. Moin, JFM 225: 213-240, 1991). On the other hand, we wish to characterise the flow system on the verge of re-laminarization. Under this condition it is expected that the secondary corner vortices and the near-wall coherent structures collapse in terms of length scales leading to a global motion with a limited number of degrees of freedom. The eventual existence of this reduced basin of attraction may help in shedding some light on the generation mechanism of the secondary flow and on the mechanisms related with non-linear transitional regime. Another objective of the present work aims at establishing a detailed, highly resolved DNS description of this class of flow that received little attention in the past (S. Gavrilakis, JFM 244, 101-129, 1992, A. Huser & S. Biringen, JFM 257, 65-95, 1993).

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