Abstract Submitted
for the DFD13 Meeting of
The American Physical Society

Turbulent spots in a channel: an experimental study on the inner structure and the large-scale flow JOSÉ EDUARDO WESFREID, GRÉGOIRE LEMOULT, PMMH (UMR 7636 CNRS-ESPCI), KONRAD GUMOWSKI, Warsaw University of Technology, Inst Aeronaut & Appl Mech, Poland, MINGYANG LUO, JEAN LUC AIDER, PMMH (UMR 7636 CNRS-ESPCI) — Transition to turbulence in plane Poiseuille flow in channels, occurs in presence of localized coherent structures, known as turbulent spots, composed of an assemblage of small-scale longitudinal vortices. We present an exhaustive experimental description of these spots, in a water channel of rectangular cross section. The test section's half height is h = 10mm, its length is 220h, and its width is 15h. We study the response of the flow to a single, short perturbation, which above Re =1300 will always trigger the development of a turbulent spot. The fine structure of the flow field inside and around a turbulent spot is obtained from the measurements of the three components of the velocity fields in a cross sectionnal plane with Time Resolved Stereoscopic Particule Image Velocimetry. The flow in the turbulent can be decomposed into a large-scale motion consisting of an asymmetric quadrupole centred on the spot and a small-scale part consisting of streamwise streaks. From the observations of the temporal evolution of the energy of the streamwise and spanwise velocity perturbations, it is suggested that a self-sustaining process can occur in a turbulent spot above a given Reynolds number. We also compare the dynamical evolution of the turbulent fluctuations and the mean flow distortions, with the predictions of reduced models predicting the main features of subcritical transition to turbulence.

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Date submitted: 02 Aug 2013 Electronic form version 1.4