Abstract Submitted
for the DFD06 Meeting of
The American Physical Society

Threshold exponents of streamwise transition in pipe flows ALVARO MESEGUER, FERNANDO MELLIBOVSKY, Dept. Fisica Aplicada, Universitat Politecnica de Catalunya — Subcritical transition in pipe flow is explored for a wide range of Reynolds numbers within the interval $\mathrm{Re} \in [2.5 \times 10^3, 1.26 \times 10^4]$ by means of a spectral method that resolves the transitional dynamics with nearly 3.5×10^4 degrees of freedom on a medium aspect-ratio domain of length $32\pi/5$. The aim of this exploration is to provide a characterization of the basin of attraction of the basic regime by measuring the minimal amplitude of an initial global perturbation leading to transition. The analysis is based on a particular theoretical scenario that considers streamwise-independent finite amplitude initial vortical perturbations that trigger global transition via optimal inflectional instabilities of streamwise-dependent modes with selected axial wavenumbers. Disturbances consisting of $1, 2$ and 3 pairs of vortices are investigated. Long lasting turbulent regimes and relaminarized flows are distinguished by means of time integrations of suitable length between $T_{\min} = 600$ and $T_{\max} = 1000$ advective time units. Some transitional runs are specifically analized to exemplify the transition scenario under investigation and its independence of pipe length is verified with a few computations on a longer pipe of length 32π (1.4×10^5 degrees of freedom). For large values of the Reynolds number, a theoretical scaling law for the threshold amplitude of a perturbation required to trigger transition is provided. Different types of perturbations seem to respond to different scaling laws.

Alvaro Meseguer
Dept. Fisica Aplicada, Universitat Politecnica de Catalunya

Date submitted: 02 Aug 2006 Electronic form version 1.4