Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

Streamwise-Localized Solutions with natural 1-fold symmetry SEBASTIAN ALTMEYER, Institut of Science and Technology Austria, ASHLEY WILLIS, School of Mathematics and Statistics, University of Sheffield, Sheffield S3 7RH, UK, BJÖRN HOF, Institut of Science and Technology Austria, 3400 Klosterneuburg, Austria — It has been proposed in recent years that turbulence is organized around unstable invariant solutions, which provide the building blocks of the chaotic dynamics. In direct numerical simulations of pipe flow we show that when imposing a minimal symmetry constraint (reflection in an axial plane only) the formation of turbulence can indeed be explained by dynamical systems concepts. The hypersurface separating laminar from turbulent motion, the edge of turbulence, is spanned by the stable manifolds of an exact invariant solution, a periodic orbit of a spatially localized structure. The turbulent states themselves (turbulent puffs in this case) are shown to arise in a bifurcation sequence from a related localized solution (the upper branch orbit). The rather complex bifurcation sequence involves secondary Hopf bifurcations, frequency locking and a period doubling cascade until eventually turbulent puffs arise. In addition we report preliminary results of the transition sequence for pipe flow without symmetry constraints.

Sebastian Altmeyer
Institut of Science and Technology Austria, 3400 Klosterneuburg, Austria

Date submitted: 30 Jul 2014 Electronic form version 1.4