Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Evolution of vortex-surface fields in the K-type temporal transition in channel flow YAOMIN ZHAO, YUE YANG, SHIYI CHEN, State Key Laboratory for Turbulence and Complex Systems, College of Engineering, Peking University — The vortex-surface field (VSF), a Lagrangian-based method (Yang and Pullin, *J. Fluid Mech.*, 685, 2011), is used to study the evolution of vortical structures in the K-type temporal transition in channel flow. Iso-surfaces of an evolving VSF can represent vortex surfaces composed of vortex lines in evolution. Since the VSF was only used in simple flows with periodic boundary conditions, the validity of different wall boundary conditions for the VSF transport equation is first discussed, and then the Neumann boundary condition is applied in the implementation. The initial VSF is uniquely determined by proposed criteria, and its iso-surfaces are streamwise-spanwise planes. Compared with the evolution of material surfaces with the same initial scalar field, the VSF evolution can capture the topological changes of vortical structures that are induced by the interaction between different hairpin-like vortices. It is noted that the vortex reconnection is a critical mechanism for the breakdown of vortical structures in the late transitional stage, and is challenging to be characterized via Eulerian-based methods.

Yaomin Zhao
State Key Laboratory for Turbulence and Complex Systems,
College of Engineering, Peking University

Date submitted: 30 Jul 2015 Electronic form version 1.4