

Abstract Submitted  
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**Generation of hairpin vortex packet in channel flow at  $Re_\tau \leq 590$ <sup>1</sup>**

KYOUNGYOUN KIM, Hanbat National University, South Korea — The generation of hairpin vortex packet from an initial single vortex is examined by direct numerical simulation for channel flows at  $Re_\tau = 180, 395, \text{ and } 590$ . The initial vortex structure is given by conditionally averaged flow field with the Q2 event specified at  $y^+ = 50$  in fully developed turbulent channel flow. The vortex packet formation in higher Reynolds number flows is very similar to that in  $Re_\tau = 180$  reported by Zhou *et al.* (1999, J. Fluid Mech.); the initial vortex is developed to a primary hairpin vortex (PHV) and the secondary hairpin vortex is generated upstream of PHV. As time proceeds, the vortices move downstream with almost the same convection velocity and little dispersion, forming a vortex packet. Comparison of the packet formation for different  $Re_\tau$  reveals that the secondary hairpin vortex is generated with time scales based on the wall units. At the time when the head of PHV has grown to the channel center, the inclination angle of the vortex packet is approximately  $12 \sim 14^\circ$  which is insensitive to  $Re_\tau$ , consistently with linear stochastic estimation results with PIV measurement by Christensen & Adrian (2001, J. Fluid Mech.).

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Kyoungyoun Kim  
Hanbat National University, South Korea

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