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Frequency Domain Nonlinear Energy Transfer Study in a Laboratory Plasma M. XU, G.R. TYNAN, C. HOLLAND, Z. YAN, S.H. MULLER, J.H. YU, University of CA, San Diego — We report here the experimentally measured internal and kinetic nonlinear energy transfer rates in a linear plasma device CSDX (Controlled Shear Decorrelation Experiment) using a recently developed technique [1]. The results clearly show net kinetic energy transfer from turbulence to zonal flows, thus directly show the turbulence-driven mechanism of shear flows. In addition, it was found that the radial flux of vorticity is dominantly responsible for the redistribution of kinetic turbulent energy among different frequencies (or different scales). Combined with published results [2], we know that it plays dual roles: the spreading of momentum in configuration space and the spreading of energy among different scales. The bicoherence was also computed, which shows that the phase coherence between zonal flows and turbulence plays an important role in the nonlinear energy transfer from turbulence to zonal flows. We also report the results from linear eigenmode stability analysis based on the Hasegawa-Wakatani model. Despite the use of flat profiles of electron temperature, ion viscosity, etc., it shows that the first two radial eigenmodes n=1 and n=2 are linearly unstable at the typical CSDX condition, suggesting that these two radial eigenmodes are the driving source for zonal flows. [1] M. Xu et al , Phys. Plasmas 16 042312 (2009). [2] Holland C et al, Phys. Rev. Lett. 96 195002 (2006)

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