

Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Evolution of the velocity gradient tensor in the near field of a square cylinder MASSIMILIANO BREDA, OLIVER BUXTON, Imperial College London — The condition of the velocity gradient tensor (VGT) is analysed in the near field of the flow past a square cylinder. The data was acquired by tomographic particle image velocimetry at a moderate Reynolds number ($Re = 16,000$). The analysis focused on the evolution of the joint pdf (jpdf) between the second and third invariants of the characteristic equation for the VGT. These invariants are known to fully characterise the state of the VGT and have been previously used to observe the transition to a fully developed turbulent state in the interface region between turbulent and non-turbulent flows. We analyse the flow very close to the cylinder, where developed turbulence is not necessarily expected. The findings show that in the mean recirculation region, where the intermittency of the shear layer is low no tear drop shaped jpdf, indicative of fully developed turbulence, is found. Once the intermittency increases, tear drop shaped jpdfs are found where the velocity fluctuations are not Gaussian distributed, suggesting the small scales reach a fully developed turbulent state ahead of the large ones. This is further investigated by analysing the geometry of the local straining, the vorticity-strain rate alignment and enstrophy production.

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Date submitted: 29 Jul 2015

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