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Direct numerical simulations of turbulent wakes with non-equilibrium similarity scalings THIBAULT DAIRAY, JOHN CHRISTOS VASSILICOS, Imperial College London — Recently, turbulent flow regions with dissipation scalings incompatible with equilibrium Richardson-Kolmogorov phenomenology have been discovered in the lee of regular and fractal grids. Considering the non-equilibrium dissipation law with a similarity analysis, new scaling laws have recently been obtained for the streamwise evolution of the centreline wake mean profiles (PRL 111, 144503 (2013)). In the present study, DNS of spatially evolving wakes generated by bluff plates with both simple square and irregular edge peripheries (the latter allowing the formation of jet-wake flows) have been carried out using the in-house code Incompact3d. The Reynolds number based on the plate length L, equal to the square-root of the plate area, and the freestream velocity is 5000. The self-similarity of the mean flow, Reynolds-stresses and the dissipation rate of turbulent kinetic energy have been analysed as well as the scaling laws. In the region where the flow is found to be axisymmetric and self-similar, the viscous term in the momentum equation is two orders of magnitude smaller than the other terms and the mean flow profile evolves in accordance with the non-equilibrium law up to 100L. Furthermore, the non-equilibrium dissipation law is observed for both regular and irregular plates.

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