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On velocity gradient dynamics and fine-scale structure: experiments support DNS and models JOHN LAWSON, University of Cambridge, JAMES DAWSON, Norwegian University of Science and Technology — The fine scales of turbulence are embodied by statistics of velocity gradients. In solving exact equations for their evolution, the challenge is to specify how the pressure Hessian acts. This is determined by the footprints that "structures" of enstrophy and strain leave in conditional average pressure fields. We use direct and approximate conditional averaging methods to extract this structure from different turbulence datasets: a direct numerical simulation and a unique scanning tomography experiment in a "French washing machine". Direct comparisons between simulation and experiment show the structure and resulting dynamics are in excellent, quantitative agreement. This evidence supports existing modelling approaches and provides insights towards their refinement. Moreover, it demonstrates the dynamical significance and the reproducibility of fine-scale structure.

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