Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Spectral structure and linear mechanisms in a 'rapidly' distorted boundary layer[1] SOURABH DIWAN[2], Indian Inst of Science, JONATHAN MORRISON, Imperial College London — A characteristic feature of a turbulent boundary layer (TBL) at high Reynolds numbers is the presence of coherent motions such as the 'large scale motions' and 'superstructures'. In this work we attempt to mimic such coherent motions and their spectral structure using a simplified experimental arrangement of a boundary layer flow over a flat plate subjected to grid-generated turbulence and/or localized patch of surface roughness. The velocity measurements done downstream of a grit roughness patch (in absence of grid turbulence) show that over a certain distance the energy spectrum of streamwise velocity fluctuations shows a bi-modal shape which resembles that found in a high-Re TBL. We also carry out experiments with both grid turbulence and grit roughness present and show that it is possible to 'synthesize' the structure of a TBL in the wall-normal direction, in the limited context of streamwise coherent motions, using the present experimental design. These results indicate that the predictions of the Rapid Distortion Theory (RDT) can be applied to the present case in a region close to the plate leading edge, and we examine the linearized effects of 'blocking' and 'shear' on turbulent fluctuations near the edge of the boundary layer and close to the wall in the framework of the RDT.

[1]We acknowledge financial support from EPSRC (grant no. EP/1037938)
[2]The work was done when the author was a research associate in the Aeronautics Department at Imperial College London

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Date submitted: 01 Aug 2016 Electronic form version 1.4