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Two-dimensional energy spectra in a high Reynolds number turbulent boundary layer[1] DILEEP CHANDRAN, RIO BAIDYA, JASON MONTY, IVAN MARUSIC, Univ of Melbourne — The current study measures the two-dimensional (2D) spectra of streamwise velocity component (u) in a high Reynolds number turbulent boundary layer for the first time. A 2D spectra shows the contribution of streamwise (λ_x) and spanwise (λ_y) length scales to the streamwise variance at a given wall height (z). 2D spectra could be a better tool to analyse spectral scaling laws as it is devoid of energy aliasing errors that could be present in one-dimensional spectra. A novel method is used to calculate the 2D spectra from the 2D correlation of u which is obtained by measuring velocity time series at various spanwise locations using hot-wire anemometry. At low Reynolds number, the shape of the 2D spectra at a constant energy level shows $\lambda_y \sim \sqrt{z\lambda_x}$ behaviour at larger scales which is in agreement with the literature. However, at high Reynolds number, it is observed that the square-root relationship gradually transforms into a linear relationship ($\lambda_y \sim \lambda_x$) which could be caused by the large packets of eddies whose length grows proportionately to the growth of its width. Additionally, we will show that this linear relationship observed at high Reynolds number is consistent with attached eddy predictions.

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