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The breakdown of the viscous regime in riblets[1] RICARDO GARCÍA-MAYORAL, U. Politécnica Madrid, JAVIER JIMÉNEZ, U. Politécnica Madrid and CTR Stanford — We investigate the mechanisms involved in the breakdown of the viscous regime in riblets, with a view to determining the point of optimum performance, where drag reduction ceases to be proportional to the riblet size. This occurs empirically for a groove cross-section $A_g^+ \approx 120^+$. To study the interaction of the riblets with the overlaying turbulent flow, we systematically conduct DNSes in a ribbed turbulent channel with increasing riblet size. The conditionally averaged crossflow above and within the grooves reveals a mean recirculation bubble that exists up to the point of viscous breakdown, isolating the groove floor from the overlying crossflow, and preventing the high momentum fluid from entering the grooves. We do not find evidence of outside vortices lodging within the grooves until $A_g^+ \approx 400$, which is well past the drag minimum, and already into the drag increasing regime. Interestingly, as the bubble breaks down, we observe that quasi-two-dimensional spanwise structures form just above the riblets, similar to those observed above porous surfaces and plant canopies, which appear to be involved in the performance degradation.

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