Energy dissipation caused by boundary layer instability at vanishing viscosity

Natacha Nguyen van yen[1], Marie Farge[2,a], Kai Schneider[3],
Matthias Waidmann[1], Rupert Klein[1]

[1] Institut für Mathematik, Freie Universität Berlin, Berlin, Germany
[2] LMD-CNRS, Ecole Normale Supérieure, Paris, France
[3] Institut de Mathématiques de Marseille, Aix-Marseille Université, Marseille, France

[a] marie.farge@ens.fr

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A qualitative explanation for the scaling of energy dissipation by high Reynolds number fluid flows in contact with solid obstacles is proposed in the light of recent mathematical and numerical results. Asymptotic analysis suggests that it is governed by a fast, small scale Rayleigh-Tollmien-Schlichting instability with an unstable range whose lower and upper bounds scale as $Re^{3/8}$ and $Re^{1/2}$, respectively. By linear superposition the unstable modes induce a boundary vorticity flux of order Re^{1}, a key ingredient in detachment and drag generation according to a theorem of Kato. These predictions are confirmed by numerically solving the Navier-Stokes equations in a two-dimensional periodic channel discretized using compact finite differences in the wall-normal direction, and a spectral scheme in the wall-parallel direction.