Three-dimensional structure of alternative Reynolds stresses in
turbulent channels\textsuperscript{1} KOSUKE OSAWA, Tokyo Institute of Technology and UPM,
JAVIER JIMENEZ, Universidad Politecnica de Madrid — As explained in another
talk in this meeting, the ambiguity of the fluxes in the momentum conservation law
allows alternative definitions for the Reynolds stresses. We study here the three-
dimensional structures of the tangential stress that minimises the total r.m.s. flux
fluctuations in turbulent channels at several $Re_{\tau} \geq 10^3$. As in the case of the
classical shear stress, it is found that the structures can be classified into wall-
detached and wall-attached families. The latter carry most of the overall stress and
are geometrically self-similar, although less elongated than for the classical ones.
Although they span the full range of scales from viscous to the channel height, larger
structures are less common than in the classical case, apparently missing very large
‘global’ modes. They are also less fractal ($D_F \approx 2.5$) than the ‘sponges of flakes’
of the classical quadrant structures ($D_F \approx 2.1$), and more inclined with respect to
the wall, $45^\circ$ versus $20^\circ$, suggesting that they may be related to the ‘hairpin legs’
discussed by several authors.

\textsuperscript{1}Funded by the Coturb project of the ERC and Erasmus Mundus

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Date submitted: 29 Jul 2016

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