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Impact of Drag Reduction Control on Energy Box of a Fully Developed Turbulent Channel Flow YOSUKE HASEGAWA, Institute of Industrial Science, The University of Tokyo, DAVIDE GATTI, Karlsruhe Institute of Technology, ANDREA CIMARELLI, Universita Politecnica delle Marche, BETTINA FROHNAPFEL, Karlsruhe Institute of Technology, MAURIZIO QUADRIO, Politecnico di Milano, INSTITUTE OF INDUSTRIAL SCIENCE, THE UNIVERSITY OF TOKYO COLLABORATION, KARLSRUHE INSTITUTE OF TECHNOLOGY COLLABORATION, UNIVERSITA POLITECNICA DELLE MARCHE COLLABORATION, POLITECNICO DI MILANO COLLABORATION — We introduce the Constant Power Input (CPI) concept to clarify how a drag reduction control affects energy budget of a fully developed turbulent channel flows. The entire kinetic energy is decomposed into the mean and fluctuating components, and the total dissipation is accordingly divided into the dissipation of the mean filed and the turbulent dissipation. The CPI condition is essential in the present study, since it strictly restricts the amount of power applied to the flow system. This allows us to identify how each flow control strategy changes the energy flows between each component and the viscous dissipation. Ultimately, if we succeed in suppressing all turbulence, the turbulent dissipation should vanish and the power applied to the flow system should be dissipated only by the dissipation of the mean velocity, which should have a parabolic profile. Our fundamental question in the present study is whether there exists unique relationship between the changes in the turbulent dissipation and the resultant drag reduction effect. In order to provide the definite answer to this question, we introduce triple decomposition of the velocity field, and validate our approach by considering two different flow control strategies.

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