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Splitting of turbulent spot in transitional pipe flow. XIAOHUA WU, Royal Military College of Canada, PARVIZ MOIN, Stanford University, RONALD J. ADRIAN, Arizona State University — Recent study (Wu et al, PNAS, 1509451112, 2015) demonstrated the feasibility and accuracy of direct computation of the Osborne Reynolds' pipe transition problem without the unphysical, axially periodic boundary condition. Here we use this approach to study the splitting of turbulent spot in transitional pipe flow, a feature first discovered by E.R. Lindgren (Arkiv Fysik 15, 1959). It has been widely believed that spot splitting is a mysterious stochastic process that has general implications on the lifetime and sustainability of wall turbulence. We address the following two questions: (1) What is the dynamics of turbulent spot splitting in pipe transition? Specifically, we look into any possible connection between the instantaneous strain rate field and the spot splitting. (2) How does the passive scalar field behave during the process of pipe spot splitting. In this study, the turbulent spot is introduced at the inlet plane through a sixty degree wide numerical wedge within which fully-developed turbulent profiles are assigned over a short time interval; and the simulation Reynolds numbers are 2400 for a 500 radii long pipe, and 2300 for a 1000 radii long pipe, respectively. Numerical dye is tagged on the imposed turbulent spot at the inlet. Splitting of the imposed turbulent spot is detected very easily. Preliminary analysis of the DNS results seems to suggest that turbulent spot slitting can be easily understood based on instantaneous strain rate field, and such spot splitting may not be relevant in external flows such as the flat-plate boundary layer.

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