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Effect of wall roughness on the large scale circulation in turbulent convection with cubic confinement NAJMEH FOROOZANI, JOSEPH NIEMELA, The Abdus Salam ICTP, VINCENZO ARMENIO, University of Trieste, KATEPALLI SREENIVASAN, New York University — Large-eddy simulations of turbulent Rayleigh-Bernard convection were conducted for a fluid of Prandtl number Pr=0.7 confined within a cubic box with rough top and bottom walls and Rayleigh number Ra=10^8. Two cases were considered, in which the roughness elements were formed by 1) 8 grooves aligned parallel to one set of the lateral walls and 2) 64 pyramidal structures uniformly distributed without a preferred orientation. For case (1), we observe that the large scale circulation (LSC) is unstable: on average it is aligned parallel to one set of lateral walls– along the direction of the grooves– but oscillates between the two adjacent diagonal planes with a well-defined frequency. For case (2), the LSC is oriented along one diagonal plane or the other, with occasional switching between them, consistent with observations made by Foroozani, et al. PRE 95, 033107 (2017) for the case of mechanically smooth walls in the same cubic geometry. Finally, when the roughness height for case (1) is reduced so that the horizontal boundaries are hydrodynamically smooth, the LSC reverts to this same diagonal orientation with occasional switching.

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