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Direct numerical simulations of Couette flow with unstable stratifications ALEXANDER BLASS, XIAOJUE ZHU, ROBERTO VERZICCO, DETLEF LOHSE, RICHARD STEVENS, Univ of Twente — A series of direct numerical simulations of Couette flow with unstable stratification have been performed with a second-order finite difference code, optimized for a GPU cluster (AFiD GPU). Defining h as the channel height, shear Reynolds numbers up to $Re_\tau = hu_\tau/\nu \approx 370$ have been achieved. Looking at the different mean temperatures and velocities of the datasets, it can be seen that, as expected, the convection and shear regimes compete with each other. For low Ra, the statistics show a shear dominated flow field, whereas it becomes more difficult for the shear to dominate in the higher Ra regime. Studying the the Nusselt number (Nu) as function of the Re number for different Ra numbers shows that for higher Ra the heat transfer first decreases with increasing shear before it increases strongly for higher mechanical driving. This unexpected non-monotonic change of Nu as a function of Re is due to a breakup of the large scale convection rolls formed by the buoyancy forces when moderate shear is applied. The large scale dynamics of pure thermal and pure mechanical driving can be observed in the extreme cases.

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