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Direct and inverse energy cascades in a forced rotating turbulence experiment ANTOINE CAMPAGNE, Laboratoire FAST, CNRS, Université Paris-Sud, 91405 Orsay, France, BASILE GALLET, Laboratoire SPHYNX, Service de Physique de l'État Condensé, DSM, CEA Saclay, CNRS, 91191 Gif-sur-Yvette, France, FRÉDÉRIC MOISY, PIERRE-PHILIPPE CORTET, Laboratoire FAST, CNRS, Université Paris-Sud, 91405 Orsay, France — Turbulence in a rotating frame provides a remarkable system where 2D and 3D properties may coexist, with a possible tuning between direct and inverse cascades. We present here experimental evidence for a double cascade of kinetic energy in a statistically stationary rotating turbulence experiment. Turbulence is generated by a set of vertical flaps which continuously injects velocity fluctuations towards the center of a rotating water tank. The energy transfers are evaluated from two-point third-order three-component velocity structure functions, which we measure using stereoscopic PIV in the rotating frame. Without global rotation, the energy is transferred from large to small scales, as in classical 3D turbulence. For nonzero rotation rates, the horizontal kinetic energy presents a double cascade: a direct cascade at small horizontal scales and an inverse cascade at large horizontal scales. By contrast, the vertical kinetic energy is always transferred from large to small horizontal scales, a behavior reminiscent of the dynamics of a passive scalar in 2D turbulence. At the largest rotation rate, the flow is nearly 2D and a pure inverse energy cascade is found for the horizontal energy.

Jean-Pierre Hulin
Laboratoire FAST, CNRS, Université Paris-Sud, 91405 Orsay, France

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