MPIDS Colloquium

MAX-PLANCK-GESELLSCHAFT

Rotating Rayleigh-Bénard convection: Probing the transition to the rotation-dominated regime

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Most geo- and astrophysical flows are driven by strong thermal forcing and affected by high rotation. In these systems, direct measurements of the physical quantities are not possible due to their large scales, remoteness and complexity. A model containing the main physical constituents is rather beneficial. This approach is given by the problem of rotating Rayleigh-Bénard convection (RRBC): a rotating fluid layer heated from below and cooled from above. For large-scale systems, the governing parameters of RRBC take extreme values, leading to a regime of geostrophic turbulence.
Background rotation causes different flow structures and heat transfer efficiencies in Rayleigh-Bénard convection. Three main regimes are known: rotation-unaffected (regime I), rotation-affected (regime II) and rotation-dominated (regime III). Regimes I and II are easily accessible with experiments and numerical simulations, thus they have been extensively studied. On the other hand, access to regime III is more troublesome. Thus, regime III and the transition to this regime are less explored.
In this work, we study regime III and these hypotheses from a new perspective: Lagrangian velocity and acceleration fluctuations and autocorrelations of tracers from experiments. We have found that the transition to regime III coincides with three phenomena; the vertical motions are suppressed, the vortical plumes penetrate further into the bulk and the vortical plumes interact less with their surroundings. These findings allow us to evaluate the available hypotheses and to understand more about regime III. These regime transitions will be discussed in this talk.

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