Fluids and Space Engineering Seminar

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Location: ZARM, Room 1280

Impact of centrifugal buoyancy on strato-rotational instability

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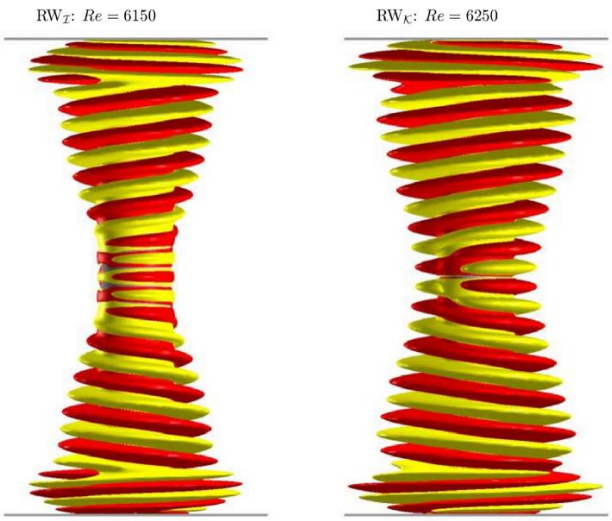

The instability of the flow between two differentially rotating cylinders with the fluid being stably stratified, the stratified Taylor--Couette flow, is an idealized setting which may be of relevance to processes the atmosphere and oceans and accretion disks. Even when the hydrodynamics are centrifugally stable, stable stratification can lead to instability due to a resonant interaction between non-axisymmetric inertia-gravity waves trapped near each of the two cylinders, the so called strato-rotational instability. The present investigation is motivated by the recent experiments of Flor et. al. 2018, who found spiral structures confined to the inner rotating cylinder in a regime where the inner cylinder radius is small compared with the outer cylinder radius. This is a very different regime to that studied for SRI. The spiral structures they observed are reminiscent of the radiative instability. The main mode of instability was found to result in helical waves with small azimuthal wavenumber. We have performed numerical simulations and dynamical systems analysis of this problem, and found good agreement with the experiments. We show that the breaking of the reflection symmetry observed in the experiments is due to centrifugal effects that are not included in the usual treatments of the problem. The role of the symmetries in the problem is also explored in detail. The dynamics is dominated by the interaction of two helical waves originating at the endwalls, and interacting about the mid cylinder height.