

Seminar of Graduate Students 2022 Math



연세대학교 수학기산학부

The quasi-geostrophic approximation for the rotating stratified fluids

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2022. 10. 28. (Fri) 2:00 p.m.

Sci. Building #225

Abstract : We prove that the solution of the 3D inviscid Boussinesq equations converges to the solution of the quasi-geostrophic (QG) equations in an asymptotic regime where the intensities of rotation and stratification increase to infinity while the rotation-stratification ratio tends to any positive number other than one. Despite the non-uniformity of the generic convergence rates near the region where the ratio is one, we further show that such quasi-geostrophic approximation continues to be valid even when the ratio goes to one as long as both intensities increase to infinity fast enough. In contrast, we prove non-convergence when such intensities grow sufficiently slow to infinity with the ratio tending to one. Our proof of the non-convergence result contains the first mathematical proof of the Devil's staircase paradox that was originally cast in Theoret. Comput. Fluid Dynamics 9, 223-251 (1997). Combining both results for convergence and non-convergence, we give a lower bound for the growth of the convergence rates when the ratio tends to one. This is a joint work with Junha Kim (KIAS) and Jihoon Lee (CAU).

주최: 4단계 BK21 수리과학 및 계산교육 연구단



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