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Numerical investigation of the onset of centrifugal buoyancy in a rotating cavity[1] DIOGO B. PITZ, OLAF MARXEN, JOHN CHEW, University of Surrey — Buoyancy-induced flows in a differentially heated rotating annulus present a multitude of dynamics when control parameters such as rotation rate, temperature difference and Prandtl number are varied. Whilst most of the work in this area has been motivated by applications involving geophysics, the problem of buoyancy-induced convection in rotating systems is also relevant in industrial applications such as the flow between rotating disks of turbomachinery internal air systems, in which buoyancy plays a major role and poses a challenge to accurately predict temperature distributions and heat transfer rates. In such applications the rotational speeds involved are very large, so that the centrifugal accelerations induced are much higher than gravity. In this work we perform direct numerical simulations and linear stability analysis of flow induced by centrifugal buoyancy in a sealed rotating annulus of finite gap with flat end-walls, using a canonical setup representative of an internal air system rotating cavity. The analysis focuses on the behaviour of small-amplitude disturbances added to the base flow, and how those affect the onset of Rossby waves and, ultimately, the transition to a fully turbulent state where convection columns no longer have a well-defined structure.

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