

Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

New considerations for centrifugal buoyancy effects in fast rotating flows JOSE MANUEL LOPEZ ALONSO, FRANCISCO MARQUES, Departament de física aplicada, Universitat Politècnica de Catalunya, MARC AVILA, Friedrich-Alexander-Universität Erlangen-Nürnberg, Cauerstrasse 4, 91058 Erlangen, Germany — Boussinesq type approximations accounting for centrifugal buoyancy are well-known and have been used with remarkable results in problems where a distinguished frame of reference is readily identified. However, it does not consider those flows where different parts may rotate independently, such as Taylor-Couette flows with stratification and/or heating, cylindrical containers with the lids rotating at different angular velocities, etc... In these flows, there is not a unique angular velocity and the differences among them may originate that terms which are not considered by the classical Boussinesq approximation become important. Moreover, this centrifugal effect is not only important when we have rotating walls, but also if a strong vortex appears dynamically in the interior of the domain. We propose a new and easy way to introduce the centrifugal buoyancy into the Navier-Stokes equations which takes into account the previous considerations. We present a linear analysis of stability in an axially periodic Taylor-Couette system subjected to a negative gradient of temperature in order to illustrate the differences of using both approximations when considering the centrifugal effects.

Jose Manuel Lopez Alonso
Departament de física aplicada, Universitat Politècnica de Catalunya

Date submitted: 03 Aug 2012

Electronic form version 1.4