Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Global stability map of the flow in a horizontal concentric cylinder forced by natural convection[1] J.J. SERRANO-AGUILERA, Universidad de Malaga, FRANCISCO J. BLANCO-RODRIGUEZ, Universidad de Sevilla, LUIS PARRAS, Universidad de Malaga — There are a large number of studies in the literature on natural convection in the annular region between horizontal concentric cylinders. However, not many publications dealing with global stability analysis in this kind of flow have been published in the literature. For a fixed diameter ratio $A \equiv D_i/L = 2\,R_i/(R_o - R_i)$, being R_i and R_o the inner and outer cylinder radii respectively, and assuming Boussinesq approximation, the solution only depends on Prandtl ($Pr \equiv \nu/\alpha$) and Rayleigh ($Ra \equiv g\,\beta\,L^3(T_i - T_o)/(\nu\,\alpha)$) numbers where $T_i - T_o$ is the temperature difference between the inner and outer cylinders. A spectral collocation code has been developed to solve the problem by means of Chebyshev and Fourier differentiation matrices for $A = 1.25$ and it has been validated with both classical experimental results and numerical simulations. Steady solutions have been sought within the range $Pr \in [10^{-2}, 1]$ and $Ra \in [10^2, 5 \times 10^6]$. As a result, a steady solution Pr-Ra map (consisting of 149 x 75 points) has been traced, where the different families of similar solutions found are detailed, mainly characterized by presenting single or multiple plumes. In addition, two main double-solution regions have been found.

[1]J.J. Serrano-Aguilera would like to acknowledge funding received from the Spanish Government (Juan de la Cierva Formación grant FJCI-2017-32403)

Francisco Blanco-Rodrguez
Universidad de Sevilla

Date submitted: 10 Aug 2020 Electronic form version 1.4