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Lagrangian chaos in three- dimensional steady buoyancy-driven flows[1] SEBASTIAN CONTRERAS, MICHEL SPEETJENS, HERMAN CLERCX, Eindhoven University of Technology — Natural convection plays a key role in fluid dynamics owing to its ubiquitous presence in nature and industry. Buoyancy-driven flows are prototypical systems in the study of thermal instabilities and pattern formation. The differentially heated cavity problem has been widely studied for the investigation of buoyancy-induced oscillatory flow. However, far less attention has been devoted to the three-dimensional Lagrangian transport properties in such flows. This study seeks to address this by investigating Lagrangian transport in the steady flow inside a cubic cavity differentially-heated from the side. The theoretical and numerical analysis expands on previously reported similarities between the current flow and lid-driven flows. The Lagrangian dynamics are controlled by the Péclet number (Pe) and the Prandtl number (Pr). Pe controls the behaviour qualitatively in that growing Pe progressively perturbs the integable state (Pe=0), thus paving the way to chaotic dynamics. Pr plays an entirely quantitative role in that Pr<1 and Pr>1 amplifies and diminishes, respectively, the perturbative effect of non-zero Pe.

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