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Diffusion in fractal wakes and convective thermoelectric flows

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We calculate diffusion and scaling of the velocity ald vorticity in a thermoelectric driven heating and cooling experimental device in order to map the different transitions between two and three dimensional convection in an enclosure and complex driven flows. The size of the water tank is of 0.2 x 0.2 x 0.1 m and the heat sources or sinks can be regulated both in power and sign [1-3]. The thermal convective driven flows are generated by Seebeck and Peltier effects in 4 wall extended positions of 0.05 x 0.05 cm each. The parameter range of convective cell array varies strongly with the Topology of the boundary conditions. At present side heat fluxes are considered and estimated as a function of Rayleigh, Peclet and Nusselt numbers,[4-6] Visualizations are performed by PIV, Particle tracking and shadowgraph.
Diffusion is measured in the transition from a homogeneous linearly stratified fluid to a cellular or layered structure by means of stirring. Patterns arise by setting up a convective flow generated by a buoyant heat flux [5,6]. The experiments described here investigate high Prandtl number mixing using brine and fresh water in order to form a density interface and low Prandtl number mixing with temperature gradients.

Using ESS and selfsimilarity structures in the velocity and vorticity fieds and intermittency [2] that forms in the flow is related to mixing and stiring. The evolution of the mixing fronts are compared and the topological characteristics of the merging of the plumes and jets are examined for different configurations. We also present a detailed comparison of the evolution of RM and RT, Jets and Plumes in overall mixing. The relation between fractal analysis and spectral analysis can be very useful to determine the evolution of scales. Experimental and numerical results on the advance of a mixing or nonmixing front occurring at a density interface due to gravitational acceleration are analyzed considering the fractal and spectral structure of the fronts like removable plate experiments [7] for Rayleigh-Taylor flows.
The evolution of the turbulent mixing layer and its complex configuration is studied taking into account the dependence on the initial modes at the early stages and its spectral, self-similar information [8,9]. Spectral and Fractal analysis on the images has been used in order to estimate dominant mixing structures as well as the dispersion relations of basic instabilities [2,10].

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