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Interfacial Instabilities in Torsional Flows CHING-YAO LAI, Dept. of Physics, Nat'l Taiwan University, Y.-T. SUN, Dept. of Physics, Nat'l Taiwan Normal University, C.-C. CHANG, Inst. of Physics, Academia Sinica, Taipei, Taiwan, Y.-Y. CHEN, Dept. of Physics, Nat'l Taiwan University, P. ARRATIA, Dept. of Mechincal Engineering, University of Pennsylvania, J.- C. TSAI, Inst. of Physics, Academia Sinica, Taipei, Taiwan — In this presentation, we report on current findings on morphology of an oil-water interface in a torsional flow produced by rotating the upper lid of a cylindrical tank. Here, the upper half of the tank is filled with silicon oil and the lower half is filled with water. The interface morphology is investigated as a function of the Reynolds number, based on the upper fluid, and of aspect ratio between the cylinder height and radius (AR=H/R). We find that, at moderate AR, raising the rotation rate (or Re) can induce a continuous change of the oil-water interface morphology from a simple hump to a flat top (plateau), and to a double mound before the interface becomes unstable [1]. At high AR, long water threads and fluid break-ups occur either along the central axis or at a non-zero radius, reflecting the location where the upward flow exhibits a maximum. The changes in the morphology of the interface can be linked to the changes in the secondary flow in the upper fluid. The system exhibits a wealth of behaviors, including symmetry breaking, that illustrates not only the relationship between the upward (secondary) flow and the gravitational force, but also the emergence of various flow and interfacial instabilities.

[1] Lai and Ku, 2009 INTEL Int'l Scienand Engineering Fairs

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