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Interfacial Mixing by Marangoni Surfers CLEMENT GOUILLER, CHRISTOPHE YBERT, CECILE COTTIN-BIZONNE, Univ Lyon, Univ Lyon 1, CNRS, ILM, F-69622, Villeurbanne, France, ROMAIN VOLK, MICKAEL BOURGOIN, Laboratoire de Physique, ENS de Lyon, Univ Lyon, CNRS, 69364 Lyon CEDEX 07, France, FLORENCE RAYNAL, LMFA, Univ Lyon, ECL, INSA Lyon, Univ Lyon 1, CNRS, F-69134 Ecully, France — Marangoni effects constitute a major source of interfacial flows, classically induced by a local release of heat or surfactant. When this release originates from a particle floating at the fluid surface, particle sources additionally self-propel generating complex flows and dynamics. In the present work, we pour glass-bubbles at the surface to reveal interfacial mixing properties induced by interfacial swimmers. Experimentally, we access their dynamics, the floaters concentration and velocity fields to get insights into the interfacial transport properties. From the concentration field standard deviation, we evidence that the system reaches a steady-state of incomplete floaters mixing after a few minutes. We provide a model, in good agreement with the experiments, that predicts the value of the standard deviation reached. Qualitatively, we rationalize the steady-state as a competition between mixing by the random motion of many stirrers and unmixing due to the Marangoni flow structure around a swimmer, which constantly rejuvenate gradients in the form of a depleted area around each particle. Finally, examination of the energy spectra reveals complex multi-scale properties with some analogy with turbulent mixing despite no inertial turbulence occurs in the subphase.

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