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Mechanistic study of slug formation in turbulent gas-laminar liquid multiphase flow in horizontal channels SHA MIAO, KELLI HENDRICKSON, YUMING LIU, Massachusetts Inst of Tech-MIT, MASSACHUSETTS INSTITUTE OF TECHNOLOGY TEAM — We present numerical simulations of slug generation from stratified flow in horizontal channels for a turbulent-gas/laminar-liquid using a Fully-Coupled Immersed Flow (FCIF) solver. FCIF uses an immersed boundary method to couple an unsteady Reynolds Averaged Navier Stokes (uRANS) and a depth-integrated wave solver to efficiently simulate disparate flows on a single non-boundary conforming grid. We establish slug formation as a two-stage process. Initially, relatively short waves develop due to linear interfacial instability and then evolve into long solitary waves via wave coalescence due to nonlinear wave resonance. The gas-to-liquid energy transfer is first by interfacial shear stress and then ultimately by interfacial pressure forcing. We observe the interfacial pressure gradient first correlates with wave slope. In the second stage it correlates with elevation due to the competition between Bernoulli and viscous effects in the wave-influenced gas layer. Guided by these findings, we perform an asymptotic analysis on the second stage. This analysis shows the occurrence of slugging depends on the total flow rate and there exists a critical threshold above which waves grow faster than tri-exponential functions to form a slug.

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