Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Bubble coalescence at any Reynolds number JAMES MUNRO, University of Cambridge, CHRISTOPHER ANTHONY, OSMAN BASARAN, Purdue University, JOHN LISTER, University of Cambridge — When two bubbles touch, a hole is formed in the fluid sheet between them, and surface tension drives a radial flow which quickly pulls the hole wider. The singular shape and velocity of the initial configuration make experimental imaging or numerical simulation of the very early stages of coalescence challenging. Here we present detailed similarity solutions for the thickness of the fluid sheet and the velocity profile, and show that the radius of the hole increases as $r_E \propto t^{1/2}$ for any Reynolds (Ohnesorge) number. Remarkably, the initially quadratic profile of the sheet allows for an exact solution in which inertia and viscosity have the same scalings with time and remain in fixed proportion. Solution of a third-order set of ordinary differential equations determines the prefactors and profiles. In addition, asymptotic analysis of the compressional boundary layer structure in the inviscid limit formally justifies and brings new insight to earlier ad hoc 'blob' models. Comparison can be made between our similarity solutions, full Navier–Stokes simulations and experimental data from Paulsen et al., Nat. Commun., vol. 5, 2014.

James Munro
University of Cambridge

Date submitted: 29 Jul 2015 Electronic form version 1.4