Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

The velocity gap in fracture: Insights from foam SASCHA HILGENFELDT, Mechanical Science and Engineering, University of Illinois at Urbana-Champaign, PETER STEWART, School of Mathematics and Statistics, University of Glasgow — When gas is injected into a quasi-two-dimensional gas/liquid foam at high enough rate, the local pressure drops across films lead to Rayleigh-Taylor-like instabilities and successive breakage of the films. The rupture propagates as a steady brittle crack in the foam material at well-defined speed. Experimentally, it is observed that the speed cannot drop below a critical value, reached at a critical driving pressure. This is analogous to the *velocity gap* discussed in the literature on solid-state fracture, variously ascribed to dynamical effects of discrete bond breaking or irreducible dissipation, but never fully understood or unambiguously observed in experiment. We show that in the foam, such behavior follows from a combination of two dissipative contributions related to bubble and film motion and can be understood directly from fluid dynamical principles. In a succession of models, we capture the phenomenon robustly representing the foam fracture in (i) a 2-D network; (ii) a 1-D array of discrete films; and (iii) a 1-D continuum limit of the discrete model. The general character of the result encourages analogous arguments for solid-state fracture.

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Date submitted: 01 Aug 2017 Electronic form version 1.4