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Universal Shapes formed by Interacting Cracks MELISSA FENDER, North Carolina State University, FREDERIC LECHENAULT, University of Montpellier, KAREN DANIELS, North Carolina State University — Brittle failure through multiple cracks occurs in a wide variety of contexts, from microscopic failures in dental enamel and cleaved silicon to geological faults and planetary ice crusts. In each of these situations, with complicated curvature and stress geometries, pairwise interactions between approaching cracks nonetheless produce characteristically curved fracture paths known in the geologic literature as en passant cracks. While the fragmentation of solids via many interacting cracks has seen wide investigation, less attention has been paid to the details of individual crack-crack interactions. We investigate the origins of this widely observed crack pattern using a rectangular elastic plate which is notched on each long side and then subjected to quasistatic uniaxial strain from the short side. The two cracks propagate along approximately straight paths until the pass each other, after which they curve and release a lenticular fragment. We find that, for materials with diverse mechanical properties, the shape of this fragment has an aspect ratio of 2:1, with the length scale set by the initial cracks offset s and the time scale set by the ratio of s to the pulling velocity. The cracks have a universal square root shape, which we understand by using a simple geometric model and the crack-crack interaction.

Melissa Fender
North Carolina State University

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