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High Speed Strain Measurements Surrounding Hydraulic Fracture in Brittle Hydrogel WILL STEINHARDT, SHMUEL RUBINSTEIN, Harvard University — Hydraulic fractures of oil and gas shales occur miles underground, below complex, layered rocks, making measurements of their dynamics, extent, or structure difficult to impossible. Rocks are heterogeneous at a wide range of length scales, and investigating how these non-uniformities affect the propagation and extent of fractures is vital to improving both the safety and efficiency of hydraulic fracturing operations. To study these effects we have developed a model system using brittle, heavily cross-linked hydrogels that we can fracture with fluids and observe with a fast camera. By embedding tracer particles within the gel and using laser sheet microscopy, we obtain three dimensional stress and strain maps of the zone surrounding a hydraulic fracture tip. Gels can also be set in layers or interfaces with tunable strengths or with designed heterogeneities, allowing us to understand the fundamental science of hydraulic fractures and investigate the dynamics of controllably complex materials.

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