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Supporting Information for

Spatiotemporal properties of sub-Rayleigh and supershear ruptures inferred from full-field dynamic imaging of laboratory experiments

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Additional Supporting Information (Files uploaded separately)

Table S1
Captions for Movies S1 to S4

Table S1. Imaging and image analysis parameters for vision measurements

Camera	HPV-X 400 x 250 pixel array
Lens	Nikon AF Micro-Nikkor 200 mm
Light source	Cordin 605
Exposure	200 ns
Aperture setting	F/8
Small field of view	
Field of view	19 x 12 mm^2
Subset size	41 x 41 to 51 x 51 $pixels^2$
Step	1 pixel
Filter type	Center-weighted gaussian
Magnification	45.7 - 46.5 μm/pixel
Average speckle size	279 μm
Large field of view	
Field of view	131 x 82 mm^2
Subset size	41 x 41 $pixels^2$
Step	1 pixel
Filter type	Center-weighted gaussian
Magnification	327.9 μm/pixel
Average speckle size	984 μm

Movie 1. Experimental measurements of a sub-Rayleigh rupture revealing the spatiotemporal evolution of the fault-parallel (left) and fault-normal (right) velocity components. Full-field velocity maps with contour lines (top) and plots of the particle velocities tracked along the fault (bottom). The particle velocities in m/s are obtained for the sub-Rayleigh case discussed in the text (P = 12 MPa, α = 24°). Time is in microseconds starting from rupture nucleation. The rupture arrival is anticipated by the dilatational field entering the imaging window at a time t = 60.3 μs, signaled by the two lobes in the fault-parallel velocity field and the associated positive motion in the fault-normal direction. As the rupture enters the field of view at t = 63.3 μs, the fault-parallel velocity discontinuity across the interface increases rapidly with the particle velocity reaching +/- 1.2 m/s on each side of the fault. At the same time, the fault-normal velocity is characterized by a pronounced negative motion, localized around the rupture tip, with a peak of 2.4 m/s indicating the predominance of the fault-normal over the fault-parallel motion for sub-Rayleigh ruptures.

Movie 2. Experimental measurements of a supershear rupture revealing the spatiotemporal evolution of the fault-parallel (left) and fault-normal (right) velocity components. Full-field velocity maps with contour lines (top) and plots of the particle velocities tracked along the fault (bottom). The particle velocities in m/s are obtained for the supershear case discussed in the text (P = 23 MPa, α = 29°). Time is in microseconds starting from rupture nucleation. The rupture arrival is signaled by the sharp increase in the fault-parallel velocity up to 12 m/s. The fault-parallel motion is accompanied by a fault-normal motion in the positive $\boldsymbol{x_2}$ direction with a peak of 1.5 m/s. The positive fault-normal motion is localized to a near-fault region and is followed by a negative motion of 1 m/s, indicating the prevalence of the fault-parallel over the fault-normal motion for supershear ruptures. The evolving maps also capture the formation of shear Mach fronts, a key feature of supershear ruptures.

Movie 3. Spatiotemporal surface of the fault-parallel velocity of a supershear rupture. The plot is produced for the supershear rupture discussed in the text with P = 23 MPa and α = 29°. At the beginning of the animation, the fault-parallel velocity time history is shown for a point on the interface ($x_2 = 0^-$) and at the center of the field of view ($x_2 = 8.9\ \mathrm{mm}$), replicating the time history shown in Figure 9b (blue curve). The plot is then rotated to display the x_2 axis and the animation develops by incrementally adding time histories at increasing values of x_2, up to $x_2 = -5.2\ \mathrm{mm}$, so that the last curve added corresponds to the time history shown in Figure 9d (blue curve). The three-dimensional plot is then spun around to show the spatiotemporal surface.

Movie 4. Spatiotemporal surface of the fault-normal velocity of a supershear rupture. The plot is produced for the supershear rupture discussed in the text with P = 23 MPa and α = 29°. At the beginning of the animation, the fault-parallel velocity time history is shown for a point on the interface ($x_2 = 0^-$) and at the center of the field of view ($x_2 = 8.9\ \mathrm{mm}$), replicating the time history shown in Figure 9b (red curve). The plot is then rotated to display the x_2 axis and the animation continues by incrementally adding time histories at increasing values of x_2, up to $x_2 = -5.2\ \mathrm{mm}$, so that the last curve added corresponds to the time history shown in Figure 9d (red curve). The three-dimensional plot is then spun around to show the spatiotemporal surface.