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Dynamics of Discontinuous Shear Thickening suspensions

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Concentrated suspensions of hard particles such as cornstarch in water exhibit Discontinuous Shear Thickening, in which an increasing shear rate drives a transition from liquid- to solid-like mechanical behavior. In steady-state shear this phenomena is a result of a dynamic version of jamming in which forces are transmitted along particle contact networks that span to system boundaries and repeatedly form and break up. Several dynamic phenomena observed in such suspensions have long been assumed to be a consequence of this shear thickening, but cannot be explained as a direct result of shear thickening; for example a uniquely strong impact response which allows a person to run on the fluid surface. We perform experiments in which a concentrated suspension is subjected to transient impact. We find that the strong impact response is due a short-lived jammed contact network spanning to the boundaries and a delay time required for this dynamically jammed region to propagate to the boundary. The resulting ability of this system-spanning solid-like region to support loads can explain the ability of a person to run on the surface of these fluids. This delay before a solid-like response may also explain several other dynamic phenomena observed in these fluids.