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Diving into a shear-thickening bath PHILIPPE BOURRIANNE, Mechanical Engineering, MIT, ROBERT E. COHEN, Chemical Engineering, MIT, GARETH H. MCKINLEY, Mechanical Engineering, MIT — Shear-thickening fluids, made of suspensions of micro or nanoparticles, react to imposed excitations with a tunable behavior. At low shear-rate, they flow like a Newtonian or weakly shear-thinning liquid, whereas their viscosity rapidly increases following a more rapid perturbation. Due to this enhanced dissipation, shear-thickening fluids are known for their remarkable ability to absorb energy during collisions. When a solid object impacts a bath of shear-thickening fluid, the initial velocity determines the different settling regimes that are observed. We will describe these different regimes with regard to the rheological properties of the shear-thickening liquid and the characteristics of the impacting object. A few surprising observations could be noticed. First, a high velocity is not always the best way to penetrate such suspensions. Under such conditions, an appropriately-shaped fast-moving object can also bounce during the impact due to the shear-thickening behavior. By comparing the deceleration of an object into a viscous Newtonian and a shear-thickening liquid, we will explain the spectacular properties of shear-thickening during a collision.

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