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Disentangling the role of hydrodynamic and frictional forces in a shear-thickening suspension

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Who among us has not spent countless hours squeezing, rubbing, and smushing gooey substances like, tooth paste, silly putty, corn starch, and even bodily fluids between our fingers? If we could magnify our view and look deep within the substances we are handling what structures would we find? How, do these structures lead to the fascinating mechanical properties that we experience on the scale of our fingers. In this talk I will address the phenomenon of shear thickening in which the viscosity of a suspension increases with increasing shear rate. I will describe recent measurements we have made using a newly developed confocal rheoscope that, for the first time, experimentally visualize the hydrodynamically induced particle clusters. Such clusters have been implicated in continuous shear thickening. It remains controversial as to whether thickening in such suspensions also arises from frictional interactions between particles. The distinct contributions of frictional and hydrodynamic forces are typically difficult to measure independently using conventional techniques. Here, I will describe our approach for using both bulk rheometry techniques and our confocal rheoscope to disentangle their contributions to the total stress response.