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Pressure and Shear Stress Distribution of Drop Impacts. TING-PI SUN, XIANG CHENG, University of Minnesota, Twin Cities — Drop impacts are ubiquitous and relevant to many important natural and industrial processes. Although the kinematics of drop impact such as the morphology of impacting drops have been extensively studied experimentally due to the fast advance of high-speed photography techniques, the dynamic aspects of drop impacts remains largely unexplored. Here, we investigate the pressure and shear stress distributions of drop impacts via a newly-developed experimental tool, high-speed 3D stress microscopy. By combining laser-sheet illumination with high-speed photography, we track the fast movements of fluorescent particles embedded in elastic gels under the impact of liquid drops. The measurements enable us to obtain the strain of the elastic gels induced by the impact. The temporal evolution of impact pressures and shear stresses of liquid drops can then be extracted based on the strain-stress relation of continuum mechanics. Our study on the pressure distribution confirms the key prediction of the self-similar theory and numerical simulations, where the maximum impact pressure occurs near the contact line, rather than the center of impacting drops. In addition, we also quantify the fast temporal evolution of impact-induced shear stresses, information crucial for mitigating impact-induced damages on solid substrates. This research is support by NSF CAREER DMR-1452180.

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