Impacts of Hydrophobic Spheres and Bouncing Droplets: A kinematic matching model.

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Impacts of small solids and droplets onto the surface of a fluid bath have important applications, including the study of surface dwelling animals and the effect of rain on climate. They also play a role in the fascinating hydrodynamic quantum analog experiments. Here, we study the simplest impact problem from basic principles. We derive linear free surface equations for three dimensional fluid flow and we reduce the problem to the 2D interface using a formulation of the Dirichlet-to-Neumann map in physical space. We couple the free surface equations to the motion of a perfectly hydrophobic sphere, obtaining a parameter-free model for impact. Finally, we use these findings to model the repeated impact of droplets onto an oscillating bath.