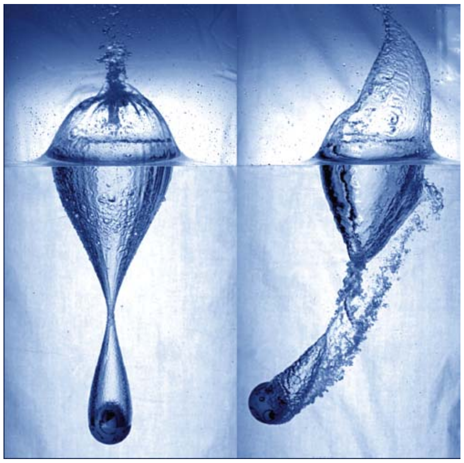
Center for Fluid Mechanics Seminar



Cavity dynamics of water entry for spheres and ballistic projectiles

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ABSTRACT

The complex hydrodynamics of water entry are investigated experimentally for low Froude numbers for spheres and ballistic projectiles. The cavity formed by the projectiles can be readily altered as a function of projectile spin, surface coating and density. For example, the splash and cavity dynamics of the water entry process are highly altered for the spinning case compared to impact of a sphere without spin. A transverse spinning motion induces a lift force on the sphere and thus causes significant curvature in the trajectory of the object along its descent, similar to a curve ball pitch in baseball. A basic force model can be used to evaluate the lift and drag forces on the sphere after impact; resulting forces follow similar trends to those found for spinning spheres in oncoming flow, but are altered slightly as a result of the subsurface air cavity.

Physical models are derived from the projectile behavior captured through high-speed video image sequences. New phenomena have been witnessed via these techniques including a wedge of fluid that crosses the cavity in the case of transverse rotational velocity. The wedge formation is a result of the contact line properties, surface roughness and spin rate. Non-rotating, spherical projectiles impacting a water surface generate different cavity and splash behaviors depending on the static wetting angle of the projectile surface, in a range of low-moderate Froude numbers. The static contact angle made between a liquid and a solid surface varies with surface coating and roughness, with large angles for hydrophilic coatings and small angles for hydrophobic coatings. For sufficiently hydrophilic surfaces it is possible to prevent cavity and splash all together. The effect of surface coating on the impact of spinning and non-spinning spheres will also be addressed.

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4:00pm