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Low Froude number water entry cavity dynamics JAKUB K. KOMINIARCZUK, DICK K.P. YUE, Vortical Flow Research Laboratory, M.I.T. — We analyze the dynamics of the projectile and the water entry cavity in low Froude number water impact where both kinetic and gravitational potential energy play a role. An experimental investigation is conducted where the impact and cavity development of billiard balls hitting a calm water surface at Froude number of O(10) are captured using high speed video camera at 1000 to 2000 frames per second. The phenomena associated with water entry at low impact speeds are complex as gravity, cavity pressure, flow separation, and splash generation significantly influence the cavity shape, surface closure and pinch off. For comparison, an existing analytical theory for the dynamics of water entry cavities for very high speeds is generalized and extended to low Froude number regime. In particular, this closed-form solution now accounts for effects of gravity and flow separation around the projectile. The comparison between the analytic solution and experimental results is excellent.

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