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Cavity dynamics of spinning spheres impacting the air-water interface at high velocity T.T. TRUSCOTT, MIT, A.H. TECHET, MIT — Impact of a sphere, spinning at a high rate, on the free surface of a quiescent tank of water generates an air-side splash curtain and subsurface air cavity which initially resembles the features generated by the impact of a non- spinning sphere. However after only milliseconds, it is clear that this problem is quite unique. The splash curtain forms and collapses asymmetrically and the ball moves through the water in a curved path, bending the air cavity along its trajectory. The hydrodynamics of a billiard ball (diameter 5.7 cm) impacting the free surface with a downward vertical velocity of 7.5 m/s and a clockwise angular velocity of 232 rad/s, at impact, are revealed using high speed video imaging. Initially, at impact, the momentum transfer forms a radial jet just above the free surface, until vertical growth outpaces radial expansion forming the splash curtain which eventually collapses inward, forming a dome. This dome continues to collapse, doing so asymmetrically due to the spinning motion of the sphere. A clockwise spinning sphere draws fluid from the left side of the cavity forming a vertical wedge of fluid that travels towards the right side of the cavity. The fluid eventually impacts the opposite wall, forcing air to be ejected from the cavity. As the ball travels along its curved trajectory, the cavity continues to elongate but no longer grows radially, eventually resulting in cavity pinch-off.

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