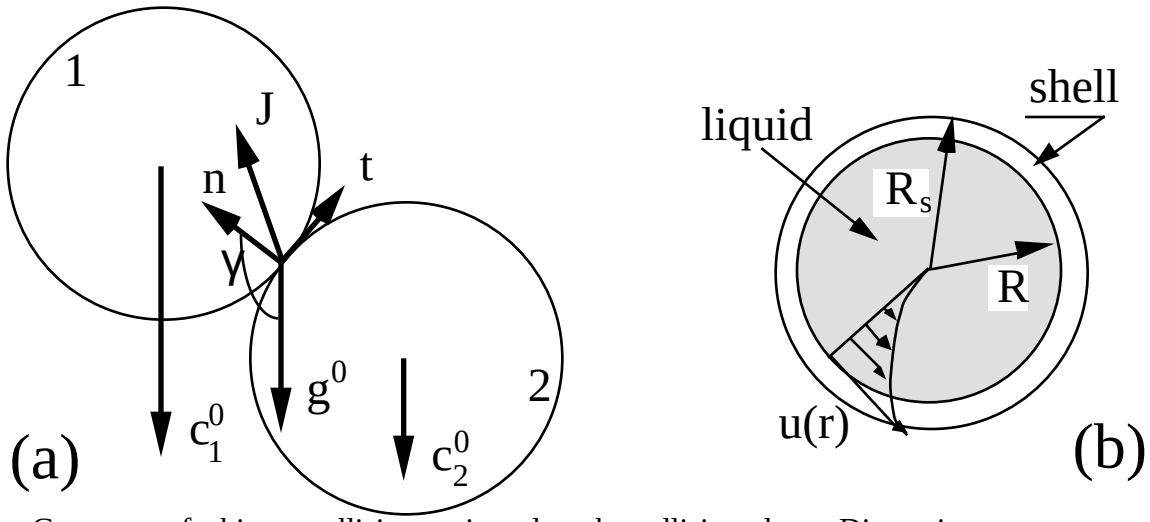
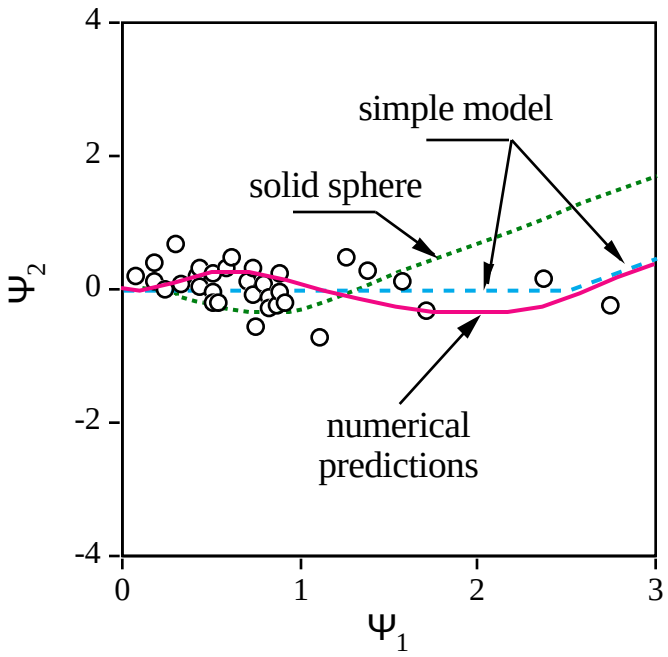
Michel Y. Louge, Christopher Tuozzolo and Adam Lorenz: "On binary impacts of small liquid-filled shells," *Phys. Fluids* **9**(12), 3670-3677 (1997).

We report the peculiar impact properties of small spherical shells filled with a viscous liquid. Upon collisions of two identical liquid-filled shells, the fluid is progressively set in rotation by the shell spin induced by tangential impact forces. An analysis of the corresponding fluid motion predicts a collision outcome unlike that of solid spheres where angular velocity is uniform. Observations of colliding vitamin-E pills reveal that the point of contact is rarely involved in gross slip. In the direction of the line of centers, collisions are adequately described by a kinematic restitution coefficient. In the perpendicular direction, they generally exhibit rolling contact.

Figure excerpts



Geometry of a binary collision projected on the collision plane. Dimensions are not to-scale. (a) Velocities, orientation and impulse at the onset of impact; (b) cut through the equatorial plane of a pill after collision.



Experimental data and models. The solid line is the prediction of the numerical analysis with $\mu_c = 0.19$ and $e = 1$. The dotted line is the corresponding prediction assuming that the pill behaves as a solid inhomogeneous sphere; clearly, this prediction fails to capture the data. The dashed lines represent the simple model of Eqs. (44) and (45) with $\mu_c = 0.19$, $e = 0.89$ and $\beta_0 = 0$. We attribute the experimental scatter to variability in geometry and properties of the pills.