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Impacts on thin elastic sheets ROMAIN VERMOREL, NICOLAS VANDENBERGHE, EMMANUEL VILLERMAUX[1], IRPHE - Aix Marseille Université, FRAGMENTATION AND MIXING TEAM TEAM — The radial cracks developing from the impact point of a projectile on a windshield are of common experience. We investigate the origin of this phenomenon using thin elastic sheets as an experimental model. A projectile launched at controlled speed impacts a free membrane at rest. A tensile front sets out from the point of impact and propagates radially at the speed of sound. Flexural waves can propagate in the extended area. Specifically, the interaction between the rigid body and the elastic sheet gives birth to a conical flexural shape whose base expands radially at a well defined velocity. During the propagation of both the tensile and flexural fronts, the radial tensile stress field results in a compressive stress in the azimuthal direction, which triggers a buckling instability. That instability is responsible for the formation of radial folds, with a well defined azimuthal wave number. Based on detailed experimental observations and measurements, we propose a model to understand the wave motion and stress field consecutive to the impact; in addition, we provide a prediction for the number of folds selected during the buckling instability as a function of the relevant parameters, including impact velocity.

[1]also at Institut Universitaire de France

Romain Vermorel
Aix Marseille Université

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