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Ribbon curling ANNE JUEL, University of Manchester, UK, CHRIS PRIOR, University of Durham, UK, JULIEN MOUSSOU, ENS Paris, France, BUDDHAPRIYA CHAKRABARTI, University of Durham, UK, OLIVER JENSEN, University of Manchester, UK — The procedure of curling a ribbon by running it over a sharp blade is commonly used when wrapping presents. Despite its ubiquity, a quantitative explanation of this everyday phenomenon is still lacking. We address this using experiment and theory, examining the dependence of ribbon curvature on blade curvature, the longitudinal load imposed on the ribbon and the speed of pulling. Experiments in which a ribbon is drawn steadily over a blade under a fixed load show that the ribbon curvature is generated over a restricted range of loads, the curvature/load relationship can be non-monotonic, and faster pulling (under a constant imposed load) results in less tightly curled ribbons. We develop a theoretical model that captures these features, building on the concept that the ribbon under the imposed deformation undergoes differential plastic stretching across its thickness, resulting in a permanently curved shape. The model identifies factors that optimize curling and clarifies the physical mechanisms underlying the ribbon's nonlinear response to an apparently simple deformation.

Anne Juel
University of Manchester

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