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Gaussian curvature and confinement in thin shells

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Non-Euclidean shells, when confined, can deform to a broad assortment of large scale shapes and smaller scale wrinkling and folding patterns quite unlike what produced by their flat counterparts. The intrinsic, natural curvature of shells is the central element that allows for this rich morphological landscape, but it is also the source of geometric nonlinearities that renders an analytic treatment of non-Euclidean shells, even under small load, virtually intractable. Understanding the shapes of confined non-Euclidean shells frequently requires tools and approaches that might be non-standard for flat sheets. In this talk we discuss some snapshots of the morphological landscape of confined curved shells. We use theory, simulations and experiments to explore the large scale deformation of a confined thin spherical shell with an opening. We then proceed to investigate the wrinkling patterns produced by shallow doubly curved shells when external load introduces lateral confinement. From these examples, we see Gaussian curvature emerging as a powerful tool that can shed light on phenomena inaccessible by the mechanics of flat sheets.