Abstract Submitted
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Anomalously soft non-Euclidean spring IDO LEVIN, ERAN SHARON, Hebrew Univ of Jerusalem — In this work we study the mechanical properties of a frustrated elastic ribbon spring - the non-Euclidean minimal spring. This spring belongs to the family of non-Euclidean plates: it has no spontaneous curvature, but its lateral intrinsic geometry is described by a non-Euclidean reference metric. The reference metric of the minimal spring is hyperbolic, and can be embedded as a minimal surface. We argue that the existence of a continuous set of such isometric minimal surfaces with different extensions leads to a complete degeneracy of the bulk elastic energy of the minimal spring under elongation. This degeneracy is removed only by boundary layer effects. As a result, the mechanical properties of the minimal spring are unusual: the spring is ultra-soft with rigidity that depends on the thickness, t , as $t^{7/2}$, and does not explicitly depend on the ribbon's width. These predictions are confirmed by a numerical study of a constrained spring. This work is the first to address the unusual mechanical properties of constrained non-Euclidean elastic objects. We also present a novel experimental system that is capable of constructing such objects, along with many other non-Euclidean plates.

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