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Hiding the weakness: structural robustness using origami design BIN LIU, Physics Department, Cornell University, CHRISTIAN SANTANGELO, Department of Physics, University of Massachusetts, Amherst, ITAI COHEN, Physics Department, Cornell University — A non-deformable structure is typically associated with infinitely stiff materials that resist distortion. In this work, we designed a structure with a region that will not deform even though it is made of arbitrarily compliant materials. More specifically, we show that a foldable sheet with a circular hole in the middle can be deformed externally with the internal geometry of the hole unaffected. Instead of strengthening the local stiffness, we fine tune the crease patterns so that all the soft modes that can potentially deform the internal geometry are not accessible through strain on the external boundary. The inner structure is thus protected by the topological mechanics, based on the detailed geometry of how the vertices in the foldable sheet are connected. In this way, we isolate the structural robustness from the mechanical properties of the materials, which introduces an extra degree of freedom for structural design.

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