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Metamaterials shake up textbook mechanics.

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We defy two fundamental properties at the basis of mechanics using mechanical metamaterials close to topological transitions. First, we realize highly symmetric metamaterials whose stiffness is *non-extensive*, namely it behaves non-monotonically as the system size is increased. Second, we create asymmetric and topological mechanical metamaterials that exhibit *static non-reciprocity*, i.e. transmit displacements very differently when pushed from different sides. We further demonstrate that such non-extensive and non-reciprocal properties are associated with two distinct length scales that diverge when the metamaterials become isostatic and symmetric, respectively. These two limits, which correspond to two distinct topological transitions, provide a very efficient framework to largely enhance non-reciprocity and non-extensiveness and add significant design principles to the metamaterials toolbox.