Emergent perversions in the buckling of heterogeneous elastic strips

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A perversion in an otherwise uniform helical structure refers to a kink that connects two helices with opposite chiralities. Such singularity structures are widely seen in natural and artificial mechanical systems, and they provide the fundamental mechanism of helical symmetry breaking. However, it is still not clear how perversions arise in various helical structures and which universal principles govern them. Here, we investigate intrinsic perversion properties which are independent of strip shapes. This study reveals the rich physics of perversions in the three-dimensional elastic system, including the condensation of strain energy over perversions during their formation, the repulsive nature of the perversion-perversion interaction and the coalescence of perversions that finally leads to a linear defect structure. This study may have implications for understanding relevant biological motifs and for use of perversions as energy-storers in the design of micro-muscles and soft robotics.

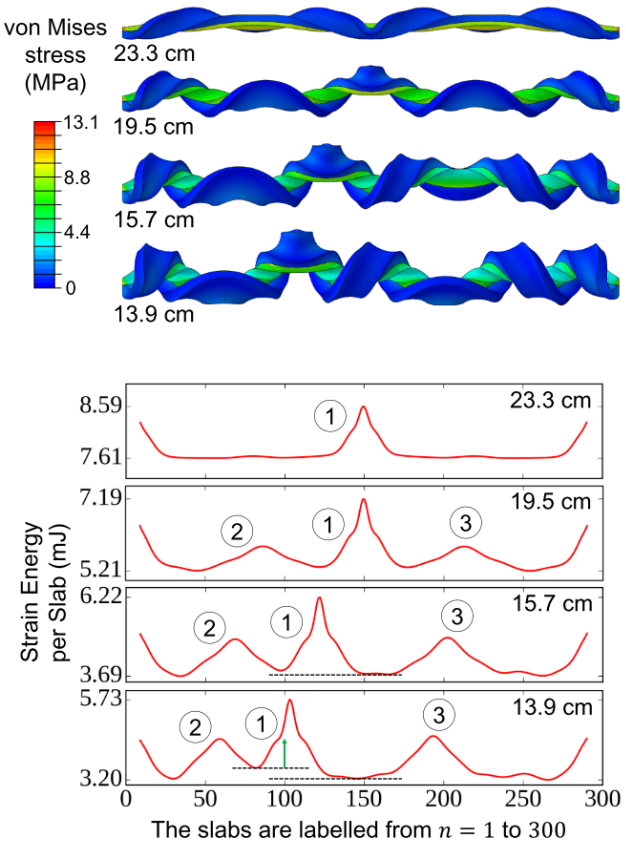

Figure: The formation and evolution of three perversions in a single bistrip. (a) and (b) show the conformations and the corresponding strain energy distribution. The green arrow in (b) indicates energy elevation and therefore repulsion between perversions.

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