Abstract Submitted
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Statistical Mechanics of Square Frames[1] SOURAV BHABESH, DAVID YLLANES, Syracuse University, KITP UC Santa Barbara, MARK BOWICK, KITP UC Santa Barbara,Syracuse University, MICHAEL MOSHE, Harvard University, Syracuse University — Kirigami has opened a new avenue for manipulating mechanical properties of thin sheets to create metamaterials. It is well known that thermal fluctuations renormalize the bending rigidity of elastic membranes, leading to power-law stiffening as a function of system size. Kirigami structures, however, are expected to decrease the bending rigidity and it is of particular importance to explore how thermal fluctuations affect the mechanics of sheets with non-trivial topology. We explore sheets with single square holes (frames) via Monte Carlo simulations and a geometric formalism of elasticity theory. We find that thermal fluctuations lead to frame buckling from a flat (low temperature) to a buckled (high temperature) state. Further, we note that allowing frames to buckle requires a trade off between stretching and bending energy. We also find that buckling is accompanied by the formation of E cones and simple cones, giving rise to Gaussian curvature at the corners of the square hole. Buckling is also sensitive to the size of the hole, with larger holes buckling more readily.

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