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Twist Buckling and the Foldable Cylinder: An Exercise in Origami

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The buckling of the thin circular cylindrical shell under torsion is one of the fundamental problems of elastic stability. But, unlike its counterpart loaded in axial compression, it develops a deflection pattern like a mechanism from origami, whereby the system can be folded completely flat with length reduced to zero. The mechanism is simply demonstrated by twisting a rolled length of paper between two rigid mandrels. The talk will explore the relationship between initial buckling, first-order post-buckling, and the final folding mechanism, in the twisted cylindrical shell. It will demonstrate that the circumferential wavenumber is decided at the point of instability and remains unchanged throughout. However, as the system moves to accommodate the fixed geometry of the final folded shape, the obliqueness of the wavepattern changes; crest and valley lines start parallel to one another, but rotate by different amounts to create the fold lines of the mechanism.

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