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**Helical buckling of flexible filaments in viscous flow** BRATO CHAKRABARTI, University of California, San Diego, YANAN LIU, Northwest University, Xi'an, China, JOHN LAGRONE, RICARDO CORTEZ, LISA FAUCI, Tulane University, OLIVIA DU ROURE, ESPCI, Paris, DAVID SAINTILLAN, University of California, San Diego, ANKE LINDNER, ESPCI, Paris — Helical morphologies of slender structures in flow are generic and have been observed in various experiments and manufacturing processes over a range of length scales. In contrast with the classical helical buckling of elastic rods that requires application of end moments, helical buckling of freely suspended filaments is a spontaneous symmetry breaking induced by distributed viscous forces. In a step towards elucidating this phenomenon, we demonstrate using microfluidic experiments that actin filaments first buckle in compressional flow due to viscous stresses and subsequently form coiled conformations, and two complementary sets of simulations in different geometries also reveal the same. The radius of the emerging helices is found to be independent of filament length, which we explain using a scaling law. To explain the origin of helical buckling, we also perform a weakly nonlinear stability analysis. Following a linear Euler buckling regime induced by compressive stresses, unstable planar modes are shown to interact in the presence of geometric nonlinearities and spontaneously give rise to three-dimensional helical morphologies. Our theory highlights why helical coiling is so ubiquitous in strain-dominated flows.

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