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Dynamics of Buckling of an Elastic filament in a Viscous fluid[1]

MOUMITA DASGUPTA, ARSHAD KUDROLLI, Clark University — We study the buckling of an elastic filament when immersed in a Newtonian fluid as it undergoes a uniaxial compression. Although there have been investigations of buckling of semi-flexible filaments in complex materials including locomotion of microorganisms, in cytoskeleton of microtubules and helical plant roots, there is a gap in the understanding of the dynamics of buckling instability for the simpler Newtonian case. Therefore, we investigated the growth of buckled modes of an elastic ribbon under various compression rates which buckles into configurations which depend of the relative magnitude of the elastic and viscous forces. At low compression rates, the ribbon buckles quasi-statically to form the standard one-mode shape in agreement with the fundamental Euler buckling mode. As the compression rate is increased, the ribbon undergoes systematic increase in the number of modes at onset. In all cases, the ribbon relaxes after compression stops to the fundamental Euler mode. We will discuss the fits to the shape in terms of sums of Euler modes as well as Fourier modes, and their growth and decay. Finally, the effect of the fluid viscosity on the evolution of the buckled mode will be discussed.

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