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Hydrodynamic stability of moderately-deflated, giant unilamellar vesicles in general linear flows VIVEK NARSIMHAN, CHARLIE LIN, Purdue University — In this talk, we perform boundary element simulations to describe the shape and stability of osmotically deflated vesicles in a wide range of flows. The first half of this talk recaps vesicle dynamics in purely extensional flows, which are commonly found in contractions/expansions and/or suction flows. Above a critical flowrate, we find that moderately deflated vesicles undergo an asymmetric shape instability that looks fundamentally different than droplet breakup. The physical origins of such vesicle shapes are discussed in detail and compared with microfluidic experiments. In the second half of the talk, we discuss vesicle stability in a general linear flow that contains both vorticity and extension. We find that the critical capillary number for vesicle instability diverges as one moves from pure extension to pure shear, which suggests that vesicles are incredibly hard to break in pure shear flow. We also find that the vesicle's interior viscosity plays little role in its stability, which is quite different than what is observed for droplets. We provide physical explanations for these observations by examining membrane tension profiles and using geometric scaling arguments. We will conclude by showing preliminary data of vesicle shapes in oscillatory flows.

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