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The shape of an elastic filament in a two-dimensional corner flow LAURA GUGLIELMINI, Princeton University, NICOLAS AUTRUSSON, Institute Superior de l'Aeronautique et de l'Espace, SIGOLENE LECUYER, Harvard University, ROBERTO RUSCONI, Massachusetts Institute of Technology, HOWARD STONE, Princeton University — The deformation of a flexible filament held fixed at one end in a nonuniform viscous flow with curved streamlines is considered, with a focus on the filament dynamics and steady-state shape. Our motivation arises from recent microfluidic experiments on biofilm formation: in a channel with bends, thread-like structures, or streamers, were observed, attached to the side walls downstream of each corner and connecting consecutive corners while floating in the channel middle plane (Rusconi et al., J. Roy. Soc. Interface 2010). We discuss the time evolution and final shape of the filament in different corner geometries as a function of a non-dimensional elasticity parameter that compares viscous and elastic effects. Since the filament develops tension, when the flow has curved streamlines the filament does not align with the flow, but rather it crosses the streamlines, in contrast with the behavior observed for rectilinear flows. We also discuss the buckling instabilities that occur when the filament undergoes compression for the specific case of a stagnation point flow near a wall.

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