Controlling Vortices in Dry Active Matter

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We investigate the rotation of a vortex around a circular obstacle in dry active matter in the presence of M half-circles distributed around the obstacle. To quantify this effect, we define the parameter Π_M, which is the ratio between the angular velocity of the controlled vortex and the standard deviation angular velocity of the isolated vortex. We observe two regimes of rotation. In the first regime, where $\Pi_M < 0$ corresponding to the flat side of the half-circles facing the vortex, the rotation is clockwise. In the second regime, corresponding to the curved side of the half-circles facing the vortex, $\Pi_M > 0$, and the vortex rotates counter-clockwise. We further investigate the effect of control on vortex stability, which depends on the natural stability of the vortex, revealing transitions between random, transient, and stable states. We also see that the presence of the half-circles may render the vortex more stable compared to an isolated one. Our paper indicates a possible set up to control the spontaneous rotation of dry active matter around circular obstacles.

Keywords: Vortex, dry active matter, simulation, control.
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