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Active matter and Curvature[1]

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Coupling between active motion and curvature is an integral part of many fundamental biological processes such as gastrulation and intestinal crypt fission. However, to date very little is known about how curvature affects active motion. Here we use a particle-based model to study the interplay between activity and curvature in dense systems. Using detailed numerical simulations and simple physical arguments, we show that the presence of curvature results in a number of steady-state configurations that have no analogues in flat geometries. These states are particularly interesting if topological constraints require the presence of defects in the ground states in the passive limit. We focus on polar and nematic active systems confined to move on the surface of a sphere and show that activity can lead to the formation of moving band and multidefect states. We extend our model to self-propelled filaments confined to a plane or the surface of a sphere. We show that the activity leads to an effective softening of the polymer chain. As a result of this softening, with the increase in activity, the system transitions between a jammed polymer-melt state, an active turbulent state characterised by a proliferation of hair-pin defects, to a region dominated by phase segregation (MIPS), finally followed by the onset of a homogenous state characterised by spiral motion of individual polymers.

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