# Guiding spherical microswimmers using liquid crystal topologies

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## 1 Abstract

We investigate the dynamics of spherical squirmers in an anisotropic environment: nematic liquid crystal. Squirmers can be classified as pusher, puller, or neutral based on the flow field they generate. Our findings show that when pushers are present in small numbers, they swim along the local nematic director, whereas pullers follow the direction perpendicular to the director under same conditions. This is explained by the hydrodynamic coupling of the squirmer flow field and anisotropic liquid crystal viscosities. Above a certain squirmer's volume fraction, the simulations show a transition from incoherent individual dynamics to coherent collective dynamics. When the nematic liquid crystal is patterned with spiral vortexes, the pusher squirmers show the uni-polar circular motion. This effect is explained by the overlapping of squirmer's force dipoles and the interaction with the local nematic director. We also demonstrate how these vortices or defects can be used to trap squirmers at the defect core.