Symmetry-breaking motility and diffusion of a porous object immersed in an active fluid

Yongjoo Baek[1], Ki-Won Kim[1], Yunsik Choe[1]
[1]*Seoul National University, Seoul, South Korea*

In this study, we examine the way a symmetrical, porous object, submerged in an active fluid, gains motility due to the presence of a negative drag force acting in the direction of its velocity. Past studies have proposed that this phenomenon is limited to active fluids exhibiting polar or nematic order. However, through mean-field analysis, we show that such motility can arise even in active fluids lacking any pre-existing order. The development of object motility is characterized by both continuous and discontinuous transitions linked to the symmetry-breaking bifurcation of the object's steady-state speed. Additionally, we delve into the significance of these transitions in relation to the nonmonotonic dependence of the object's diffusion coefficient on its size.