REVERSAL MOTION OF E-COLI BACTERIA IN NEMATIC LIQUID CRYSTALS

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ABSTRACT

In many situations bacteria move in complex environments associated with non-Newtonian rheology. In this context, we seek to understand how these active fluids adapt and deal with geometrical frustration induced by the environment. Interesting spatio-temporal patterns have recently been observed in nematic liquid crystals, where the motion of bacteria is directed by the orientational molecular order of the liquid crystal or director field [1]. In this work, we study the swimming reorientation of a single bacterium, *E. coli*, constrained to move along the director field of a lyotropic chromonic liquid crystal (LCLC) that is confined to a planar cell. In such an environment, the spontaneous run and tumble motion of the bacterium gets frustrated: the elasticity of the liquid crystal prevents flagella from unbundling. Interestingly, in order to change direction, bacteria execute a reversal motion along the director field, shown in the **Fig. 1**, driven by the relocation of a single flagellum to the other side of the bacterial body, coined as a frustrated tumble. We present a detailed experimental characterization of this phenomenon, exploiting exceptional spatial and temporal resolution of bacteria and flagella dynamics during swimming, obtained using a two color Lagrangian tracking technique. We suggest a possible mechanism behind the frustrated run and tumble motion, accounting for these observations.

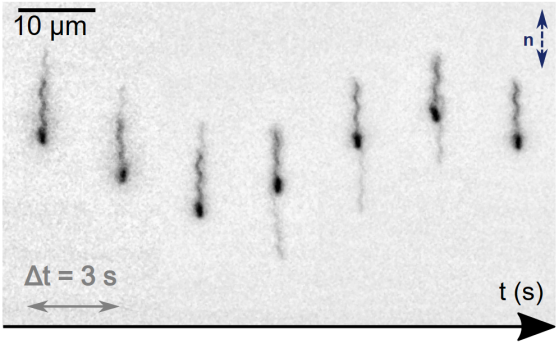

Figure 1: Snapshots of a bacterium swimming and changing direction in the liquid crystal. The nematic director is along the vertical direction, as well as the bacterium alignment.

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