Statistical physics of run-and-tumble bacteria

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Run-and-tumble bacteria, such as E. coli, are prototypical out-of-equilibrium agents. Their dynamics and steady-state behaviours therefore cannot be understood within the framework of equilibrium statistical mechanics. Nevertheless the run-and-tumble dynamics, alternating runs in quasi straight lines with sudden - and random - changes of direction, are simple enough that one can successfully construct an explicit statistical treatment which captures their large scales and long times properties. I will show how to do so and present some consequences, ranging from the sedimentation profile of bacteria to mechanisms leading to pattern formation.