Behavior of magnetic filaments under the simultaneous action of a flow and an external magnetic field.

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The formation of chain-like structures made of ferromagnetic colloids has been predicted more than four decades ago. Since the pioneering work of Tabata et al.[1] and due to advances in experimental techniques, it is possible to synthesise chains of magnetic colloids with different porperties. The formation of these chains has important implications in the behaviour of magnetic fluids. In this poster we present an extensive numerical study of the behaviour of a filament made of ferromagnetic colloidal particles subjected to the simultaneous action of a fluid flow and a stationary external magnetic field perpendicular to the flow. We found that in the presence of a shear flow the tumbling motion observed at zero field is strongly inhibited when the external magnetic field is applied. The field is able to stabilise the filament with a well defined degree of alignment that depends on the balance between hydrodynamic and magnetic torques. In addition, in the case of a Poiseuille flow, it has been found that the initial position has a long lasting influence on the behaviour of the magnetic filament when the external field is applied [2].

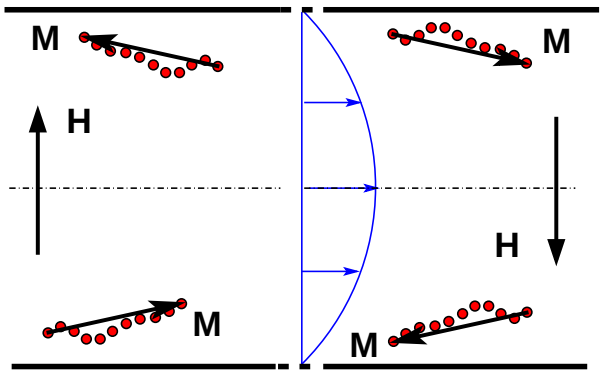

Figure 1: Possible orientations of the filament (chain magnetization M) in a Poiseuille flow and an external magnetic field H.

[1] O. Tabata, H. Kojima, T. Kasatani, Y. Isono, and R. Yoshida, Chemo-mechanical actuator using self-oscillating gel for artificial cilia, in Proceedings IEEE Sixteenth Annual International Conference on Micro Electro Mechanical Systems, pages 12?15, (2003).

[2] D. Lüsebrink, et al. The Journal of Chemical Physics, 145, 234902 (2016).