Tunable dynamics of flexible magnetic filaments in flow

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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 synthesize chains of magnetic colloids with different properties. The formation of these chains has important implications in the behaviour of magnetic fluids.

In this poster we present an extensive numerical study in which it is shown how the dynamic properties of flexible magnetic filaments in flow can be controlled with an applied external magnetic field. 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].

[1] O. Tabata, H. Kojima, T. Kasatani, Y. Isono, and R. Yoshida, Chemo-mechanical actuator using self-oscillating gel for artificial cilia, in *The Sixteenth Annual International Conference on Micro Electro Mechanical Systems, Kyoto, Japan, January 19-23, 2003* (IEEE, New York, 2003), pp. 12-15.

[2] D. Lüsebrink, J. J. Cerdà, P. A. Sánchez, S. S. Kantorovich, and T. Sintes, J. Chem. Phys. **145**, 234902 (2016).

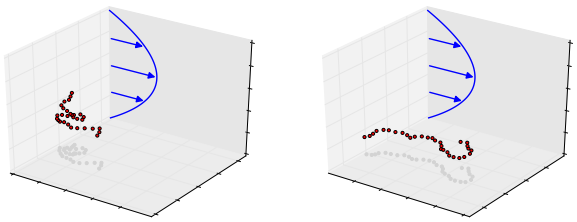

Fig. 1. Two snapshots of the characteristic conformations of a filament subjected to a Poiseuille fluid flow. Tumbling motion observed at zero field $h = 0$.

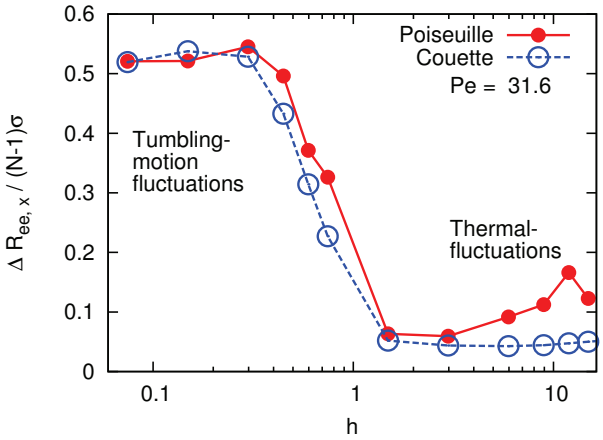

Fig. 2. Fluctuations of the end-to-end distance R_{ee} normalised by the chain contour length $(N-1)\sigma$ of a magnetic filament placed in flow (Couette and Poiseuille with a Peclet number Pe $= 31.6$) as a function of strength of the external magnetic field h.