# Nonlinear flow-induced deformation of a confined elastic fiber: toward bio-inspired particle filters

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**Résumé**

Dense fibrous media in contact with viscous flows are ubiquitous in nature and technology, from biological filtration systems to engineered porous filters. Their macroscopic transport properties crucially rely on the deformation of individual flexible fibers, yet the elementary fluid–structure mechanisms governing this coupling remain poorly understood.
Here we investigate experimentally and theoretically the flow-induced bending of an isolated quasi-two-dimensional elastic fiber confined in a viscous channel. By independently varying the fiber thickness and young's modulus, the channel geometry and the imposed flow rate, we systematically quantify the resulting fiber tip deflection. We show that the deformation exhibits a strongly nonlinear dependence on the flow rate and is a function of the geometric and mechanical parameters of the system.

A minimal pressure-drop model that builds upon analytical solutions from simple confined geometries and nonlinear elastic beam theory almost captures the measured deformations. In addition, we identify a dimensionless parameter allowing all experimental and theoretical results to collapse onto a single master curve.
This unified description provides a fundamental building block for predictive modeling of dense deformable fibrous media and opens new perspectives for the design of bio-inspired filtration systems and particle trapping devices.

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