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Landau-Squire jet as a versatile probe to measure flow rate through individual nanochannel and nanotubes ELEONORA SECCHI, SOPHIE MARBACH, ALESSANDRO SIRIA, LYDERIC BOCQUET, Department of Physics, Ecole Normale Superieure, Paris — Over the last decade, nanometric sized channels have been intensively investigated since new model of fluid transport are expected due to the flow confinement at the nanometric scale. Nanoconfinement generates new phenomena, such as superfast flows in carbon nanotubes and slippage over smooth surfaces. However, a major challenge of nanofluidics lies in fabricating nanoscale fluidic devices and developing new velocimetry techniques able to measure flow rates down to femtoL/s. In this work we report the experimental study of the velocity fields generated by pressure driven flow from glass nanochannel with a diameter ranging from 1μm to 100nm. The flow emerging from these channels can be described by the classical Landau-Squire solution of the Navier-Stokes equation for a point jet. We show that due to the peculiarity of this flow, it can be used as an efficient probe to characterize the permeability of nanochannels. Velocity field is measured experimentally seeding the fluid in the reservoir with 500 nm Polystyrene particles and measuring the velocity with a standard PIV algorithm. Predictions are tested for nanochannels of several dimensions and supported by ionic current measurement. This demonstrates that this technique is a powerful tool to characterize the flow through nanochannels. We finally apply this method to the measurement of the flow emerging from a single carbon nanotube inserted in the nanochannels and present first data of permeability measurement through a single nanotube.

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