Stokes' paradox and force undergone by a sphere or cylinder in an unbounded power law fluid

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The Stokes-type problem concerning the calculation of the drag undergone by a sphere or a cylinder in a power-law fluid in unbounded or weakly confined medium aroused the attention of many researchers [1] whose results have not been definitively established in non-inertial regime for different fluid indexes *n* and particularly for dilatant fluids in the case of a sphere. Through this talk, we try to provide an accurate numerical solution for this non-linear problem. Therefore, we will present the results obtained by different methods to certify their accuracy. Moreover, the influence of the rheological behavior of the fluid on the variation of the hydrodynamic screen length (hydrodynamic interactions) is closely studied. Finally, we elucidate the influence of the decrease of the screen length in pseudoplastic fluids which leads to the disappearance of the Stokes paradox [2] as obtained by the confinement in the case of the cylinder at very low Reynolds numbers. However, we have been surprised that the increase of the screen length is sufficient to permit the Stokes paradox to take place for dilatant fluids for $n > 2$ in the case of a sphere [4], and for $n > 1$ for a cylinder [3]. Both situations have not been confirmed before numerically due to the inertia induced by the confinement and the low Reynolds numbers requirement.

[1] R. P. Chhabra, *2007* Bubbles, drops and particles in non-Newtonian fluids. CRC press

[2] R. I., Tanner, 1993 Stokes paradox for power-law flow around a cylinder. *J. Non-Newt. Mech.* **50**, 217–224.

[3] A. Despeyroux, A. Ambari, A. Ben Richou. 2011, Wall effects on the transportation of a cylindrical particle in power-law fluids, *Journal of non-Newtonian Fluid Mechanics*, in press (réf n°: JNNFM3250).

[4] A. Despeyroux, A. Ambari, A. Ben Richou. 2011, The hydrodynamic interaction effects on the settling and the transportation of a sphere in power-law fluids, *Physics of Fluids*, under revision (réf n°: PF#11-0283).