

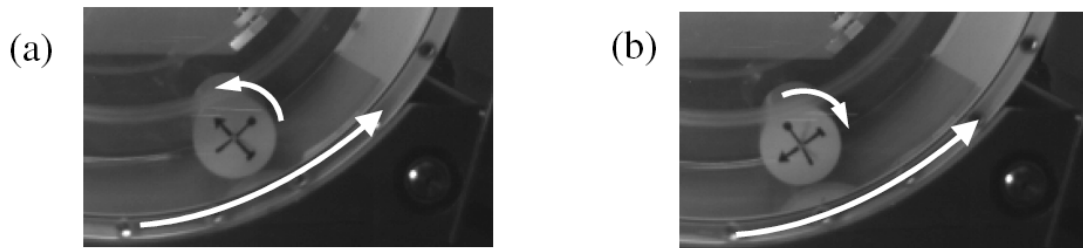
## Drag and lift forces on a counter-rotating cylinder in rotating shear flow

Chao Sun<sup>1</sup>, Tom Mullin<sup>2</sup>, Leen van Wijngaarden<sup>1</sup> and Detlef Lohse<sup>1</sup>

1. Physics of Fluids Group, Faculty of Science and Technology, J. M. Burgers Centre for Fluid Dynamics, MESA+ and Impact Institutes, University of Twente, The Netherlands.

2 Manchester Centre for Nonlinear Dynamics, University of Manchester, Oxford Road, Manchester M13 9PL, United Kingdom.

Flow around a rotating cylinder is of great fundamental interest but also of great importance in many industrial applications, such as flow control. We experimentally investigated the motion of a heavy cylinder in a drum filled with water, and rotating about a horizontal axis. The cylinder either co-rotates or counter-rotates with the rotating drum as shown in Fig. 1. The flow field around the cylinder, both for co-rotation and counter-rotation situations, was measured with Particle Image Velocimetry in order to investigate the different flow mechanism. For the counter - rotation situation, the cylinder freely rotates without contact with the wall of the drum, due to the lift force acting on it. The drag and lift coefficients, on the freely counter - rotating cylinder, were measured in a wide range of Reynolds numbers  $2,500 < Re < 25,000$  and dimensionless rotation rates  $0.0 < \alpha < 1.2$ . We found that the drag coefficient is consistent with previous measurements on a cylinder in a uniform flow. However, a significant enhancement of the lift coefficient is observed in the present measurements. We expect the enhancement of the lift force is caused by the combined effects of rotation of the cylinder and the vicinity of a wall.



**Figure 1.** Representative images for the (a) co-rotating and (b) counter-rotating cylinder; the radius of the cylinder is 30 mm.