# Dynamical behaviour of counter-current axisymmetric shear flows

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**Abstract** The dynamical behaviour of coherent structures in counter-current axisymmetric shear flow has been experimentally studied. Two kinds of vortices, i.e., axisymmetric and helical structures, were discovered with respect to different regimes in the forward velocity versus velocity ratio diagram. On axisymmetric structures, two global self-excited oscillation modes referred to as the shear layer and jet column modes could be set in the flow system and the effect of the velocity ratio on the dynamical behaviour of this kind of structures could be concluded as the principle of relative movement. On helical structures, it is a kind of streamwise vortex structures resulting from the jet column bifurcations whose temporal asymptotic behaviour could be described as a 2-torus.

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*We measured the helical flow*
*In a tube at some speeds high and low;*
*We readily reckoned*
*Two meters per second*
*As a critical speed you should know.*

## 1. Introduction

The study of the dynamical behaviour of coherent structures in the free shear flow play an essential important role in the modern research of the generation mechanism of turbulence. The coherent structures in shear flow could be classified into two groups: spanwise (including axisymmetric) and helical structures.

The dynamical behaviour of the wakes of a 2D circular cylinder have been experimentally studied in detail (Williamson 1996), a kind of amplitude modulation type of velocity fluctuations were widely discovered, e.g. near the borders between cells of different frequencies and oblique resonance regions, all of these cases corresponding to the interaction of