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The counter-rotating core of a swirling turbulent jet[1] LUCA FACCIOLO, P. HENRIK ALFREDSSON, KTH Mechanics, Stockholm — A swirling jet is generated by a fully developed, turbulent rotating pipe flow (6 m long, diameter 60 mm). The Reynolds number is 24000 and the swirl number (ratio between the velocity at the pipe wall and the bulk velocity in the pipe) 0.5. Due to the effect of the cross-stream Reynolds stress the flow in a rotating pipe does not reach a solid body rotation and instead the azimuthal velocity component lags behind it. The jet issued at the pipe end preserves, as shown by both experiments and numerical simulations, the azimuthal velocity imposed by the pipe flow in the central region a few diameters downstream. Moving further downstream the azimuthal component decays until, in the core of the jet, it becomes negative and the flow rotates in the opposite direction with respect to the rotation of the pipe. The counter-rotating core covers a region of approximately the pipe diameter and its amplitude represents a few percent of the velocity at the pipe wall but is clearly detected in experiments and simulations. Hot-wire and LDV data show the development of the jet flow field and confirm the counter- rotating core at a distance of approximately 6 diameters from the pipe outlet. Time and space resolved stereo PIV data are used to analyse the structures of the counter-rotating core in the cross flow plane, among other things with the use of POD.

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