PIV INVESTIGATIONS OF AN EXCITED AIR JET

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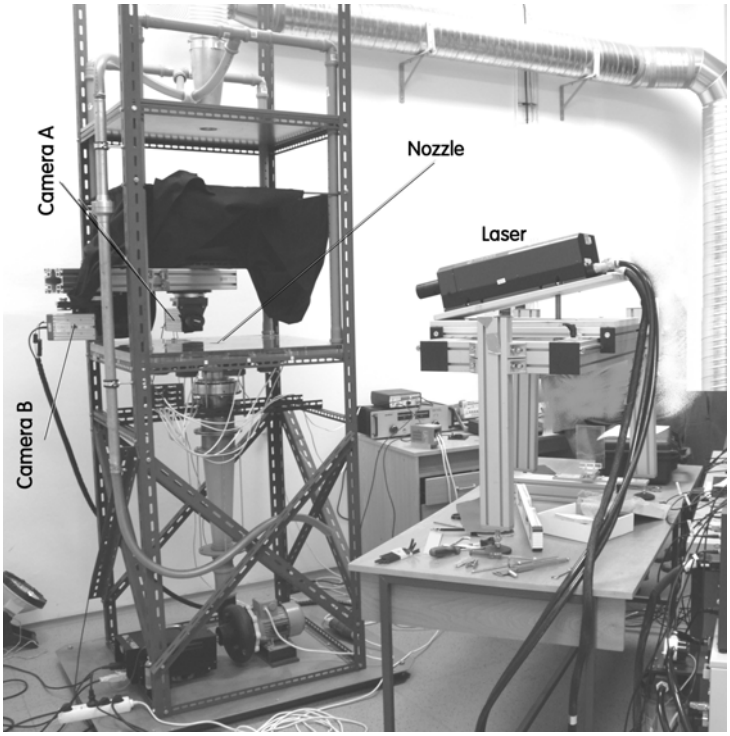
For several past years, the authors of refs. [2] – [9] have been investigating the vortical instability structures in submerged air jets. The main aim is to verify the theory [1] according to which instabilities of helical character – due to special properties of helicity - should be capable of paradoxical spectral energy transport towards small wavenumbers. At the final stage of this effect should be the generation of tornadoes and related atmospheric large-scale phenomena.

Investigated jets are visualised by addition of liquid droplet tracking particles that scatter laser light sheet illuminating the meridian plane. To facilitate a synchronised data acquisition, needed for phase averaging despite the usual phase jitter of coherent structure generation, the jets are excited by a weak pressure field [3, 4] rotating in the nozzle exit plane. It makes possible, as an alternative, also a generation of two helical vortices in the jet mixing layer chasing one another and mutually interacting.

Although the authors have developed ingenious processing of the flow visualisation records based on evaluating correlation coefficients in progressively interrogated image regions [5, 6, 9] it became obvious that visualisation alone, without extraction of quantitative velocity data cannot provide the unequivocal answers. Fortunately, it became recently possible to enhance the experiments by using the 3D PIV facility of Department D1 of the Institute of Thermomechanics.



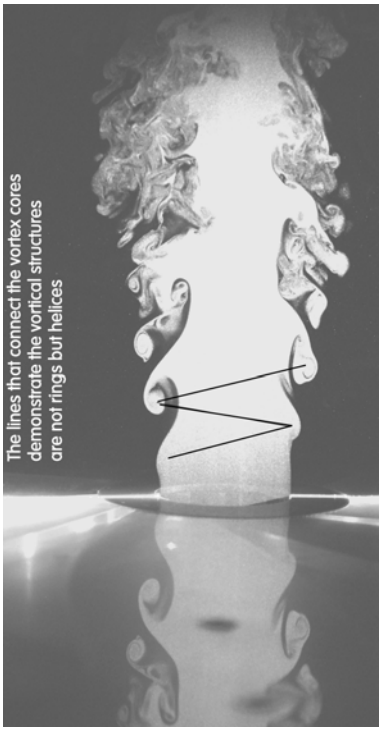


Fig. 1 (Left): The experimental setup for the PIV data acquisition. The black curtains surrounding the jet are here lifted to reveal the nozzle exit. **Fig. 2 (Right)**: A typical example of the investigated jet: Re = = 8.0 10^3, excitation frequency 62.8 Hz (Both photographs: P. Antoš)

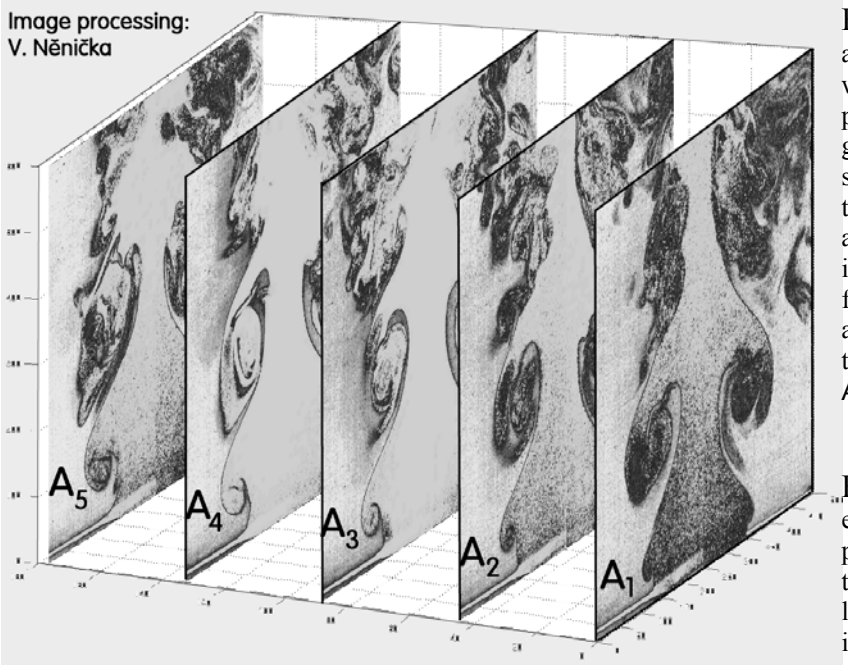
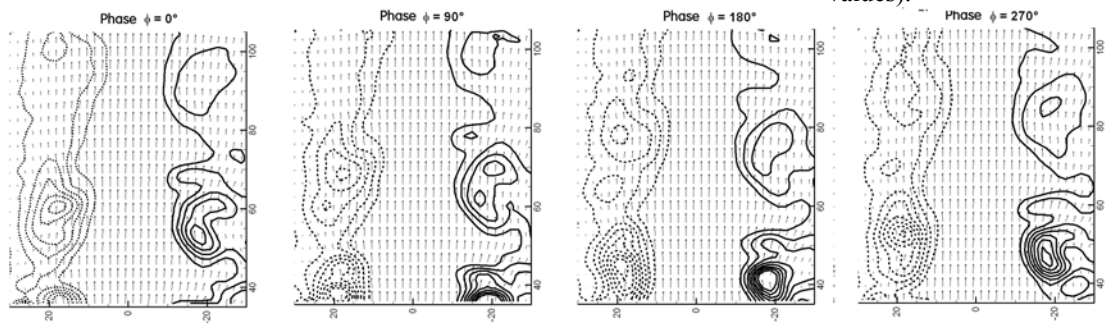


Fig. 3 **(Left)** Image acquisition synchronised with the excitation makes possible study of the progressive phases of the structure development. In this example of a sequence at increasing phase angle, it may be interesting to follow the vertical motion and growth of the section through the vortex from A_1 to A_5.

Fig. 4 **(Below)** Another example of a sequence: phase-averaged distributions of vorticity (dashed lines at left-hand sides of images represent negative values).



Acknowledgments

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