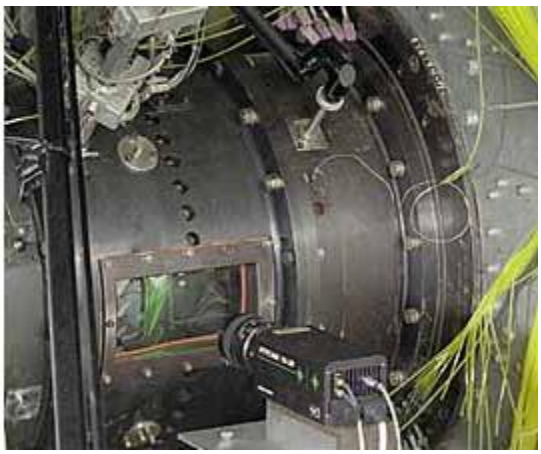
TURBOMACHINERY—MEASUREMENTS IN A TRANSONIC AXIAL COMPRESSOR

APPLICATION NOTE PIV-007

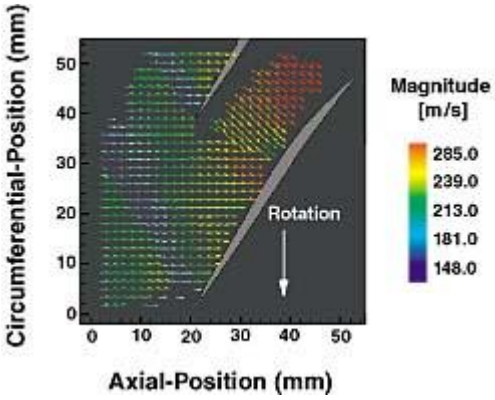
Courtesy of NASA Lewis



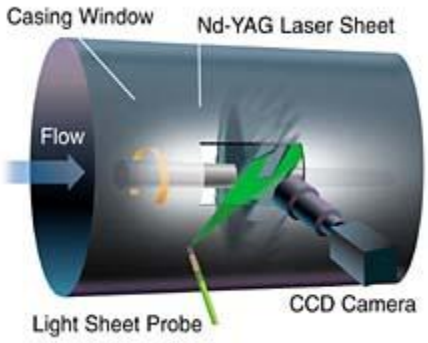
Improving the efficiency of turbomachines requires understanding the flow field occurring within rotating machinery. Although average flow field measurements provide a great deal of insight into the performance of a machine, there are many unsteady flow phenomena occurring in the complex flow fields encountered in turbomachines which may significantly impact the steady state flow. The instantaneous planar velocity measurements obtained with PIV make it a powerful technique for turbomachinery flow diagnostics.

Measurements using a Nd:YAG laser-based PIV system have been carried out in a single stage 50.8 cm diameter transonic axial compressor facility at NASA Lewis. Measurements were obtained in the blade-to-blade rotor passage at a rotational speed of 17,128 rpm. Under these operating conditions, a shock forms off the blade leading edge.

A sheet delivery system using a periscope-type configuration was employed to illuminate the flow region in the rotor passage. A 1K $\times$ 1K pixel crosscorrelation CCD camera utilizing the frame straddling technique was used to acquire the particle images. A once-per-rev signal from the rotor was used to trigger image acquisition and laser pulse triggering. The camera image acquisition and laser pulsing were all software-controlled through the system synchronizer.



The velocity vectors are color-coded by vector magnitude. The results from the measurement are shown in absolute velocity and the position of the blade-to-blade plane shock is readily observed by the sharply turning vectors in the figure.



Transonic compressor facility with PIV system set-up. Drawing depicts light sheet insertion into compressor rotor, location of casing window, and CCD camera.

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