PHASE DOPPLER PARTICLE ANALYZER (PDPA)

PATENTED TECHNOLOGY FOR HIGH QUALITY SIZE AND VELOCITY MEASUREMENTS

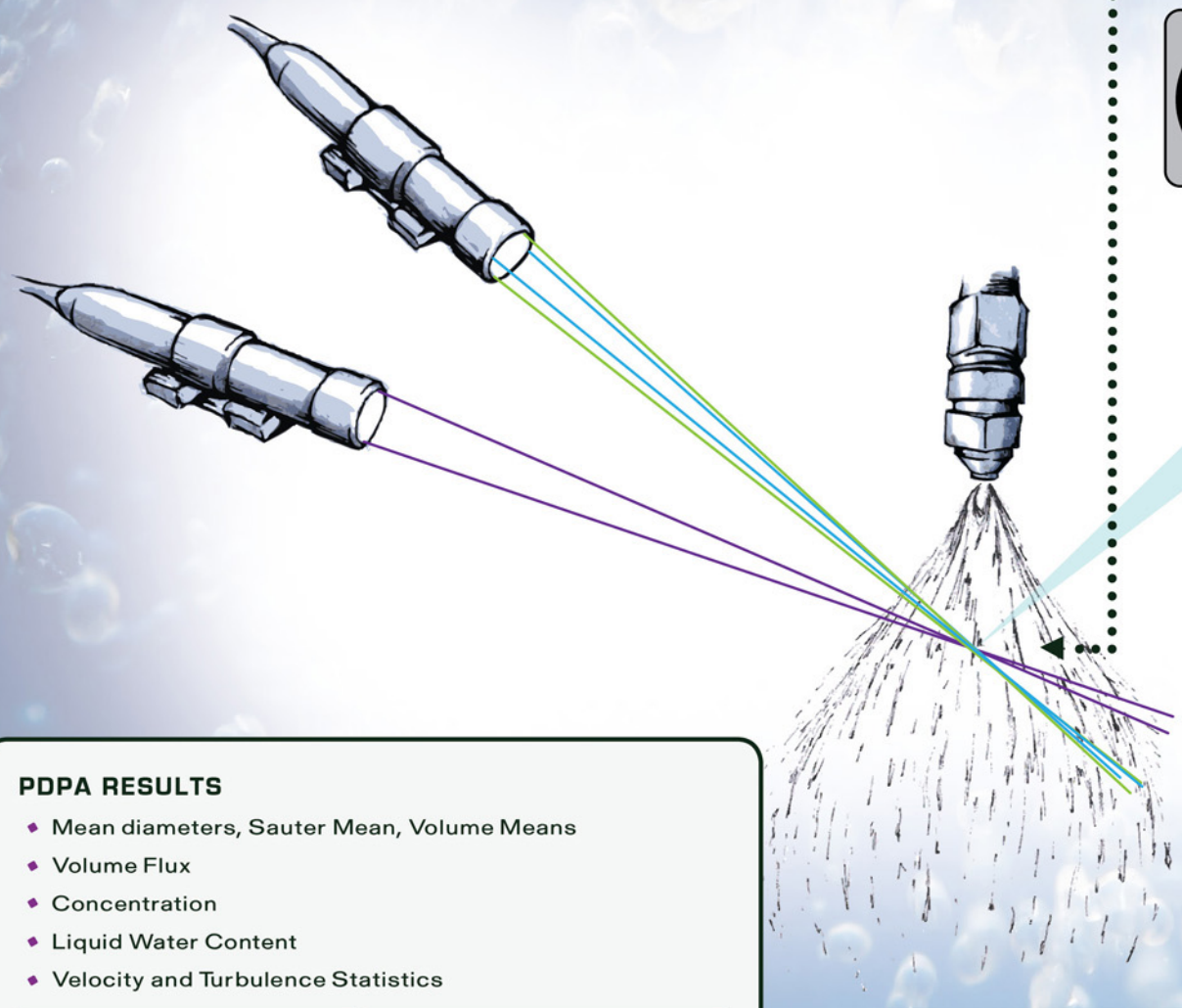
Phase Doppler Particle Analyzer (PDPA) is an extension of the Laser Doppler Velocimetry technique, used for measuring particle size and velocity at a point.

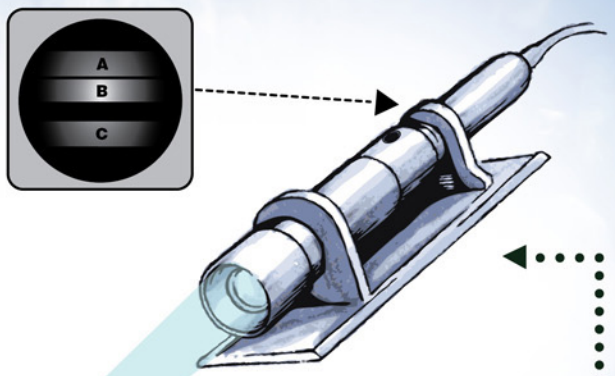
ILLUMINATION

- A continous wave (CW) laser and beam generator emit up to three beam pairs, one for each velocity component being measured.
- Each beam is split into a pair of beams, and a phase shift is applied to one of the beams.
- The beam pairs pass through a fiberoptic cable, and exit the probe with a separation distance S.
- The beams intersect at a distance D from the probe.

MEASUREMENT REGION

- Each laser beam pair crosses, which causes the wavefronts to interfere, forming a fringe pattern.
- The fringe spacing is a known function of the laser wavelength, S and D.
- The measurement region is scanned through the spray or particle field to acquire profiles and contours.
- The particles refract or reflect the fringe pattern in a manner that relates to their diameter.





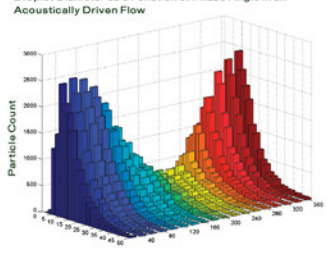
SIGNAL COLLECTION

- The measurement region is viewed by three detectors at three different positions.
- Each of the three detectors produces Dopplers burst signals similar in appearance, but out of phase with each other.
- The phase shift yields the spatial fringe frequency, which is linearly proportional to the droplet size.
- The Doppler burst amplitude is also measured and used for validation and definition of the measurement region.*
- The temporal frequency of light scattered by each beam pair is linearly related to the particle velocity.

PDPA RESULTS

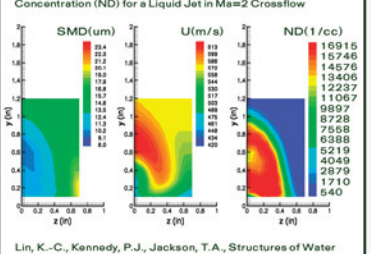
- Mean diameters, Sauter Mean, Volume Means
- Volume Flux
- Concentration
- Liquid Water Content
- Velocity and Turbulence Statistics

Droplet Diameter as a Function of Phase Angle in an Acoustically Driven Flow



Courtesy Prof. R. I. Sujith and K. Gurubaran, Dept. of Aerospace Engineering, IIT-Madras, India. See AIAA paper 2008-1046 for more details.

Sauter Mean Diameter (SMD), Streamwise Velocity (U), and Concentration (ND) for a Liquid Jet in Ma=2 Crossflow



Lin, K.-C., Kennedy, P.J., Jackson, T.A., Structures of Water Jets in a Mach 1.94 Supersonic Crossflow, AIAA Paper 2004-0971, January 2004. This work was sponsored by AFRL/ Propulsion Directorate at Wright-Patterson Air Force Base

SIGNAL PROCESSING

- The signals are digitized at multiple sampling rates to allow automatic dynamic selection of the appropriate sampling rate, to accurately measure the particle size and velocity.
- Both the Fast Fourier Transform (FFT) and autocorrelation techniques are used to obtain the frequency (velocity) and phase (diameter) of each particle that passes through the measurement region, at the highest resolution and accuracy.
- Particle size measurements are validated and correction algorithms are applied, using the measured burst amplitude.

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TSI Incorporated - 500 Cardigan Road, Shoreview, MN 55126-3996 USA
Tel: 1.800.874.2811 **E-mail:** fluid@tsi.com **Website:** www.tsi.com

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