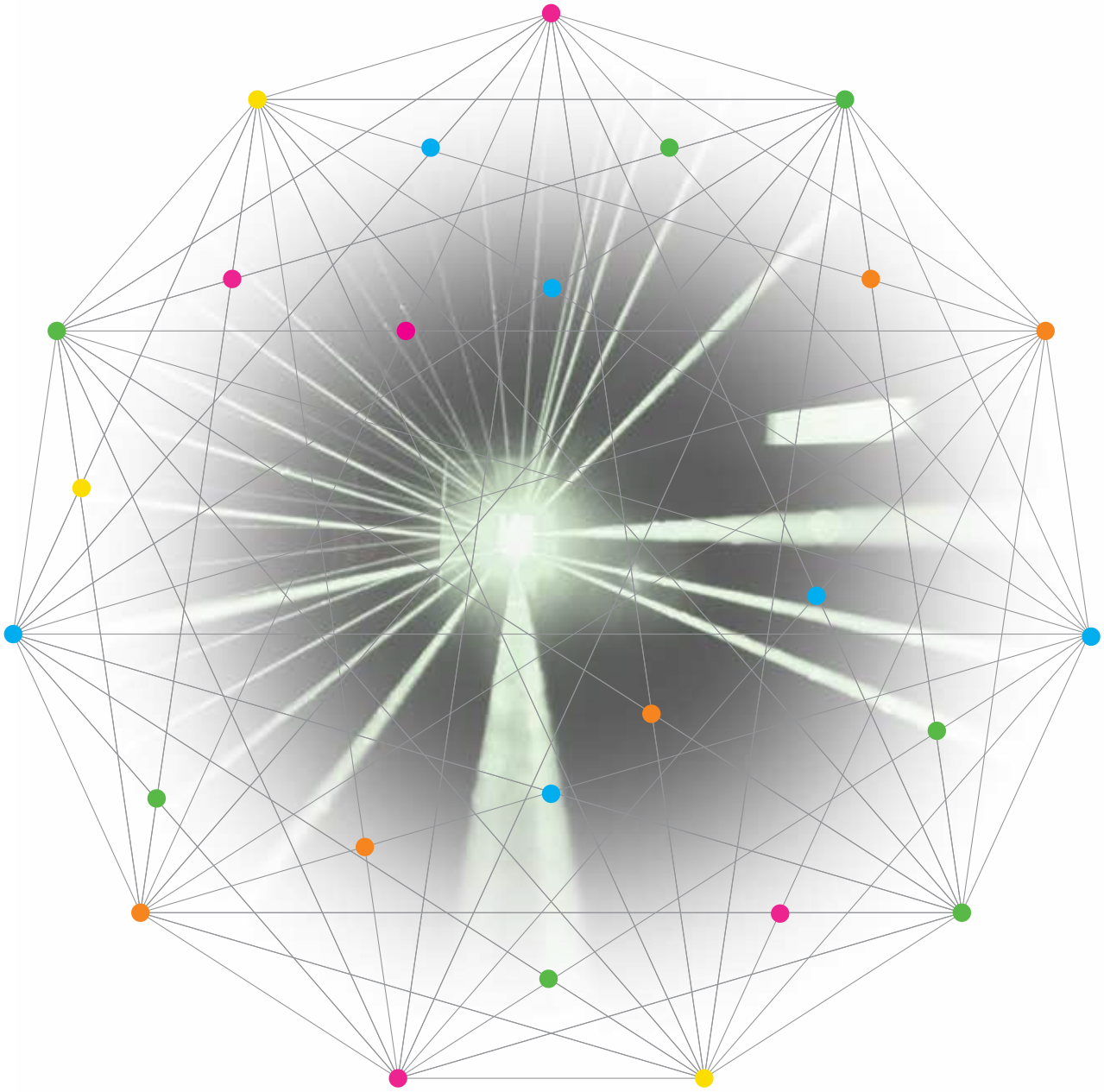
AERODYNAMIC PARTICLE SIZER® MODEL 3321

THEORY OF OPERATION



UNDERSTANDING, ACCELERATED

SOPHISTICATED, USER-SELECTABLE DATA CORRECTION ALGORITHMS

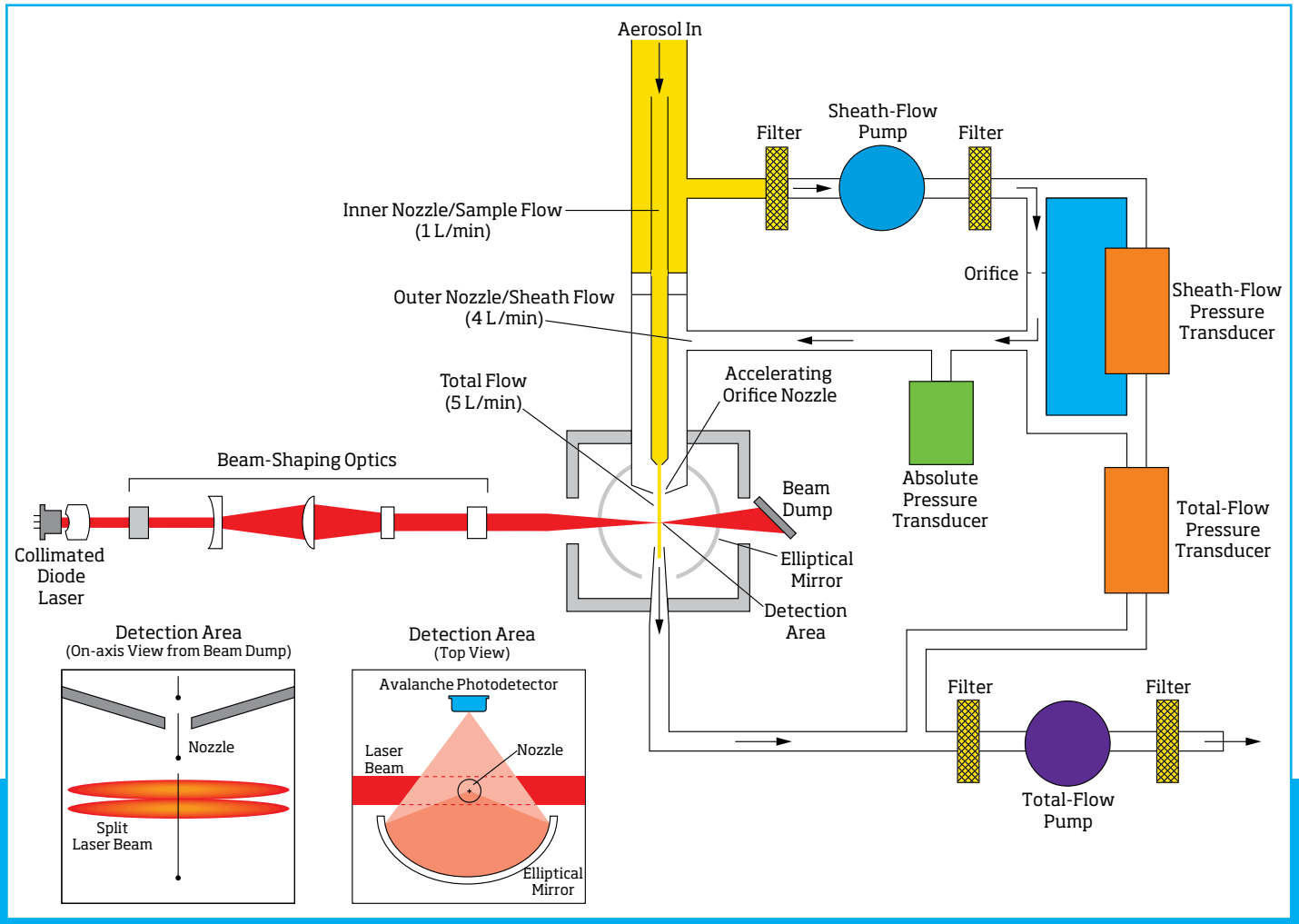
Operation

The APS accelerates the aerosol sample flow through an accelerating orifice. The aerodynamic size of a particle determines its rate of acceleration, with larger particles accelerating more slowly due to increased inertia. As particles exit the nozzle, they cross through two partially overlapping laser beams in the detection area.

Light is scattered as each particle crosses through the overlapping beams. An elliptical mirror, placed at 90 degrees to the laser beam axis, collects the light and focuses it onto an avalanche photodetector (APD). The APD then converts the light pulses into electrical pulses. The configuration of the detection area improves particle detection and minimizes Mie-scattering oscillations in the light-scattering-intensity measurements.

The use of two partially overlapping laser beams results in each particle generating a single two-crested signal. Peak-to-peak time-of-flight is measured with 4-nanosecond resolution for aerodynamic sizing. The amplitude of the signal is logged for light-scattering intensity.

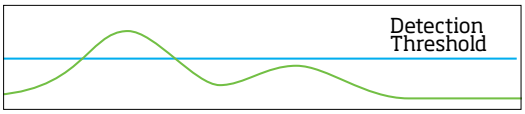
The smallest particles may have only one detectable crest and are binned separately. In uncorrelated mode, these particles are displayed in the smallest size channel (less than 0.523 micrometer). Particles with more than two crests, indicative of coincidence, are also binned separately but are not used to build aerodynamic-size or light-scattering distributions.



Time-of-Flight Measurement Results

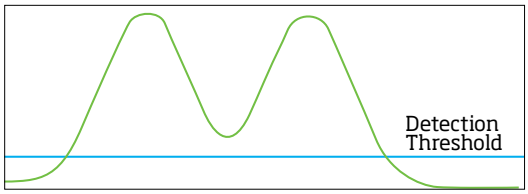
Every particle signal is processed in real time as one of four distinct events. The Model 3321 logs the occurrence of all events, but only Events 1 and 2 are included in size distribution results. Light-scattering intensity is recorded for Event 2 only.

Event 1



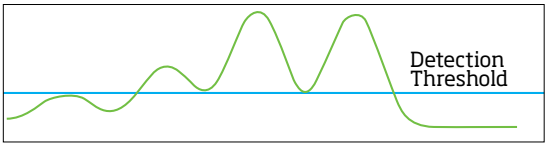
This event occurs when the signal for a small particle cannot stay above the threshold and only one crest is detected. The measurement is aborted, and the time-of-flight of the particle is not recorded. However, the event is logged for concentration calculations and displayed in the <0.523-µm size channel in uncorrelated mode.

Event 2



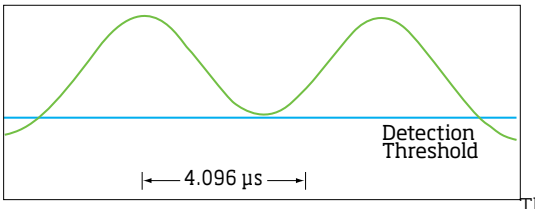
This is a valid particle measurement. The signal stays above the threshold and two crests are detected. The time-of-flight between the two crests is recorded and the events are included in the concentration calculations.

Event 3



This event is caused by coincidence. Although the signal stays above the threshold, three or more crests are detected. Events of this type are logged but not recorded for concentration or time-of-flight.

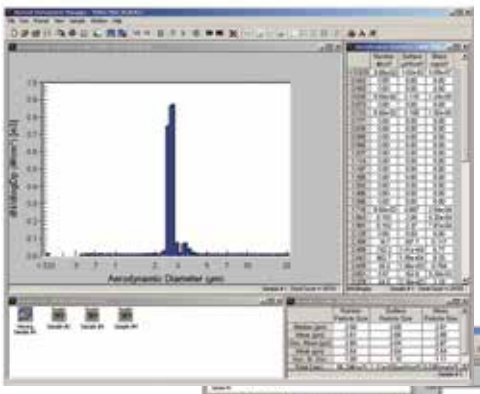
Event 4



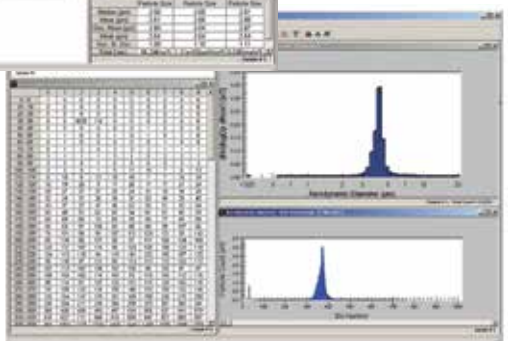
This event is outside the maximum range of the timer. The signal remains above the threshold until it moves outside the timer range, and only one crest is detected. A type 4 event is normally caused by large or recirculating particles. Again, the event is logged, but no time-of-flight is recorded.

Software

For setup and initial sampling, you can operate the APS Model 3321 without a computer using the front panel control knob and built-in display. However, to save, interpret, or print data, you must use a computer or some other data collection system. The Model 3321 includes the Aerosol Instrument Manager software, a 32-bit program designed for use with Windows operating systems. The Aerosol Instrument Manager software controls instrument operation, plus it provides impressive file management capabilities and numerous choices for data display. Graphs and tables make it easy to view channel data as well as raw data, giving you the highest resolution possible. You can view all data types–time-of-flight, light-scattering, or correlated data–with the Aerosol Instrument Manager software. An export function allows easy transport of data files to spreadsheet or other applications for customized data handling.



Aerodynamic diameter graph displayed with particle size and statistics tables



Aerodynamic diameter graph displayed with raw-data table and graph

TWO MEASURMENTS IN ONE

The Aerodynamic Particle Sizer® (APS) Model 3321 spectrometer is a high-performance, general-purpose aerosol instrument. Its unique design provides two measurements:

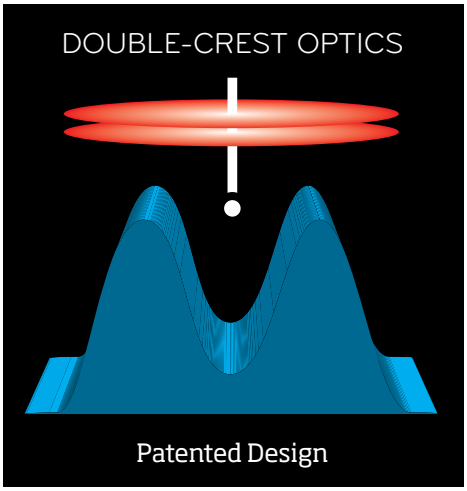
Aerodynamic diameter. The APS sizes particles using a sophisticated time-of-flight technique that measures aerodynamic diameter in real time. Because time-of-flight aerodynamic sizing accounts for particle shape and is unaffected by index of refraction or Mie scattering, it is superior to sizing by light scattering. In addition, the monotonic response curve of the time-of-flight measurement ensures high-resolution sizing over the entire particle size range.

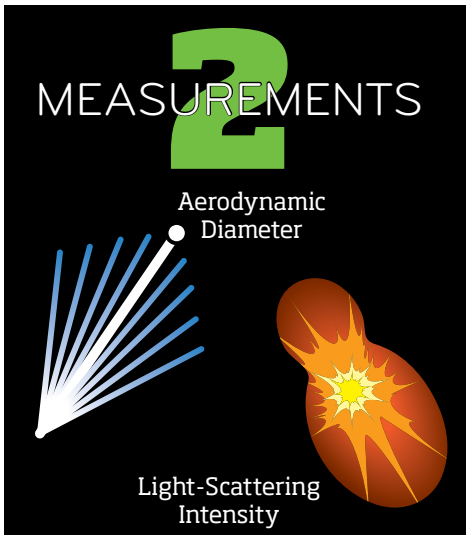
Relative light-scattering intensity. The APS detects particles from 0.37 to 20 micrometers using a light-scattering technique. While light scattering intensity is not always a reliable indicator of particle size, it remains a parameter of interest. The APS keeps this second measurement separate and distinct from aerodynamic size.

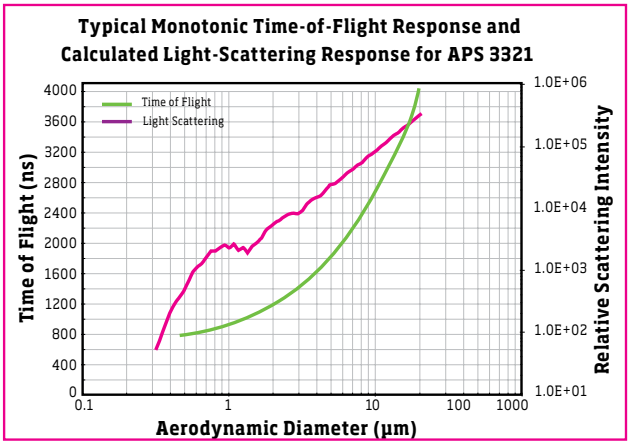
The ability to provide two measurements of each particle using the same sensor allows you to gain exciting new insights into the makeup of an aerosol. The APS uses a patented*, double-crest optical system to detect the occurrence of particle coincidence (when more than one particle is in the detection area) and to identify poor signals near the instrument's lower detection threshold. This results in robust, high-quality measurements you can trust. A well designed and easy-to-use front panel includes a control knob and built-in display. The control knob allows users to scan through data on the display and monitor or control various functions.

Other features, such as microprocessor controlled volumetric flow control, barometric pressure correction, and separate pumps for sheath and total flows, enable the APS to operate under a wide range of conditions and still maintain calibration. The Aerosol Instrument Manager® software, a 32-bit Windows®-based program, is included with each Model 3321 for complete instrument and data control.

*United States Patent Number 5,561,515







UNDERSTANDING, ACCELERATED

TSI Incorporated - Visit our website **www.tsi.com** for more information.

USA	**Tel:** +1 800 874 2811	**India**	**Tel:** +91 80 67877200
UK	**Tel:** +44 149 4 459200	**China**	**Tel:** +86 10 8251 6588
France	**Tel:** +33 4 91 11 87 64	**Singapore**	**Tel:** +65 6595 6388
Germany	**Tel:** +49 241 523030		

P/N 5001469 Rev A

Printed in U.S.A.