

HOW TO ORDER

Contact DMT for pricing or more information: +1.303.440.5576,
customer-contact@dropletmeasurement.com.



OVERVIEW

The Single Particle Soot Photometer (SP2) is the only instrument in the world that directly measures the black carbon (soot) in individual aerosol particles. Its high sensitivity, fast response, and specificity to elemental carbon make it the premier instrument for characterizing air pollution sources and documenting thin, atmospheric layers of contamination. It is also ideal for measuring soot in snow, ice or water and for calibrating other black carbon-measuring instruments like the Aethalometer.

APPLICATIONS

- » Pollution characterization
- » Air quality and visibility
- » Atmospheric and climate research
- » Health effects studies
- » Combustion emissions
- » Biomass burning

Suitable for airborne or ground-based (fixed-site or mobile sampling)



EPA Mobile Sampling Unit with SP2

ADVANTAGES

- » Measures black carbon (soot) mass in individual aerosol particles
- » Uses Nd:YAG intracavity laser-induced particle incandescence (LII), a technique that measures black carbon mass independently of particle mixing state and hence yields more accurate results
- » Detects black carbon mass at minute concentrations (below 10 ng/m³)
- » Measures particle optical size using light-scattering
- » Counts particles at concentrations up to 16,000 particles/sec (8,000 particles/cm³ at a sample flow rate of 120 volumetric cm³/minute)
- » Provides full data recording of each particle event

HOW IT WORKS

The SP2 uses the high optical power available intra-cavity from an Nd:YAG laser. Light-absorbing particles containing mainly black or elemental carbon absorb energy and are heated to the point of incandescence. The incandescent emission is measured and correlated to the particle's black carbon mass with the help of black carbon proxies like Aquadag or fullerene soot.

The SP2 also includes a scattering detector, which detects single-particle light-scattering at 1064 nm. The scattering signal can be used to indicate particle size and the black carbon mixing state at the single-particle level. The scattering detector can also be used to detect non-BC-containing aerosol number and mass concentrations.

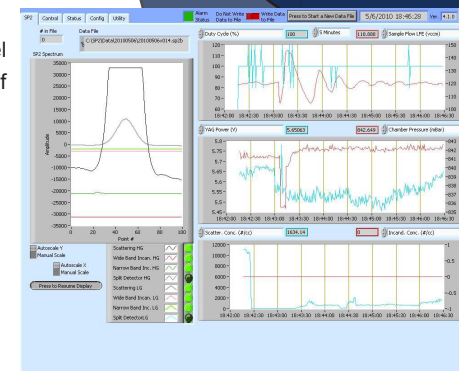
The full scattering and/or incandescence response of each particle is completely digitized for detailed analysis.

SOFTWARE

STANDARD SOFTWARE

The SP2 comes with a software program that provides a user-friendly virtual instrument panel for the control, data display, and data logging of the SP2 instrument. For instance, the program enables the user to do the following tasks:

- » View graphs of incandescence and scattering signals from individual particles
- » View the incandescent particle concentration over the last 30 minutes
- » Monitor parameters like laser power and flow measurements
- » Change the charts and data channels displayed in the software



PROBE ANALYSIS PACKAGE FOR IGOR (PAPI)

The SP2 also comes with a free copy of the Probe Analysis Package for Igor (PAPI). This program performs the following tasks:

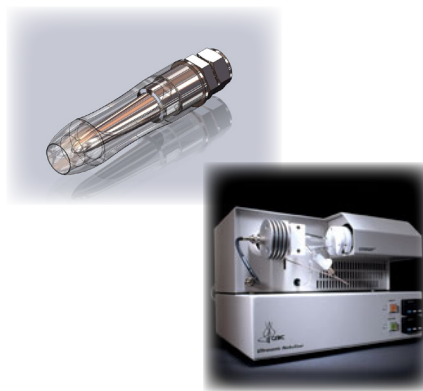
- » Processing SP2 binary files and collecting particle-peak statistics
- » Automating much of the SP2 calibration process
- » Calculating common statistics such as black carbon mass and number concentrations, black carbon number fraction, and ensemble measurements
- » Allowing user to select size bins with resolutions as fine as 5 nm
- » Providing journal-quality graphs and reports



ACCESSORIES

- » Beam scan camera and software
- » YAG optics kit (spare YAG crystal and output coupler)
- » Laser alignment bench
- » Optional auto-sampler
- » Aircraft Aerosol Inlet (far left)

New! The SP2 Nebulizer (near left)
SP2 software version 4.2 is compatible with the U5000AT+ Ultrasonic Nebulizer from CETAC



SP2 SPECIFICATIONS

Measured Parameters	<ul style="list-style-type: none">» Single-particle laser incandescence» Single-particle light scattering
Auxiliary Parameters	<ul style="list-style-type: none">» Temperature» Pressure
Derived Parameters	<ul style="list-style-type: none">» BC mass distribution as function of particle diameter» Particle number distribution as a function of particle size
Number Concentration Range	<ul style="list-style-type: none">» 25,000 particles/second» 0 – 12,500 particles/cm³ at standard flow rate of 120 volumetric cm³/minute
Particle Size Range	<ul style="list-style-type: none">» <i>Scattering signal</i>: 200 – 430 nm diameter (this range encompasses the accumulation mode of most particles, i.e. range where most mass is found). This range can be extended to 700 nm by doing post-processing of saturated signals.» <i>Incandescent signal</i>: depends on particle density, but 70 – 500 nm mass-equivalent diameter assuming a black carbon density of 1.8 g/cm³
Aerosol Medium	Air, 0 - 40 °C (32 - 104°F)
Lasers	<ul style="list-style-type: none">» Nd:YAG Laser: 1064 nm, 3 MW/cm² intracavity» Pump Laser: 808 nm, 4 W <p>The pump laser can be controlled either through the SP2 software or through the touch-screen on the SP2 front panel</p>
Sample Flow	30 – 180 volumetric cm ³ /minute (typically 120)
Flow Control	Electronic flow control with a laminar flow element (LFE) and a solenoid valve
Pump	Two single-head diaphragm pumps encased in a box
Minimum Black Carbon Detection Limit	<ul style="list-style-type: none">» 10 ng/m³» 0.3 fg/particle
Routine Maintenance	<p><i>Weekly:</i></p> <ul style="list-style-type: none">» Refreshing or replacing the desiccant in the drying cartridge on the purge line» Conducting PSL size check to monitor laser power <p><i>Monthly and around field campaigns:</i></p> <ul style="list-style-type: none">» Conducting zero check with high-efficiency filtered air sample <p><i>Annually (more frequently for high-BC environments):</i></p> <ul style="list-style-type: none">» Checking calibration of the laminar flow element on the sample inlet
Recommended Service	Annual cleaning and calibration at DMT service facility

Front Panel Display	<ul style="list-style-type: none">» System power switch» 2 USB 2.0 ports» 1/8 in. Swagelok® sample inlet» Laser ON/OFF indicator light
Rear Panel Connections	<ul style="list-style-type: none">» Keyboard port» Mouse port» VGA and HDMI monitor ports» Ethernet port» 2 RS-232 communications ports» 4 USB 2.0 ports» eSATA port» ¼ in. Swagelok® purge line» ¼ in. Swagelok® exhaust line» Exhaust vents» System and pump power connections
Computer System	<ul style="list-style-type: none">» On-board Intel®Core™ i7 CPU» 8 GB RAM» 750 GB hard drive for data storage» NI PCI-6133 DAQ interface card» NI PCI-6259 housekeeping data card» User interface via standard keyboard, mouse, and 19" monitor (included)
Software	<ul style="list-style-type: none">» SP2 Executable program written in LabVIEW» PAPI program written in Igor
Data Storage Capacity	Depends on number of particles; at a concentration of 1,000 #/cm ³ and a standard flow rate of 120 volumetric cm ³ /minute, the SP2 computer has the capacity to store 56 hours of continuous data
Communications Output	Gigabyte Ethernet interfaced through an Intel® PC82573V PCIe GbE controller
Power Requirements	<ul style="list-style-type: none">» SP2: Universal Boltage» External Pump: 30W
Dimensions	<ul style="list-style-type: none">» SP2: 48 cm W x 61 cm L x 26 cm H» Pump: 20 cm W x 25 cm L x 10 cm H» 19" Monitor: 37 cm W x 22 cm L x 39 cm H
Weight	<ul style="list-style-type: none">» SP2: 26.1 kg» Pump: 3.4 kg» 19" Monitor: 3 kg
Shipping Container	Durable Atlas Case Corporation ATA Transit Case that conforms to the Air Transport Association's Specification 300 Category 1 standards
Environmental Operating Conditions	<ul style="list-style-type: none">» Temperature: 0 – 40°C (32 – 104 °F)» Relative Humidity: 0 – 100% RH non-condensing



2545 Central Avenue
Boulder, Colorado, USA 80301
www.dropletmeasurement.com
ph: 303-440-5576, fax: 303-440-1965

Specifications are subject to change without notice. The SP2 is a Class I Laser Product with U.S. Patent # 5,920,388.

Rev B

May 10, 2012