LS Spectrometer: Specifications

The LS Spectrometer by LS Instruments is the most sophisticated light scattering system for both static and dynamic light scattering (DLS & SLS) available. The modular design of the Spectrometer allows easy replacement of individual parts making it a unique instruments suited for your specific requirements, without compromising neither precision nor quality. Ask the experts at LSI to configure the optimal solution for your laboratory.

Standard applications include:

- Particle sizing

  Hydrodynamic Radius: 0.15 nm – 5 micron*

  Radius of Gyration: 5 nm – 5 micron*
- Measurement of size distribution, polydispersity
- Diffusion coefficient, mean square displacement
- Molecular weight determination: 360 - 3600000 Dalton*
- Determination of 2nd virial coefficient
- Rayleigh ratio
- Determination of form and structure factor
- Inter particle distance in charged systems
- Process monitoring (e.g. gelation, aggregation, ageing…)

* maximum range, sample dependent

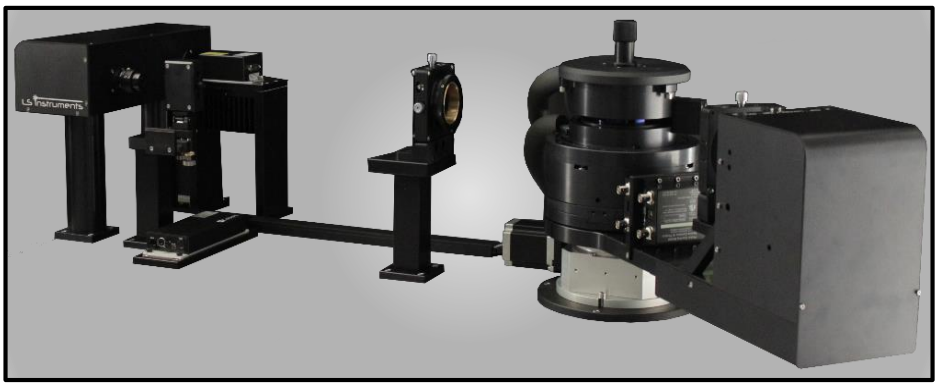


Image shows LS Spectrometer with optional items

Specifications: Version 1.05

- The LS Spectrometer performs both static (SLS) and dynamic light scattering (DLS) experiments at all scattering angles from 15° to 150° with a resolution better than 0.01°.

- Two supplied cuvette holders allow measurements with cylindrical scattering cells of two different diameters (10 mm and 5 mm nominal outer diameters). Use of the 5 mm cylindrical cell reduces required sample volume to about 50 µL.

- Temperature controllable sample chamber with index matching vat for measurements in the suggested temperature range from 1°C to 90°C (requires additional temperature bath, see options). Temperatures at or below the dew point (approximately 15 °C, but dependent upon relative humidity of environment) require purging with dry air or nitrogen in order to avoid condensation (purging facility not included). Please contact LSI, if you have special temperature requirements.

- Direct on-line temperature measurement in the index matching vat via a PT-100 temperature sensor. The vat has a anti-reflection coating to minimize scattering from reflections.

- Pseudo cross-correlation technology: All photon detectors have a certain probability to produce a second electronic pulse after they detect a photon (the so called "after-pulsing-effect"), this results in significant errors for lag times lower than 1 µs. Since the LS Spectrometer is equipped with two detectors that are assembled in pseudo cross-correlation mode it automatically eliminates the after-pulsing-effect, thus allowing measurements down to 25 ns lag time which is required typically for small or fast diffusing particles.

- The two high sensitivity APD detectors of the LS Spectrometer allow measurement of samples with very weak scattering: quantum efficiency 65% at 633 nm, dark count < 250 count/s. Single mode fiber detection system with integrated collimation optics.

- Two channel multi-tau correlator: auto and cross correlation, 12.5 ns minimum sampling time, 322 channels for multi-tau and more than 1000 channels for linear correlation, delay time range: 12.5 ns to 54976 s in multi-tau

- Laser not included (see options)

- Laser safety measures include an enclosed laser beam guide unit and beam shutter. The enclosure fully shields the beam all the way to the sample chamber, such that only diffusive light emitted from the sample chamber is visible. This diffusive light is safe for viewing as long as the mounted Laser is specified as no more than Laser Class 3b.

- Automated laser attenuation system combined with on-line laser intensity measurement. The Laser is automatically set to ideal measurement intensity. Manual setting is not required. This includes an automated safety control of the sensitive APD detector, such that it is only active under safe illumination conditions. Laser intensity can be recorded by the software for later normalization of the static light scattering data.

- 2.5 cm (1") diameter holders allow use of any standard optical filter in front of the detectors.

- PC (Windows) with flat screen (22'') and preinstalled software

- Software (supplied) controls the spectrometer to acquire data for static and dynamic light scattering experiments. The standard software includes Cumulant and CONTIN Analyses for particle sizing as well as the LSI Zimm Plot analysis package. One free upgrade of the standard software will be provided free of charge within the first year after installation. Optional software packages (not included) are available to perform advanced analysis of dynamic and static light scattering data.

- Detailed manual

- The LS Spectrometer is delivered with and mounted on an aluminum bread board of 90 x 45 cm size. An optical table is not required for the standard configuration.

- The LS Spectrometer is a precision optical instrument that requires a laboratory environment for optimum operation. No more than 60% relative humidity, temperature range 17°-26°C, temperature stability +/- 1° C within 1 h and +/- 2°C within 24 h.

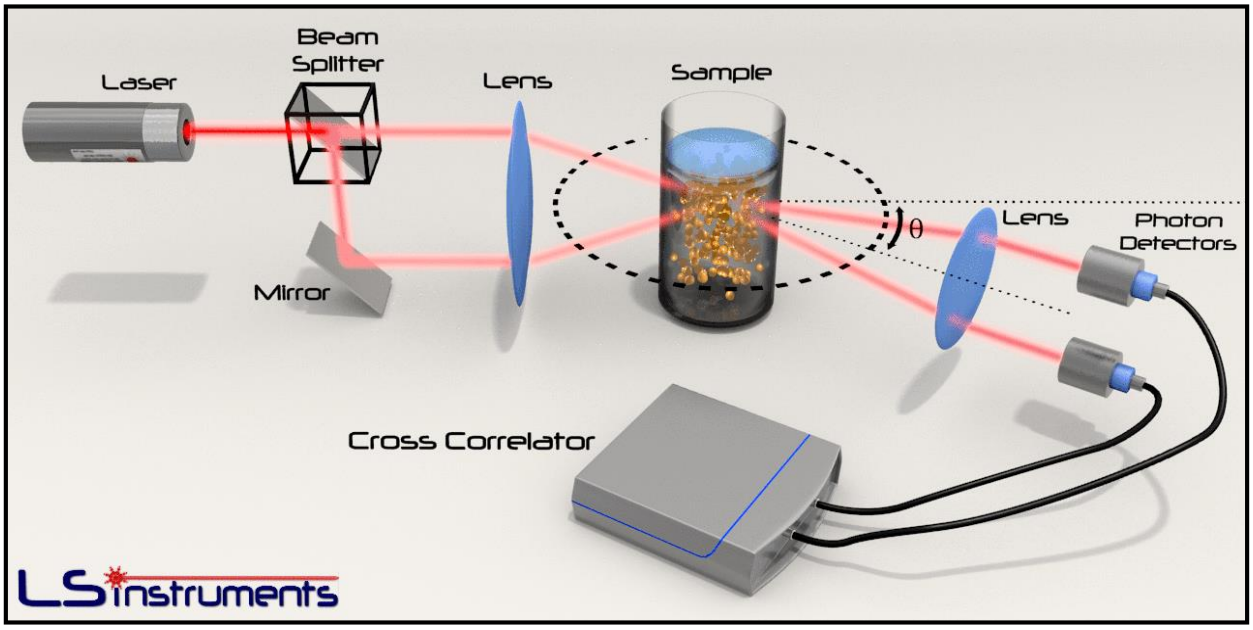
3D Cross-Correlation

DLS and SLS experiments are based on the assumption that only singly scattered light is detected. Already a small amount of multiple scattering can result in significant errors.

This is why DLS and SLS frequently require dilution of the sample to avoid multiple scattering.

With the 3D cross-correlation option multiple light scattering is suppressed efficiently, thus allowing measurements of many samples in their natural undisturbed state, without any need for dilution. Two simultaneous light scattering experiments are performed at the same scattering vector on the same sample volume in order to extract only the single scattering information common to both. This option also eliminates the after-pulsing-effect just as the pseudo cross-correlation.

Note: Obtained intercept is > 17%.

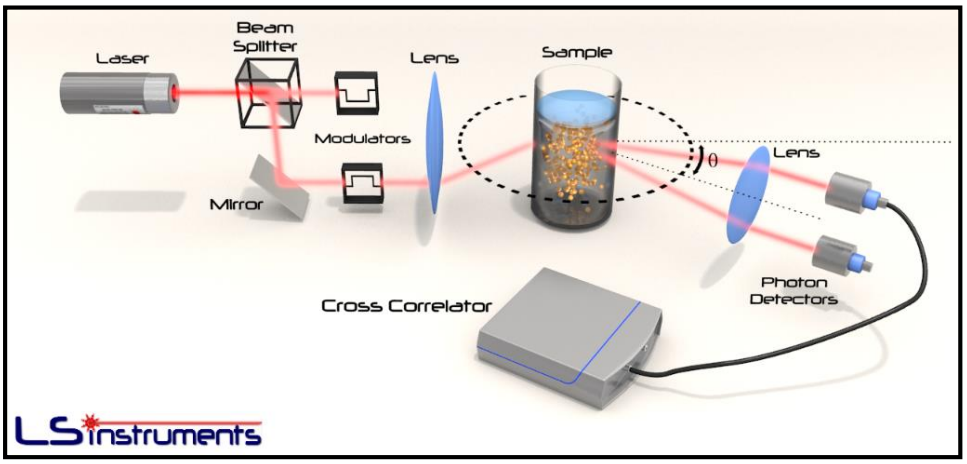


3D cross-correlation technology: Instead of using only one beam, two beams are used to probe the sample. Cross-correlation of the two signals suppresses the contribution of multiple scattering.

Suggested Optional Items

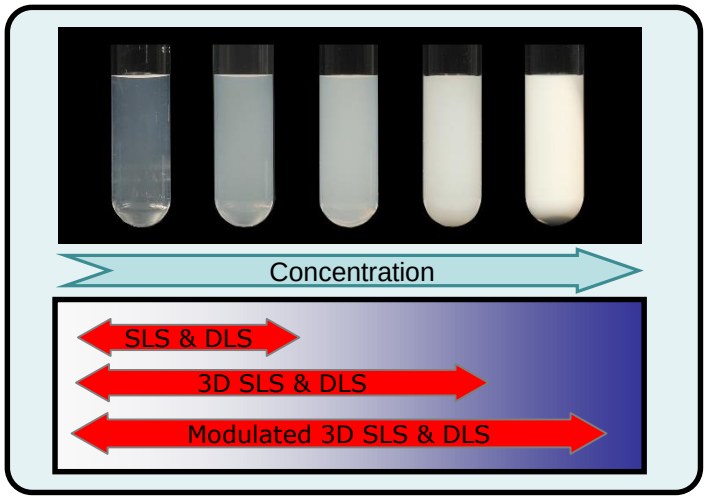
Modulated 3D

Although the 3D cross-correlation technique offers significant advantages to regular DLS and SLS, it also comes with a drawback. Because of cross-talk between the two detectors the maximal intercept is decreased from 1 to 0.25, effectively reducing the signal to noise ratio. The 3D modulation option eliminates this disadvantage. The two scattering experiments are temporally separated by modulating the incident laser beams and gating the detector outputs at frequencies exceeding the timescale of the system dynamics. This robust modulation scheme eliminates cross-talk between the two beam-detector pairs and leads to a four-fold improvement in the cross-correlation intercept.



By modulating the two illumination beams and synchronizing this with a modulation of the photon detectors, the signal to noise ratio can be improved significantly.

The modulated 3D cross-correlation mode is computer-selectable such that the standard 3D cross-correlation, pseudo-cross-correlation, and auto-correlation abilities are present and unaffected (>95% transmission through modulation unit).
Note: for Modulated 3D, the minimum available lag time is user selectable: 800 ns, 1600 ns or 3200 ns. Obtained intercept is > 65%.

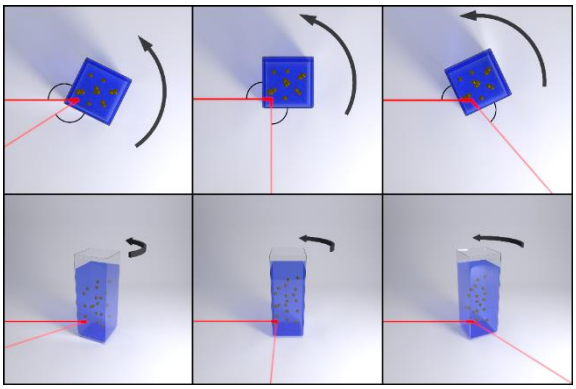


The 3D cross-correlation technology significantly extends the range of accessible sample concentrations. The range is extended even further with the modulation technology while also improving the measurement quality significantly.

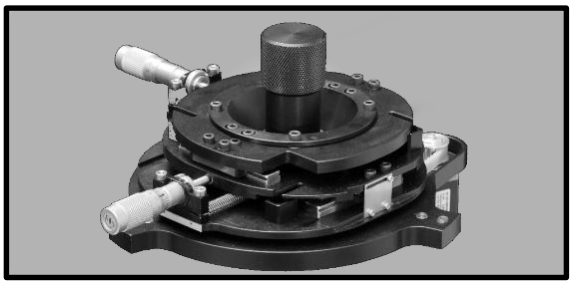
Suggested Optional Items

Sample Goniometer

Sample goniometer for measurement of non-ergodic systems (e.g. gels, glasses, foams) by continuous rotation of the sample. Additionally this allows for DLS and SLS experiments with extremely turbid samples in square cells using the so-called θ-2θ detection, where the optical path length in the sample can be adjusted and significantly reduced (as low as 0.2 mm).



The main and sample cell goniometer can be controlled separately via the spectrometer control software. The optical path length in the sample is adjustable when rectangular cells are used.



LS Spectrometer Sample Goniometer

External Circulator for Temperature Control: Julabo CF31

Constant temperature bath from -30° to 200°C with a temperature stability of +/- 0.02°C. This powerful circulator perfectly suited for the LS Spectrometer. It reduces heating and cooling time significantly compared to other circulators. It can be pre-programmed to conduct measurement series at different temperatures with the software module of LSI.

Included: Temperature bath and circulator, setup, calibration, software module for the LS Spectrometer

Notes: The suggested temperature range of the instrument itself (1° to 90°C) is not increased with this circulator.

Suggested Optional Items

Laser Options

LSI can provide high quality Lasers at a wide range of different wavelengths and intensities that are suitable for the LS Spectrometer: 457 nm, 491 nm, 532 nm, 561 nm, 633 nm or 660 nm. Please contact LSI for quotes on specific wavelength and Laser intensities. All Lasers include a special mount with heat sink suitable for assembly with the LS Spectrometer. For standard applications we suggest a DPSS 660nm, 100 mW Laser. 660 nm is the most suitable wavelength, since the detectors have the highest sensitivity at this wavelength. 100 mW is sufficient intensity for most applications and additional Laser safety measures are typically not required.

High Performance DPSS Laser 660 nm, 100 mW, 300 mW, 500 mW
Description: 660 nm, TEM00, coherence length > 10m, noise < 0.1% rms, Laser class 3B.

Other suggestions:

HeNe Laser 21 mW
Description: 632.8 nm, TEM00, noise < 0.5% rms, Laser class 3B. HeNe Lasers are less stable than DPSS Lasers and measurement quality for particles smaller than 100 nm is noticeably decreased compared to a Laser with 100 mW or more intensity.

High Performance DPSS Laser 532 nm, 100 mW, 300 mW, 500 mW
Description: 532 nm, TEM00, coherence length > 10m, noise < 0.1% rms, Laser class 3B.

High Performance DPL Laser 561 nm, 100 mW
Description: 561 nm, TEM00, coherence length > 1m, noise < 0.1% rms, Laser class 3B.

*All DPSS and DPL Lasers provided by LSI offer a longer life time, coherence length, robustness, lower sensitivity to temperature changes than HeNe Lasers, and are equipped with an optical isolator to ensure immunity to feedback. Furthermore for DPSS Lasers full or reduced power can be selected from within the software. Laser power stability is monitored by the software to ensure reliable measurements.

Suggested Optional Items

Laser Enclosure System

Depending on the equipped Laser and the laser safety standards of your laboratory, it might be necessary to enclose the LS Spectrometer with a laser protection system to fulfil the highest safety requirements possible.
For this purpose, we offer a suitable enclosure that can be mounted on an optical table (160 x 90 cm, please contact us for custom sized solutions).
The enclosure consists of a metal frame that supports a retractable laser curtain, certified according to EN 60825-4 (Laser Guards).