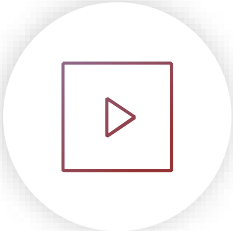
Achieve easy, fast and reliable particle/cell size analysis with NanoCuvette™ S

Introduction

avantor™

Before we begin



We will send you the recording

Submit your questions anytime. We'll do Q&A in the end

Contact us: webinar@avantorsciences.com

The speakers

Christopher Lüscher – Interim CEO, PhD

cphnano

Sangita Khatri - Research Scientist

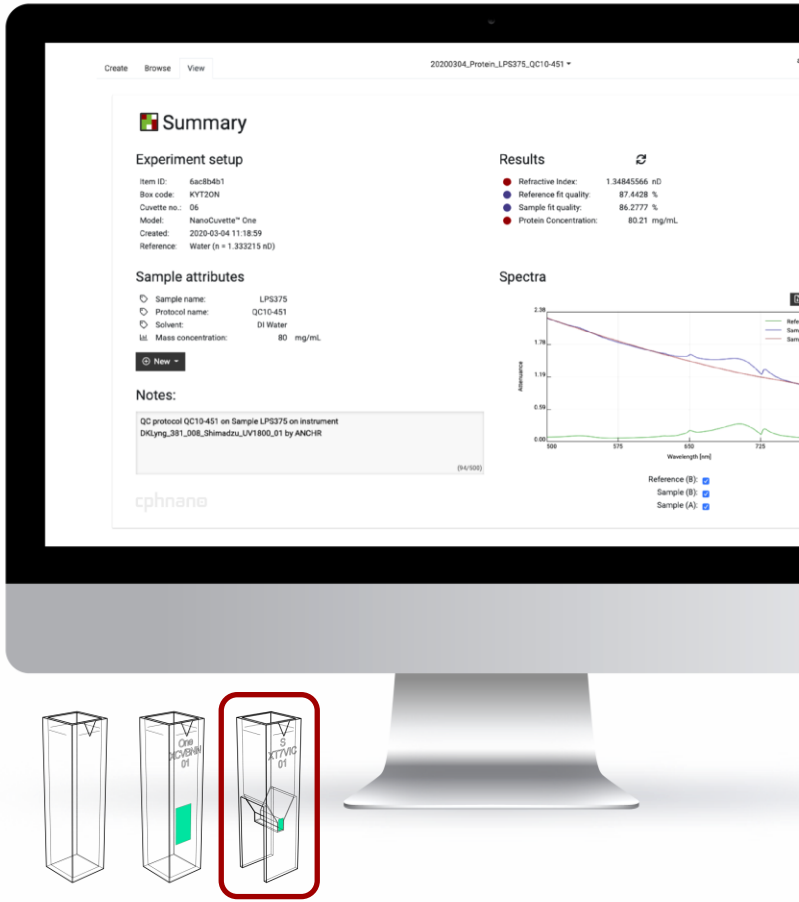
cphnano

WEBINAR 2021

avantor™ delivered by VWR™

Achieve easy, fast and reliable particle size analysis with NanoCuvette™ S

Upgrade your existing spectrophotometer with NanoCuvette™ S and cloud computing - our take on affordable particle and cell size analysis.



cphnano.com
Hørmarken 2, 3520 Farum
Denmark.
Tel: +45 36 99 27 46
info@cphnano.com

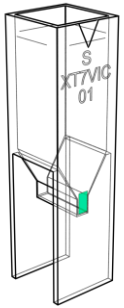
cphnano

OUTLINE

- About the company
- Absorption spectroscopy (Beer-Lambert law)
- VWR Collection spectrophotometers
- Particle Size Analysis
- NanoCuvette™ S
- SpectroWorks™
- Conclusion

Sangita Khatri
Research Scientist
sakha@cphnano.com

Christopher Lüscher, PhD
Interim CEO
chrlu@cphnano.com



EASY, FAST AND RELIABLE PARTICLE SIZE ANALYSIS

MA-DLS
>70k €

Nanosight
>40k €

PSS
>40k €

AFM
>40k €

DLS
>40k €

EXISTING INSTRUMENTS

- Expensive and complicated.
- Often errors in obtained size distributions. Imprecise results.
- Difficult to independently determine particle size, refractive index and concentration.

NB! Buy NanoCuvette™ S every day for 12 years before you have spent the same money as a DLS instrument.

Precise Concentration

Inexpensive

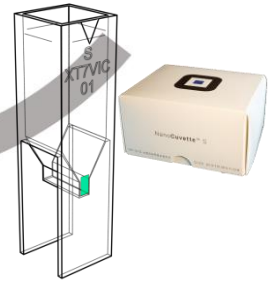
Cloud Computing

High Sensitivity

Accurate Size determination

OUR SOLUTION

- Builds on existing UV-Vis spectrophotometers
- Cloud computing modelling nano- and microparticle scattering.
- Consumable with photonic crystal supporting reuse.



Poll Question 1

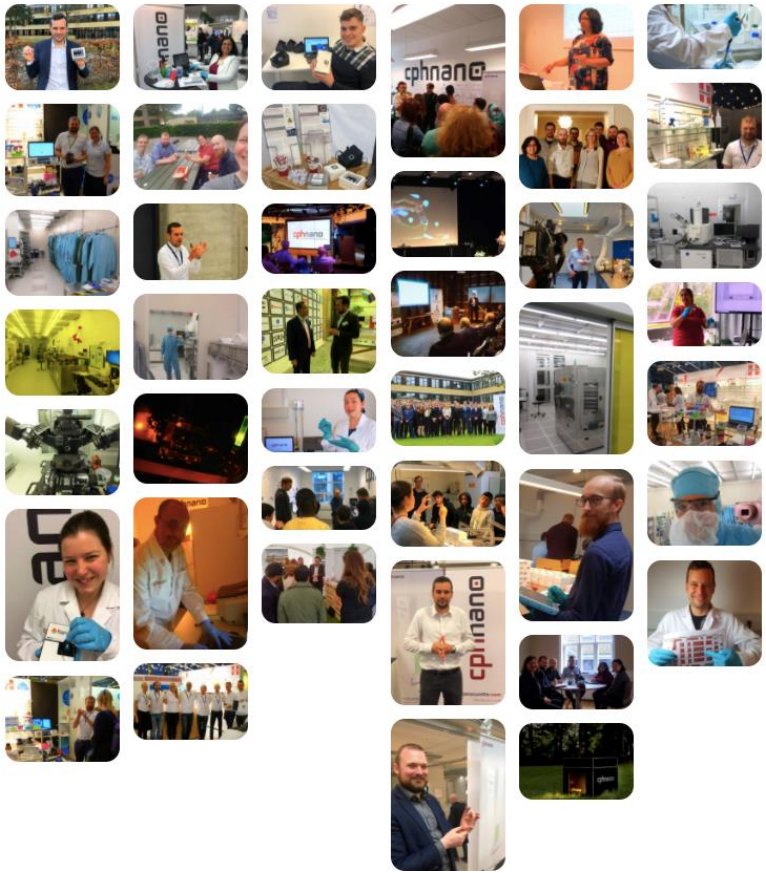
Do you have a cuvette-based UV-Vis spectrophotometer in your lab?

ABOUT THE COMPANY

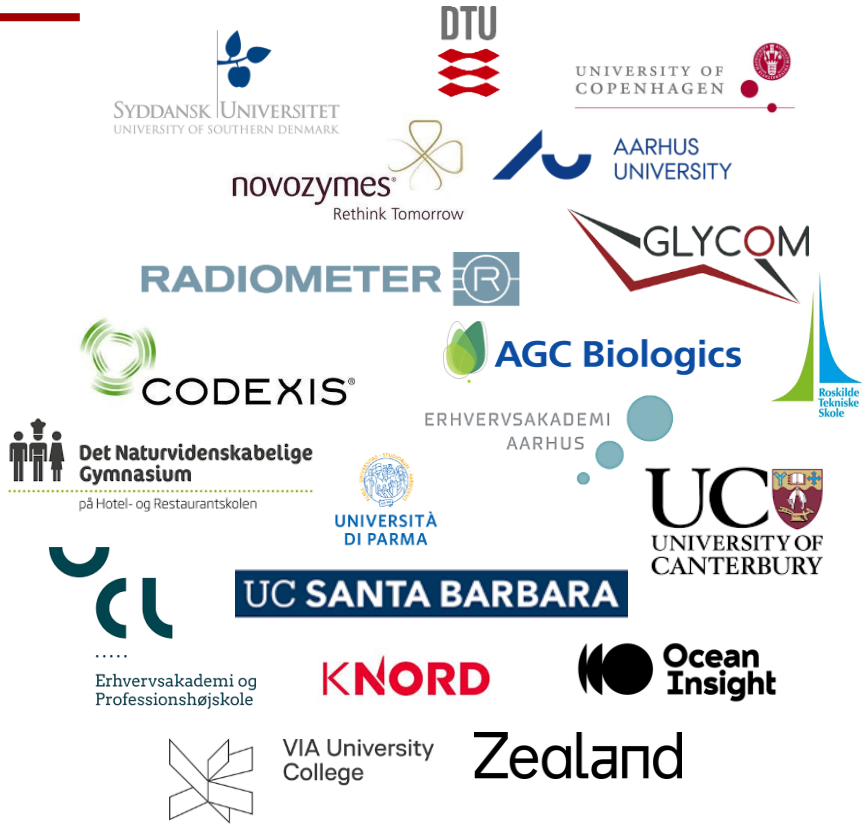
- **Founded in 2015, cphnano is a Danish labtech company** from Copenhagen that develops digital laboratory analysis and next-generation UV-Vis for the smart lab of the future.

- **We work with upgrading UV-Vis spectrophotometry** across all brands to be at the forefront at the technology development for the smart lab of the future and Industry 4.0.

- **We sell consumables and digital upgrades** for laboratory equipment through our trusted resellers and partners for an integrated, seamless digital experience.



TRUSTED BY



Customers and partners of cphnano range from biotech and life science companies to manufacturers, R&D labs and SME's as well as education institutions and university laboratories.

PRODUCTS AND SERVICES

avantor delivered by VWR
VWR.COM

NanoCuvette™ One and S (10 pcs.)

- Commodities
- Unique ID
- 8.5 mm and 15/20 mm versions
- Including SpectroWorks™ full functionality

SpectroWorks™

- Online software for spectrophotometry
- License included with NanoCuvette™ purchase
- Supports basic plastic, quartz or glass cuvettes as well
- Includes instrument light simulations for better performance
- Drag and drop easy
- All future updates included

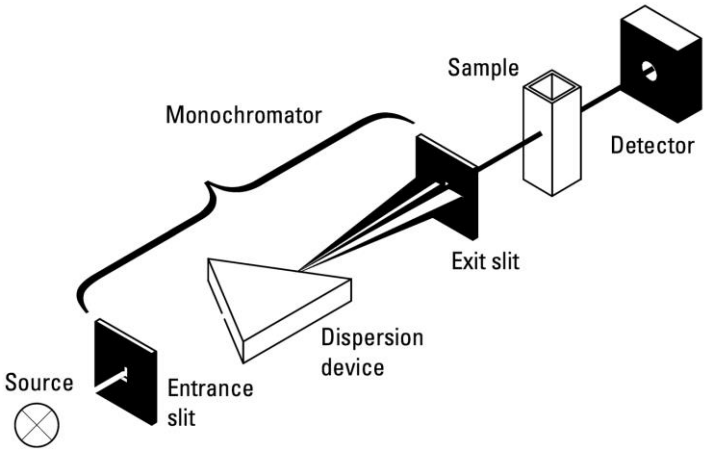
SpectroLink™

- Instrument control from smartphone, tablet or computer.
- Best possible data quality.
- No installation.

MADE IN DENMARK

THE SPECTROPHOTOMETER BUILT FOR MEASURING BEER-LAMBERT LAW

- Spectrophotometry is one of the most widely used analytical procedures in many labs.
- It is used to estimate the level of a substance in a solution and is ideal for simple routine determination of small quantities of materials such as DNA, RNA, proteins, enzymes and many other substances.

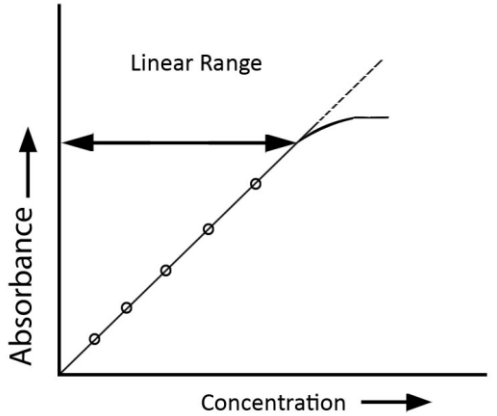


ABSORPTION SPECTROSCOPY AND THE BEER-LAMBERT LAW

The Beer-Lambert law relates the attenuation of light to the properties of the material through which the light is travelling:

$$A = \varepsilon c l + A_0$$

where A is the absorbance, ε is molar extinction coefficient, c is the concentration, l is the path length and A_0 is the background absorbance.



VWR SPECTROPHOTOMETER COLLECTION LINE-UP







Model	V-1200	UV1600-PC	3100-PC	6300-PC	M4	P4	PV4
Type	Scanning	Scanning	Scanning	Scanning	Scanning	Scanning	Scanning
Wavelengths (nm)	325-1000	190-1100	190-1100	190-1100	190-1100	190-1100	190-1100
Beam height (mm)	15	15	15	15	15	15	15
Minimum spectral band width (nm)	4	4	2.0	1	2.0	2.0	2.0
Wavelength accuracy (nm)	2.0	0.5	0.5	0.3	0.5	0.5	0.5
Max scanning speed (nm/min)	4200	4200	3000	3000		4200	4200
Connectivity interface	USB	USB	USB	USB	USB	USB	USB
NanoCuvette™ compatible	✓	✓	✓	✓	✓	✓	✓

V-1200 / UV-1600PC
The V-1200 and UV-1600PC are basic Visible and UV/Vis spectrophotometers for the routine daily quality control requirements, in process control and teaching laboratories

3100-PC
The 3100-PC for advanced measurements in quality control, biochemical and pharmaceutical applications.

6300-PC
The 6300-PC with double-beam optical system, designed for pharmaceutical, biochemical and clinical use, new material development and quality control.

M4
The M4 single split-beam spectrophotometer, with flashing xenon lamp, is an easy to use, highly reliable and accurate product.

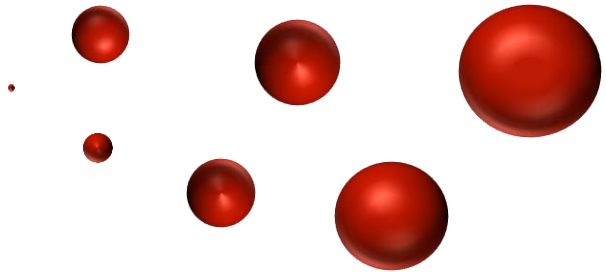
P4
The P4 UV/Visible spectrophotometer is an easy to use instrument with advanced performance

PV4
The PV4 visible spectrophotometer is an easy to use instrument with advanced performance.

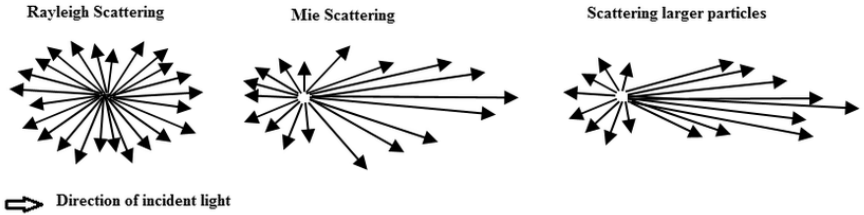
Poll Question 2

Do you have particle size analysis equipment in your lab?

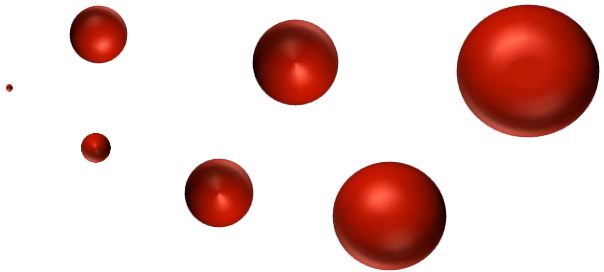
INTRODUCTION TO PARTICLE SIZE ANALYSIS



- Particle Size Analysis is the technical procedure to determine the list of values or a mathematical function that defines the relative amounts of particles dispersed in fluid sorted according to the size.
- Particle size influence the dissolution, absorption, stability, physical, chemical and pharmokinetic properties of particles.
- Particle Size Analyzers (PSA) are based on different technologies including analysis of Brownian motion, high-definition image processing and Rayleigh and Mie scattering.



PARTICLE SIZE ANALYSIS METHODS



Methods of particle size analysis

Fractionating methods

- Sieving
- Separation in liquids
- Separation in gases

Non-fractionating methods

Microscopic methods → Analysis of individual particles

- Light diffraction, scattering (DLS/SLS) methods
- Ultrasound methods
- X-ray diffraction analysis

→ Analysis of sets of particles

Poll Question 3

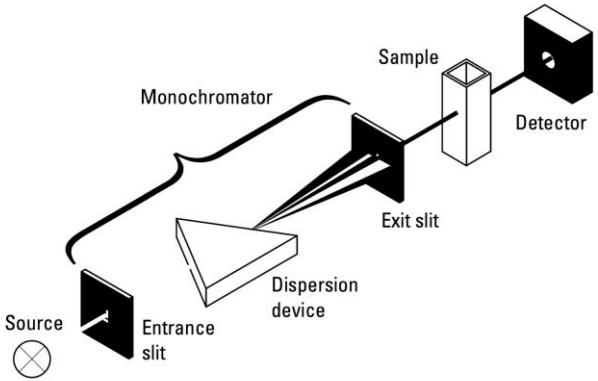
Can your instrument measure both the size and concentration at the same time?

One solution for particle size and concentration analysis

NanoCuvette™ S

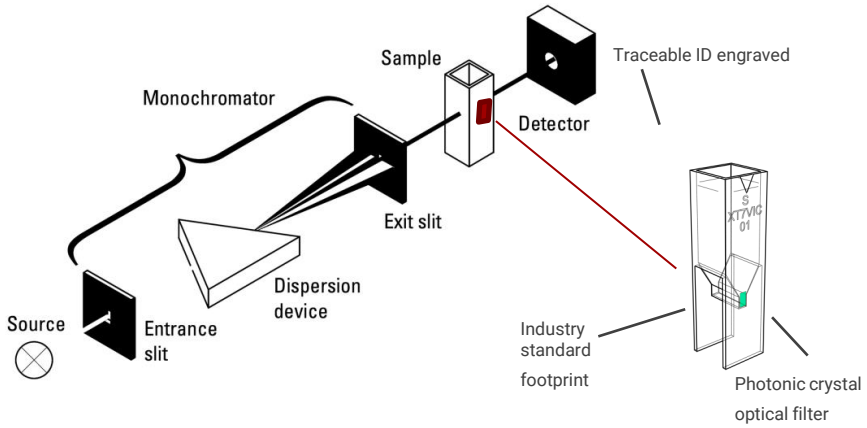
THE NANOCUVETTE UNLOCKS THE FULL POTENTIAL OF THE SPECTROPHOTOMETER

Spectrophotometry is one of the most widely used analytical procedures in biochemistry.



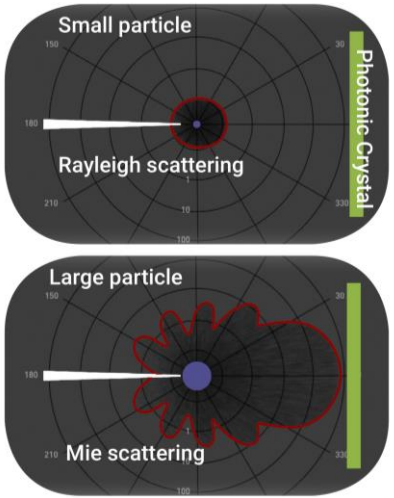
Adding an optical filter to the cuvette upgrades the analytical capability of the instrument:

- **More complementary information on same sample.**
- **Easy and fast measurement of particle size and concentration.** Direct label-free size and concentration detection from 10 nm -10 µm.



MEASUREMENT PRINCIPLE – PHOTONIC CRYSTALS AND CLOUD COMPUTING

FIGURE 4: LIGHT SCATTERING



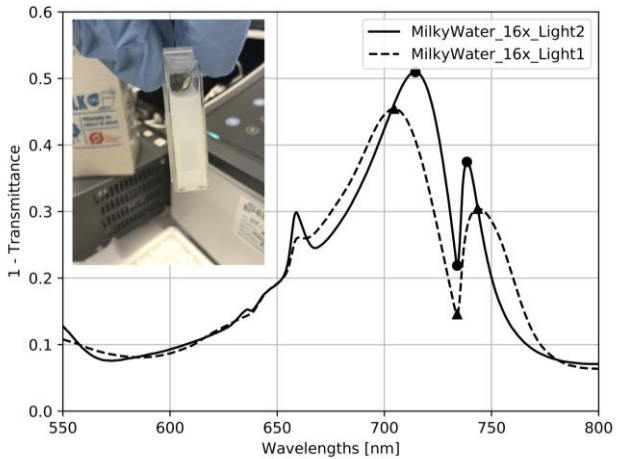
Particle and cell sizes can be measured, since light scattering depends on angle and wavelength.

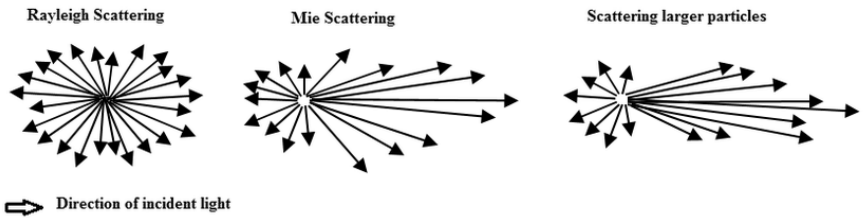
Dynamic Light Scattering (DLS) measures scattering over time at given wavelength.

Multi Angle Dynamic Light Scattering (MA-DLS) measures scattering over time at given wavelength for different angles (Malvern ZetaSizer Ultra).

NanoCuvette™ S measures scattering at different wavelengths in different angles at given time.

FIGURE 6: MEASURED MILK SPECTRUM

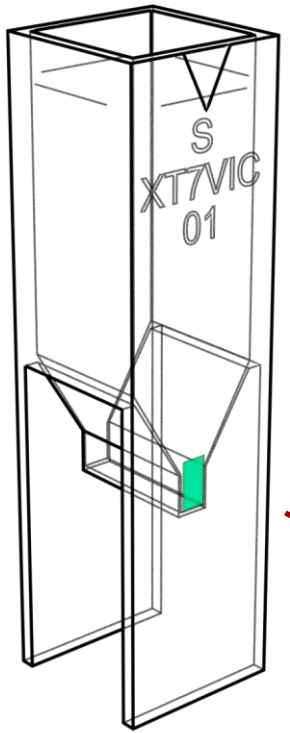




- +500 million light simulations in SpectroWorks™.
- Rayleigh scattering (nanoparticles) and Mie scattering (microparticles) simulations accessed quickly with modern cloud computing architecture.
- Side A, side B and side D SLS of the cuvette.
- +500 combinations of particle and fluid materials.

NANOCUVETTE™ S BENEFITS

- **Less sample needed for analysis.** 50 µL - 200 µL sample volume.
- **Easy and fast measurement of size and concentration.** Direct label-free size and concentration detection from 10 nm -10 µm (Limit of detection is below 0.003 % particle concentration determination).
- **Replacing expensive equipment with just the spectrophotometer.**
- **Includes all basic cuvette features.**



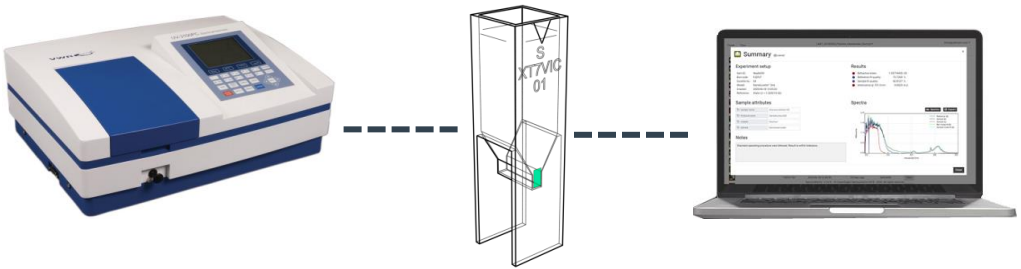
Traceable ID engraved

Photonic crystal optical filter

Poll Question 4

Which sample do you usually work with for particle size analysis?

VALIDATION OF NANOCUVETTE™ S BY PARTICLE ANALYTICAL



PARTICLE ANALYTICAL

EXPERTS IN SIZE AND CRYSTALS

Copenhagen Nanosystems ApS

TESTING AND VALIDAITON OF NANOCUVETTE™ S, SPECTROWORKS™ TOGETHER WITH UV-VIS SPECTROPHOTOMETER

30-Jul-2021

PARTICLE ANALYTICAL ApS | Agern Allé 3 | DK-2970 Hørsholm | VAT No.: DK25194934
T: +45 4576 3060 | www.particle.dk | info@particle.dk

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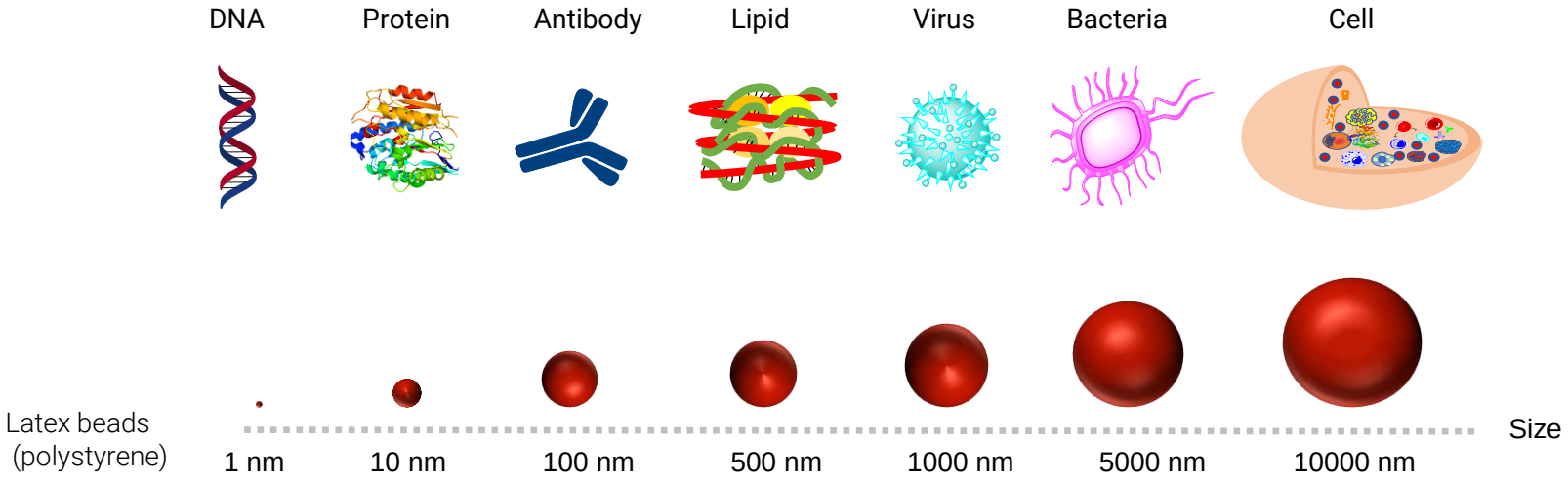
PARTICLE ANALYTICAL TESTING AND VALIDAITON OF NANOCUVETTE™ S, SPECTROWORKS™ TOGETHER WITH UV-VIS SPECTROPHOTOMETER
Date of Issue: 30-Jul-2021
Supersedes: -

Written by: Wenbo Wang, QC
Date: 30 JULI 2021

Approved by: Søren Lund Kristensen, QA
Date: 30 JULI 2021

POLYSTYRENE BEADS AS AN INDUSTRY STANDARD REFERENCE SYSTEM

Validated by external partner



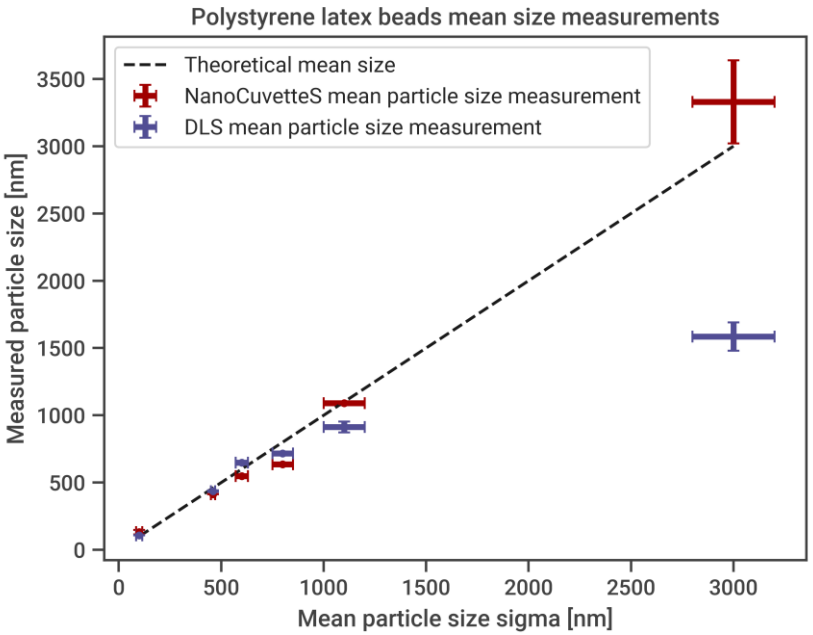
TEST AND VALIDATION IN REAL LIFE SETTINGS

- GLP Certified Particle analytical from Denmark has tested and validated the use of micro-NanoCuvette™ S and SpectroWorks™ using VWR UV6300-PC instrument.

- DLS was used for the reference instruments. DLS measurements were done by particle analytical using malvern zetasizer instrument.

- Mean particle size and concentration measurements of 6 different polystryerene latex beads were replicated for both of the instruments.

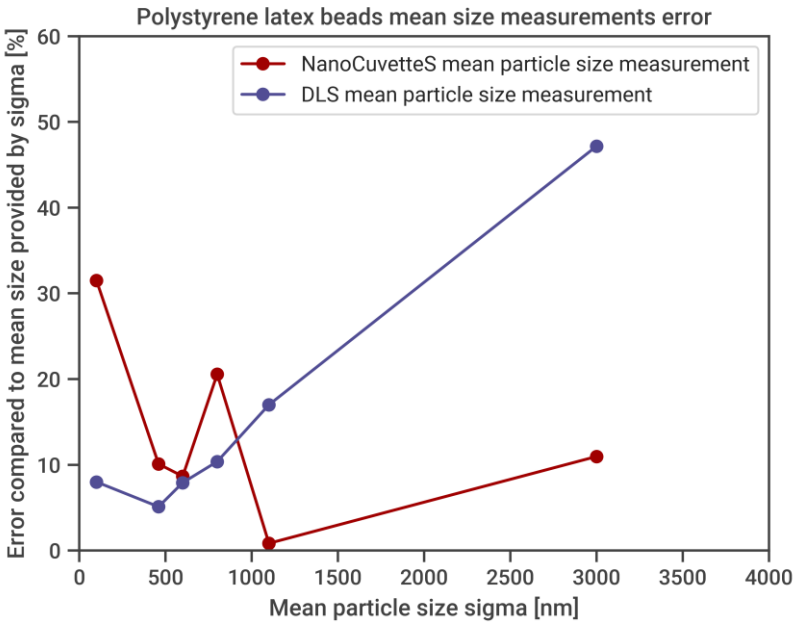
PARTICLE SIZE DISTRIBUTION I – NANOCUVETTE™ S COMPARED TO DLS

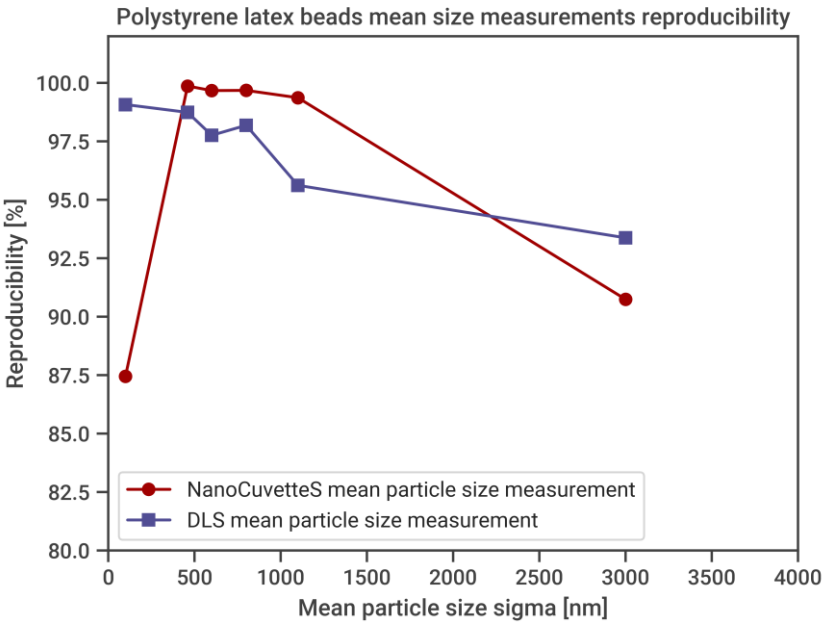


Size of Polystyrene latex beads	PDI DLS		Mean particle size (D50, nm) from DLS (% deviation from standard)		Mean particle size (nm) NanoCuvette™ S and SpectroWorks™ together with UV-vis spectrophotometer (% deviation from standard)	
	Run 1	Run 2	Run 1	Run 2	Run 1	Run 2
100 nm	0.026	0.058	109 (9.0%)	107 (7.0%)	115.00 (15.0%)	148.90 (48.9%)
460 nm	0.025	0.048	442 (3.9%)	431 (6.3%)	414.10 (10.0%)	413.04 (10.2%)
600 nm	0.040	0.086	662 (10.3%)	633 (5.5%)	546.26 (9.0%)	549.85 (8.4%)
800 nm	0.070	0.102	704 (12.0%)	730 (8.8%)	633.44 (20.8%)	637.50 (20.3%)
1100nm	0.147	0.040	873 (20.6%)	953 (13.4%)	1097.66 (0.2%)	1083.85 (1.5%)
3000 nm	0.365	0.334	1690 (43.7%)	1480 (50.7%)	3637.24 (21.4%)	3050.95 (1.9%)

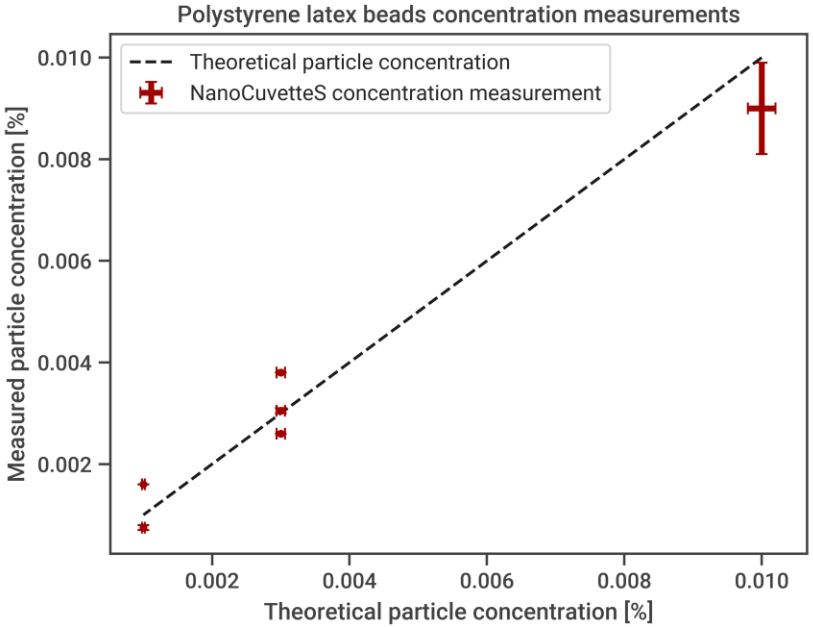
Table 1. Mean particle size (Vol.) of polystyrene latex beads measured by DLS and NanoCuvette™ S and SpectroWorks™ together with UV-Vis spectrophotometer
*Data provided by Particle Analytical

PARTICLE SIZE DISTRIBUTION II – NANOCUVETTE™ S COMPARED TO DLS





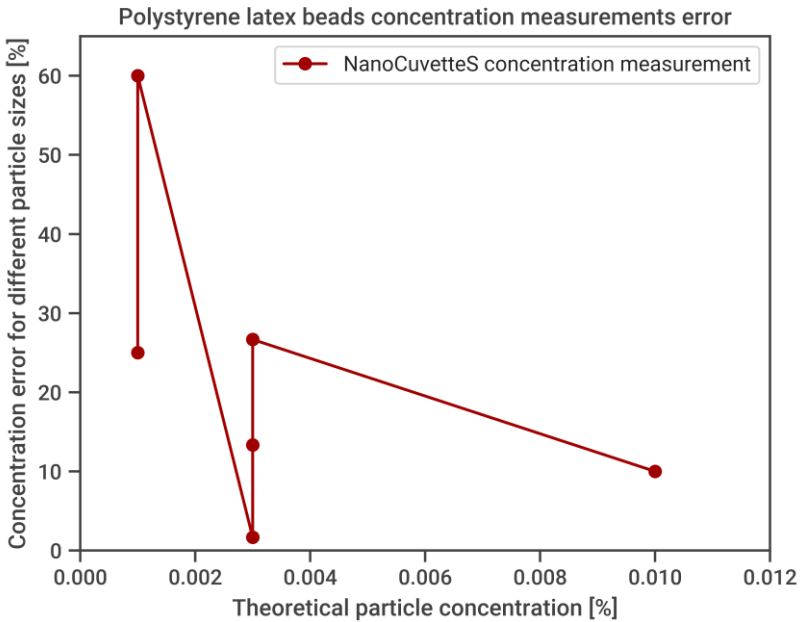
PARTICLE CONCENTRATION ANALYSIS I – NANOCUVETTE™ S AND SPECTROWORKS™

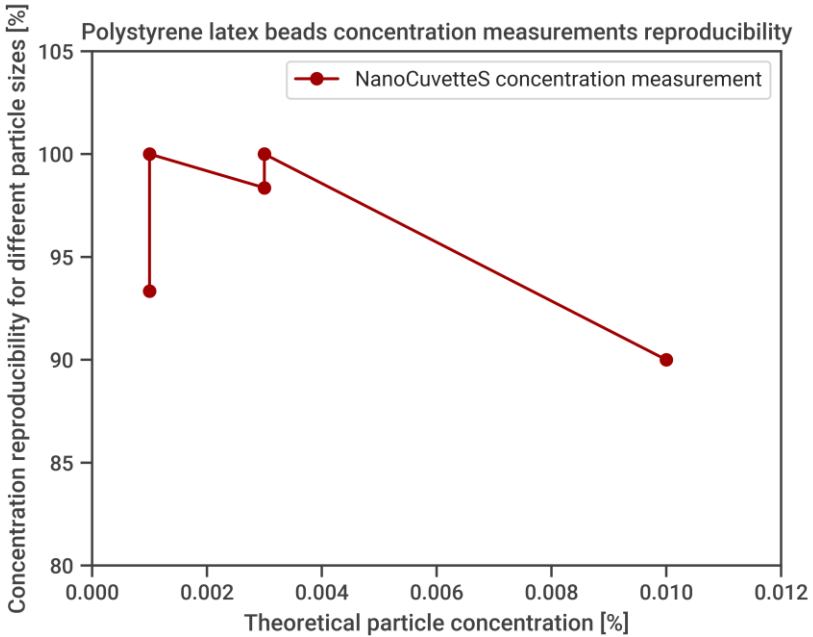


Sample name	Concentration (Vol.) Diluted from the stock	Concentration (Vol.) From NanoCuvette™ S and SpectroWorks™ together with UV-Vis spectrophotometer. Result (% deviation)	
		Run 1	Run 2
Polystyrene Latex beads 100 nm	0.01%	0.0099% (1.0%)	0.0081% (19.0%)
Polystyrene Latex beads 460 nm	0.003%	0.0038% (26.7%)	0.0038% (26.7%)
Polystyrene Latex beads 600 nm	0.003%	0.0026% (13.3%)	0.0026% (13.3%)
Polystyrene Latex beads 800 nm	0.003%	0.0030% (0.0%)	0.0031% (3.3%)
Polystyrene Latex beads 1100nm	0.001%	0.0016% (60.0%)	0.0016% (60.0%)
Polystyrene Latex beads 3000 nm	0.001%	0.0008% (20.0%)	0.0007% (30.0%)

Table 2. Concentration of the diluted polystyrene latex beads obtained using NanoCuvette™ S and SpectroWorks™ together with UV-Vis spectrophotometer.
*Data provided by Particle Analytical

PARTICLE CONCENTRATION ANALYSIS II – NANOCUVETTE™ S AND SPECTROWORKS™





PARTICLE SIZE ANALYSIS I - DYNAMIC LIGHT SCATTERING

CERTIFICATE OF ANALYSIS

Customer: CphNano
Material tested: Polystyrene Latex beads 100nm
Batch: 2021/07/23
Internal number: 32027

Analytical technique: Dynamic Light Scattering
Method of analysis: Analyseplan
Internal quality level: GMP

	$D_{10\%}$ (nm)**	$D_{50\%}$ (nm)**	$D_{90\%}$ (nm)**	Z-average*	PDI*
Run 1	79.4	109	159	118	0.026
Run 2	74.7	107	163	118.1	0.058
Average	**76.9**	**108**	**161**	**118.1**	**0.042**
Specification	- -	- -	- -	- -	- -
Evaluation	-	-	-	-	-

*The parameter is based on the intensity size distribution
**The parameter is based on the volume size distribution

Written by: [signature] Date: 28 JULI 2021

Reviewed by: ~~28 JULI 2021~~ [signature] Date: 28 JULI 2021

Approved by: ~~28 JULI 2021~~ [signature] Date: 28 JULI 2021
QC

CERTIFICATE OF ANALYSIS

Customer: CphNano
Material tested: Polystyrene Latex beads 460nm
Batch: 2021/07/23
Internal number: 32028

Analytical technique: Dynamic Light Scattering
Method of analysis: Analyseplan
Internal quality level: GMP

	$D_{10\%}$ (nm)**	$D_{50\%}$ (nm)**	$D_{90\%}$ (nm)**	Z-average*	PDI*
Run 1	320	442	605	422.2	0.025
Run 2	316	431	587	413.6	0.048
Average	**318**	**436**	**597**	**417.9**	**0.037**
Specification	- -	- -	- -	- -	- -
Evaluation	-	-	-	-	-

*The parameter is based on the intensity size distribution
**The parameter is based on the volume size distribution

Written by: [signature] Date: 28 JULI 2021

Reviewed by: [signature] Date: 28 JULI 2021

Approved by: [signature] Date: 28 JULI 2021
QC

Conclusion: NanoCuvette™ S with developed software outperforms DLS.

PARTICLE SIZE ANALYSIS II - DYNAMIC LIGHT SCATTERING

CERTIFICATE OF ANALYSIS

Customer: CphNano
Material tested: Polystyrene Latex beads 600nm
Batch: 2021/07/23
Internal number: 32029

Analytical technique: Dynamic Light Scattering
Method of analysis: Analyseplan
Internal quality level: GMP

	$D_{10\%}$ (nm)**	$D_{50\%}$ (nm)**	$D_{90\%}$ (nm)**	Z-average*	PDI*
Run 1	449	662	948	569.5	0.04
Run 2	470	633	831	596.4	0.086
Average	**462**	**646**	**899**	**582.9**	**0.063**
Specification	- -	- -	- -	- -	- -
Evaluation	-	-	-	-	-

*The parameter is based on the intensity size distribution
**The parameter is based on the volume size distribution

Written by: Date: 28 JULI 2021
Reviewed by: Date: 28 JULI 2021
Approved by: QC Date: 28 JULI 2021

CERTIFICATE OF ANALYSIS

Customer: CphNano
Material tested: Polystyrene Latex beads 800nm
Batch: 2021/07/23
Internal number: 32030

Analytical technique: Dynamic Light Scattering
Method of analysis: Analyseplan
Internal quality level: GMP

	$D_{10\%}$ (nm)**	$D_{50\%}$ (nm)**	$D_{90\%}$ (nm)**	Z-average*	PDI*
Run 1	496	704	948	621.9	0.07
Run 2	552	730	944	684.9	0.102
Average	**529**	**718**	**946**	**653.4**	**0.086**
Specification	- -	- -	- -	- -	- -
Evaluation	-	-	-	-	-

*The parameter is based on the intensity size distribution
**The parameter is based on the volume size distribution

Written by: Date: 28 JULI 2021
Reviewed by: Date: 28 JULI 2021
Approved by: QC Date: 28 JULI 2021

Conclusion: NanoCuvette™ S with developed software outperforms DLS.

PARTICLE SIZE ANALYSIS III - DYNAMIC LIGHT SCATTERING

CERTIFICATE OF ANALYSIS

Customer: CphNano
Material tested: Polystyrene Latex beads 3000nm
Batch: 2021/07/23
Internal number: 32032

Analytical technique: Dynamic Light Scattering
Method of analysis: Analyseplan
Internal quality level: GMP

	$D_{10\%}$ (nm)**	$D_{50\%}$ (nm)**	$D_{90\%}$ (nm)**	Z-average*	PDI*
Run 1	1040	1690	4030	2698	0.365
Run 2	1150	1480	2290	2756	0.334
Average	**1110**	**1550**	**3570**	**2727**	**0.349**
Specification	- -	- -	- -	- -	- -
Evaluation	-	-	-	-	-

*The parameter is based on the intensity size distribution
**The parameter is based on the volume size distribution

Written by: Date: 28 JULI 2021
Reviewed by: Date: 28 JULI 2021
Approved by: QC Date: 28 JULI 2021

CERTIFICATE OF ANALYSIS

Customer: CphNano
Material tested: Polystyrene Latex beads 1100nm
Batch: 2021/07/23
Internal number: 32031

Analytical technique: Dynamic Light Scattering
Method of analysis: Analyseplan
Internal quality level: GMP

	$D_{10\%}$ (nm)**	$D_{50\%}$ (nm)**	$D_{90\%}$ (nm)**	Z-average*	PDI*
Run 1	527	873	1250	789.6	0.147
Run 2	736	953	1230	873.5	0.04
Average	**620**	**922**	**1240**	**831.5**	**0.093**
Specification	- -	- -	- -	- -	- -
Evaluation	-	-	-	-	-

*The parameter is based on the intensity size distribution
**The parameter is based on the volume size distribution

Written by: Date: 28 JULI 2021
Reviewed by: Date: 28 JULI 2021
Approved by: QC Date: 28 JULI 2021

The validity of the method is the responsibility of the sponsor
Quality agreement not in place

Conclusion: NanoCuvette™ S with developed software outperforms DLS.

PARTICLE SIZE ANALYSIS I - NANOCUVETTE ™ S AND SPECTROWORKS ™

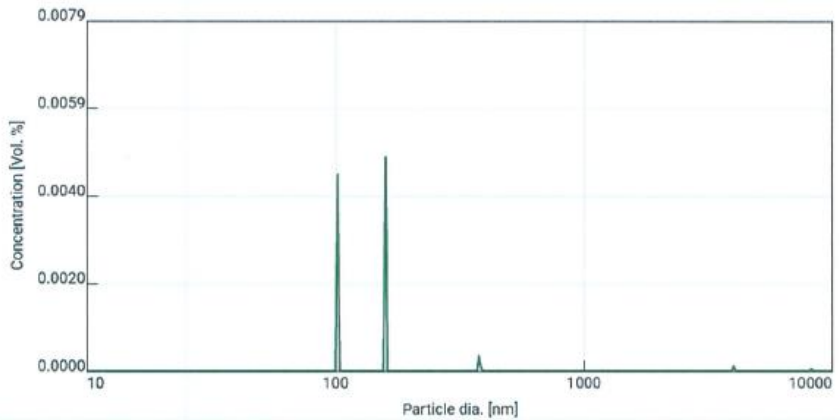
Results

Refractive Index:	1.33612794	nD
Reference fit quality:	39.4927	%
Sample fit quality:	31.7062	%
Mean Particle Diameter:	115.00	nm
Particle Concentration:	0.0099	% (Vol.)

Material tested: Polystyrene Latex beads 100nm, 0.01%
Analytical technique: NanoCuvette™S, SpectroWorks™ with Spectrophotometer

Plots

Spectra | Size distribution



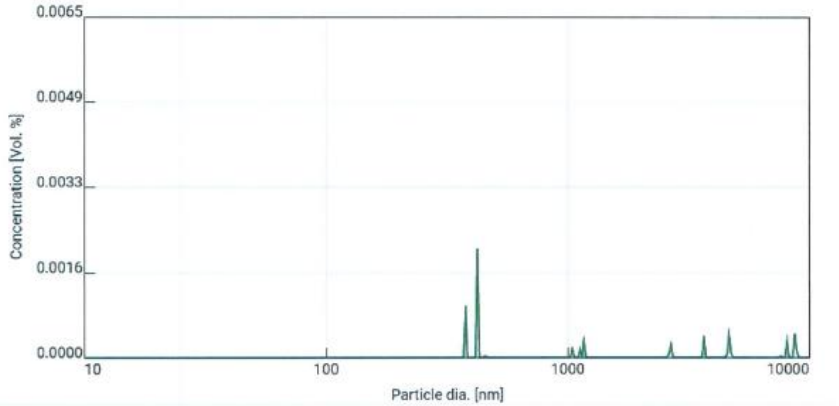
Results

Refractive Index:	1.36491180	nD
Reference fit quality:	35.5789	%
Sample fit quality:	18.6321	%
Mean Particle Diameter:	414.10	nm
Particle Concentration:	0.0038	% (Vol.)

Material tested: Polystyrene Latex beads 460nm, 0.003%
Analytical technique: NanoCuvette™S, SpectroWorks™ with Spectrophotometer

Plots

Spectra | Size distribution



Screenshots from developed software (SpectroWorks™)

PARTICLE SIZE ANALYSIS I - NANOCUVETTE ™ S AND SPECTROWORKS ™

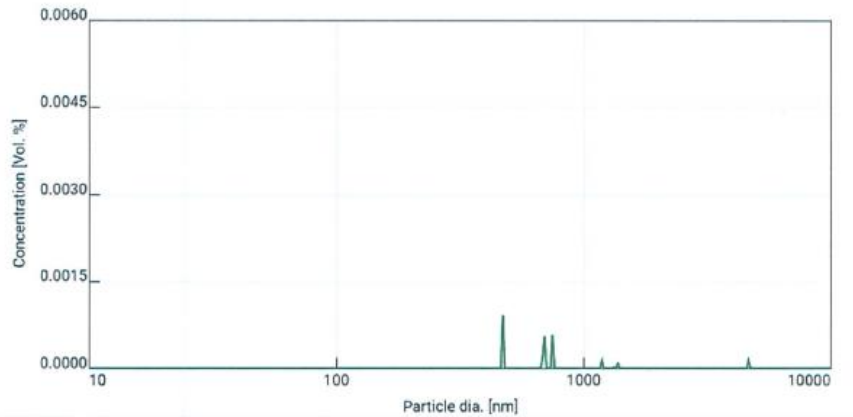
Results

Refractive Index:	1.35779775	nD
Reference fit quality:	54.7016	%
Sample fit quality:	28.0487	%
Mean Particle Diameter:	549.26	nm
Particle Concentration:	0.0026	% (Vol.)

Material tested: Polystyrene Latex beads 600nm, 0.003%
Analytical technique: NanoCuvette™S, SpectroWorks™ with Spectrophotometer

Plots

Spectra | Size distribution



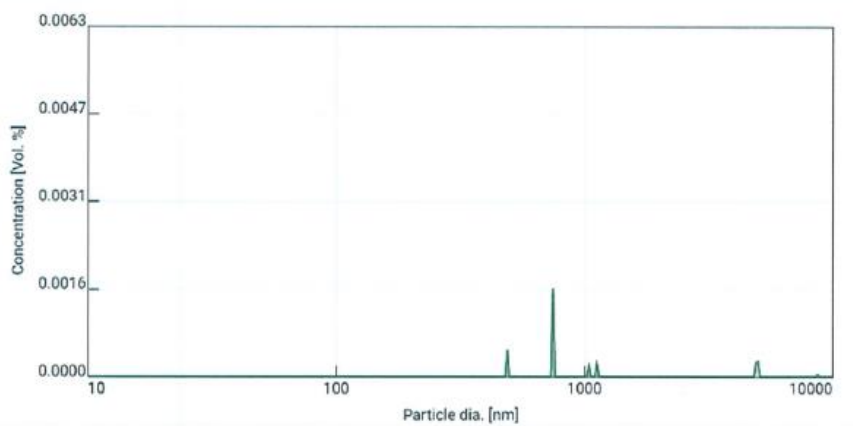
Results

Refractive Index:	1.34305982	nD
Reference fit quality:	55.9293	%
Sample fit quality:	24.9135	%
Mean Particle Diameter:	633.44	nm
Particle Concentration:	0.0030	% (Vol.)

Material tested: Polystyrene Latex beads 800nm, 0.003%
Analytical technique: NanoCuvette™S, SpectroWorks™ with Spectrophotometer

Plots

Spectra | Size distribution



Screenshots from developed software (SpectroWorks™)

PARTICLE SIZE ANALYSIS I - NANOCUVETTE ™ S AND SPECTROWORKS ™

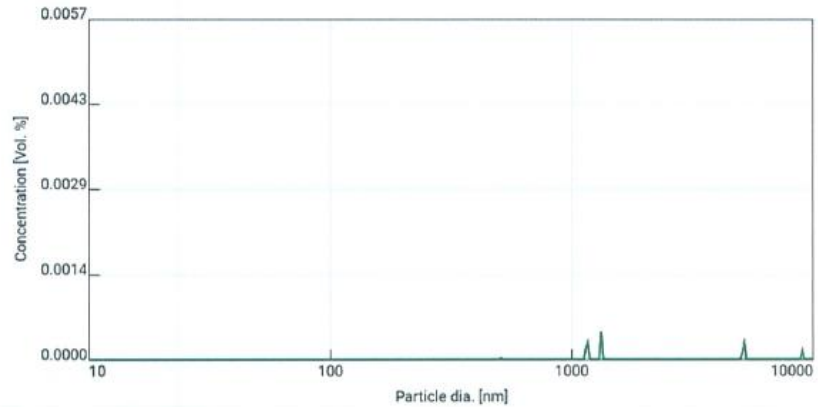
Results

Refractive Index:	N/A
Reference fit quality:	N/A
Sample fit quality:	N/A
Mean Particle Diameter:	1097.66 nm
Particle Concentration:	0.0016 % (Vol.)

Material tested: Polystyrene Latex beads 110nm, 0.001%
Analytical technique: NanoCuvette™S, SpectroWorks™ with Spectrophotometer

Plots

Spectra | Size distribution



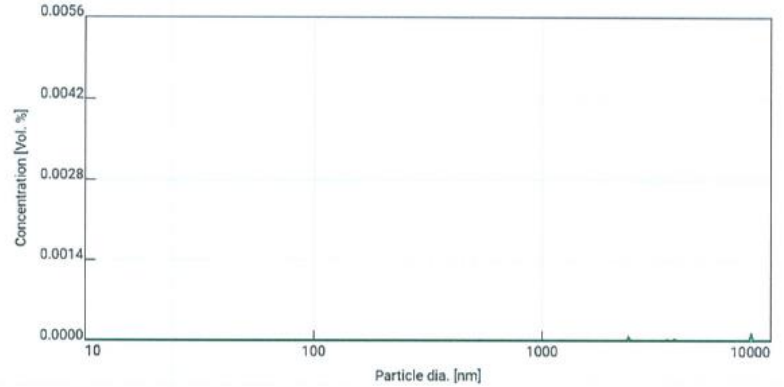
Results

Refractive Index:	1.57637491 nD
Reference fit quality:	35.7368 %
Sample fit quality:	59.9385 %
Mean Particle Diameter:	3050.95 nm
Particle Concentration:	0.0007 % (Vol.)

Material tested: Polystyrene Latex beads 3000nm, 0.001%
Analytical technique: NanoCuvette™S, SpectroWorks™ with Spectrophotometer

Plots

Spectra | Size distribution



Screenshots from developed software (SpectroWorks™)

Poll Question 5

Do you use any cloud-based software for your lab analysis? Or do you use any programming language like python and MATLAB to interpret/analyze your data?

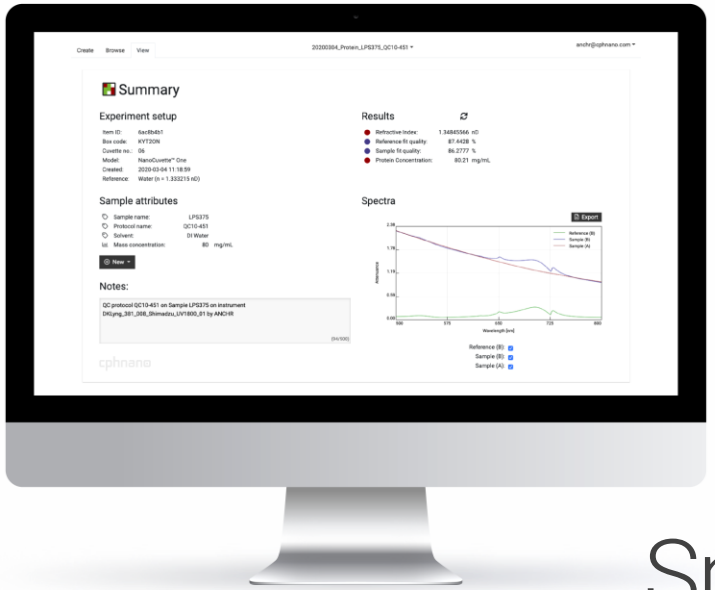
Upgrade your spectrophotometer with software

SpectroWorks™

cphnano

THE FUTURE OF UV-VIS LABWORK IS HERE.

- Drag-and-drop easy data processing
- Analysis in seconds
- One-click export for reporting



Optimize and automate your UV-Vis instrument workflow.

Online now.

SPECTROWORKS.COM

SpectroWorks™

Browser based software solution. Open API for connecting to LIMS, ELN or python. Secure data storage and tracking. No installation.

Upgrade your spectrophotometer
with NanoCuvette™ S

Conclusion

WHAT'S IN IT FOR YOU?

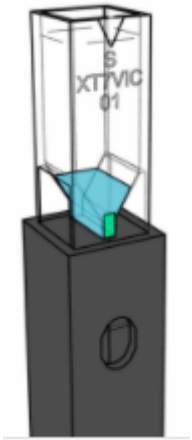
- Realiable accurate results.
- Works with existing UV-Vis spectrophotometers in the lab.
- No download of software with always updated online software platform.
- Cuvettes can be reused - check cuvette fit quality in SpectroWorks™.
- No extensive expertise needed for operation.
- Less time wasted.
- Low up-front cost.

NB! Buy NanoCuvette™ S every day for 12 years before you have spent the same money as a DLS instrument.

BENEFITS FROM VWR COLLABORATION

- VWR/Avantor's UV-Vis spectrophorometer now supports particle size and concentration measurements.
- You can order cuvettes with our lab supplies.
- Standard lab purchasement contracts can be used.
- Data sheet, technical briefs, instruction briefs and knowledge base publicly available (https://knowledge.cphnano.com/).
- Shipping across Europe.
- Fits into the exsting laboratory routines.

WHY CHOOSE US?



Supports Your Hardware

NanoCuvette™ One works with your existing UV-Vis spectrophotometer.

Designed For Humans

Easy to use with no special training required. Online support included.

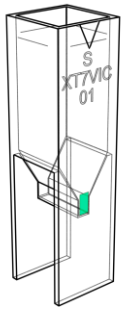
Accurate and Instant Results

Results are calculated based on spectral analysis in less than 5 seconds.

Unique Traceability

First in the industry, each cuvette is marked for traceability and access to online calibration data.

SUPERIOR TECHNOLOGY WITH NO UP-FRONT COST OR TRAINING FOR YOUR LAB



NanoCuvette™ S

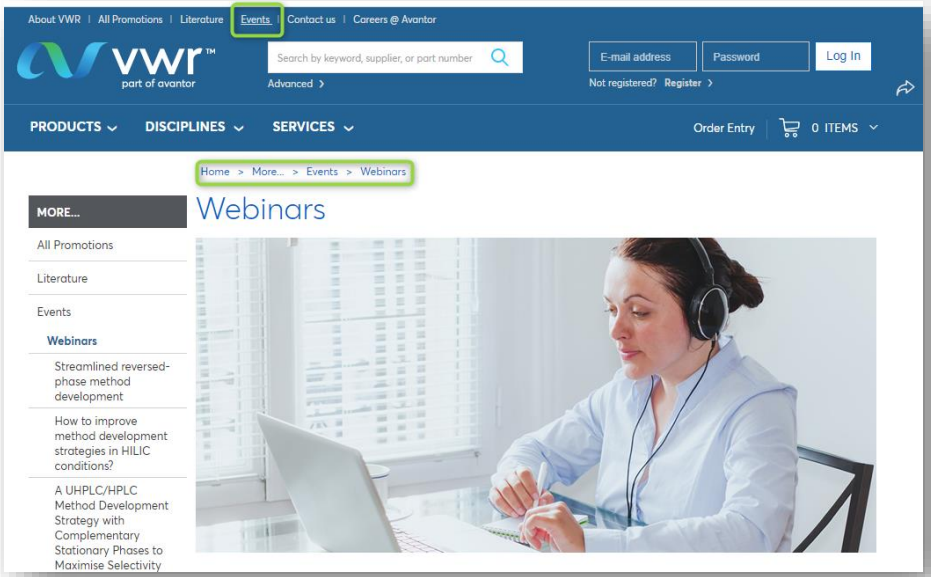
Sangita Khatri
Research Scientist
sakha@cphnano.com

Christopher Lüscher, PhD
Interim CEO
chrlu@cphnano.com

Achieve easy, fast and reliable particle size analysis with NanoCuvette™ S

Thank you!

Conclusions



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Thank you

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Webinar@avantorsciences.com

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