INTRODUCING MICROTRAC MRB

A new leader in particle characterization

Light Scattering – Image Analysis – Gas Adsorption

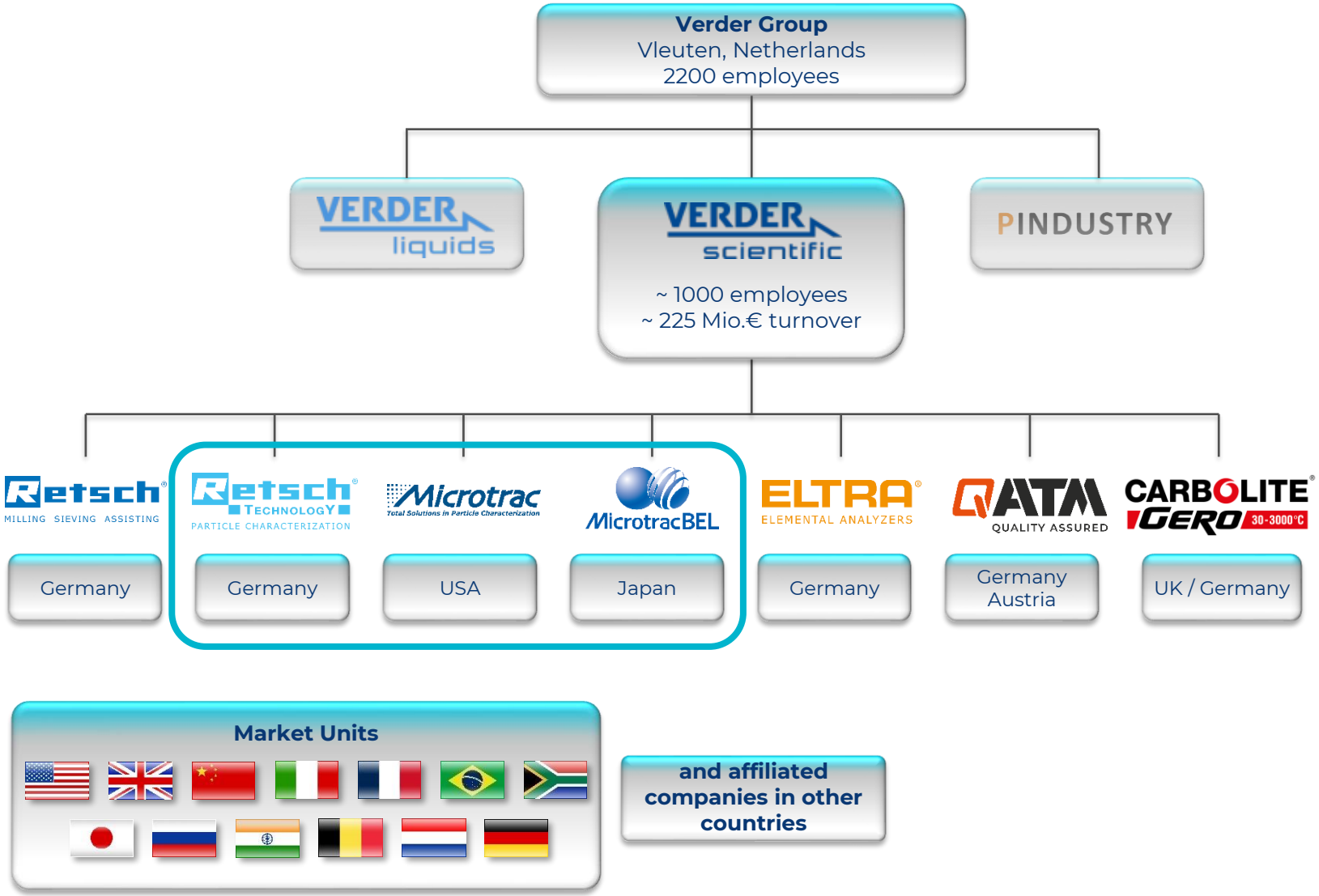
Dr. Daniel Hagmeyer

(Int. Product Management & Application LD / DLS)

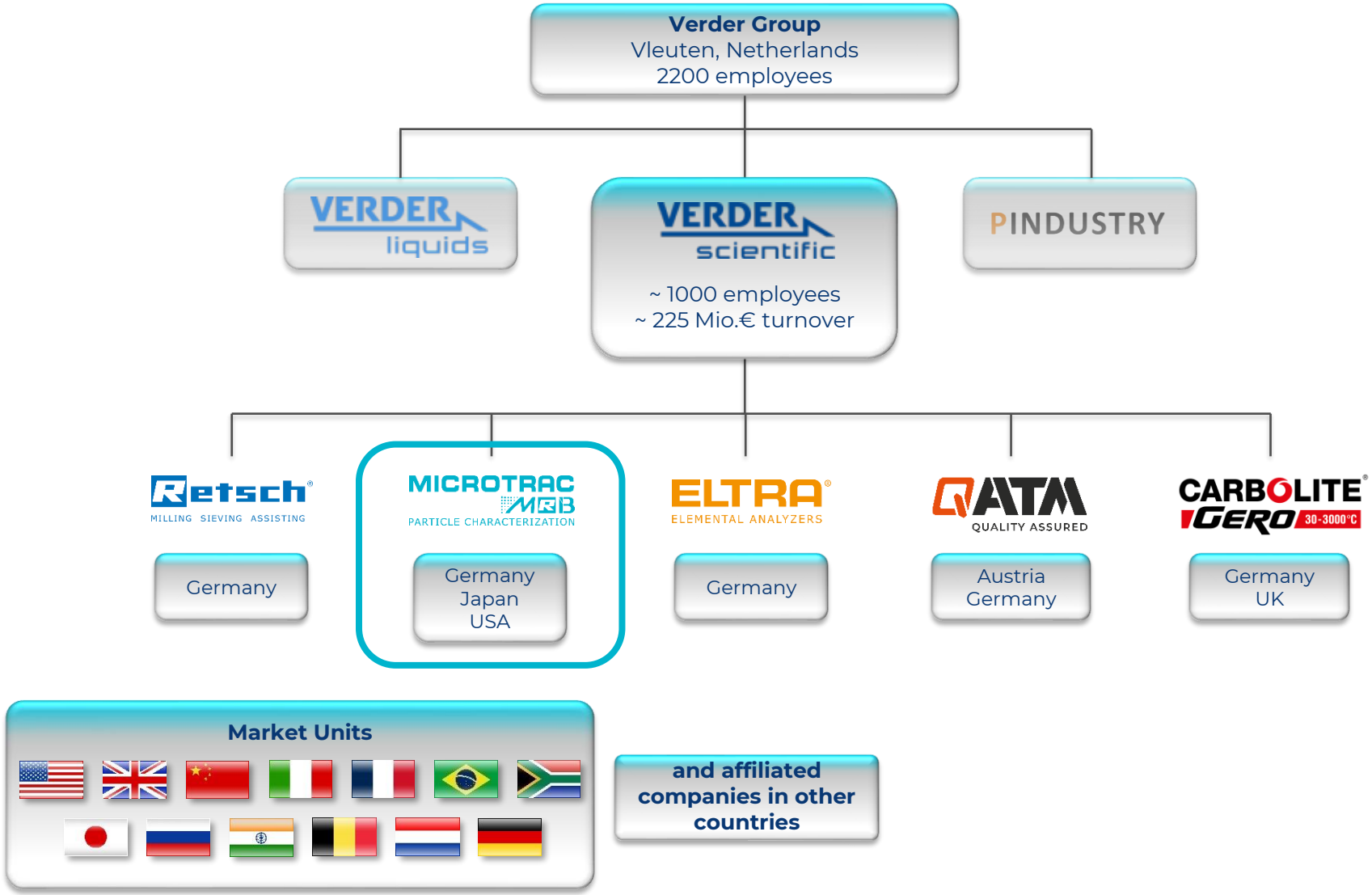
ORGANIZATION

- Hardness Testing & Materialography
- Heat Treatment
- Elemental Analysis
- Milling & Sieving
- Particle Characterization

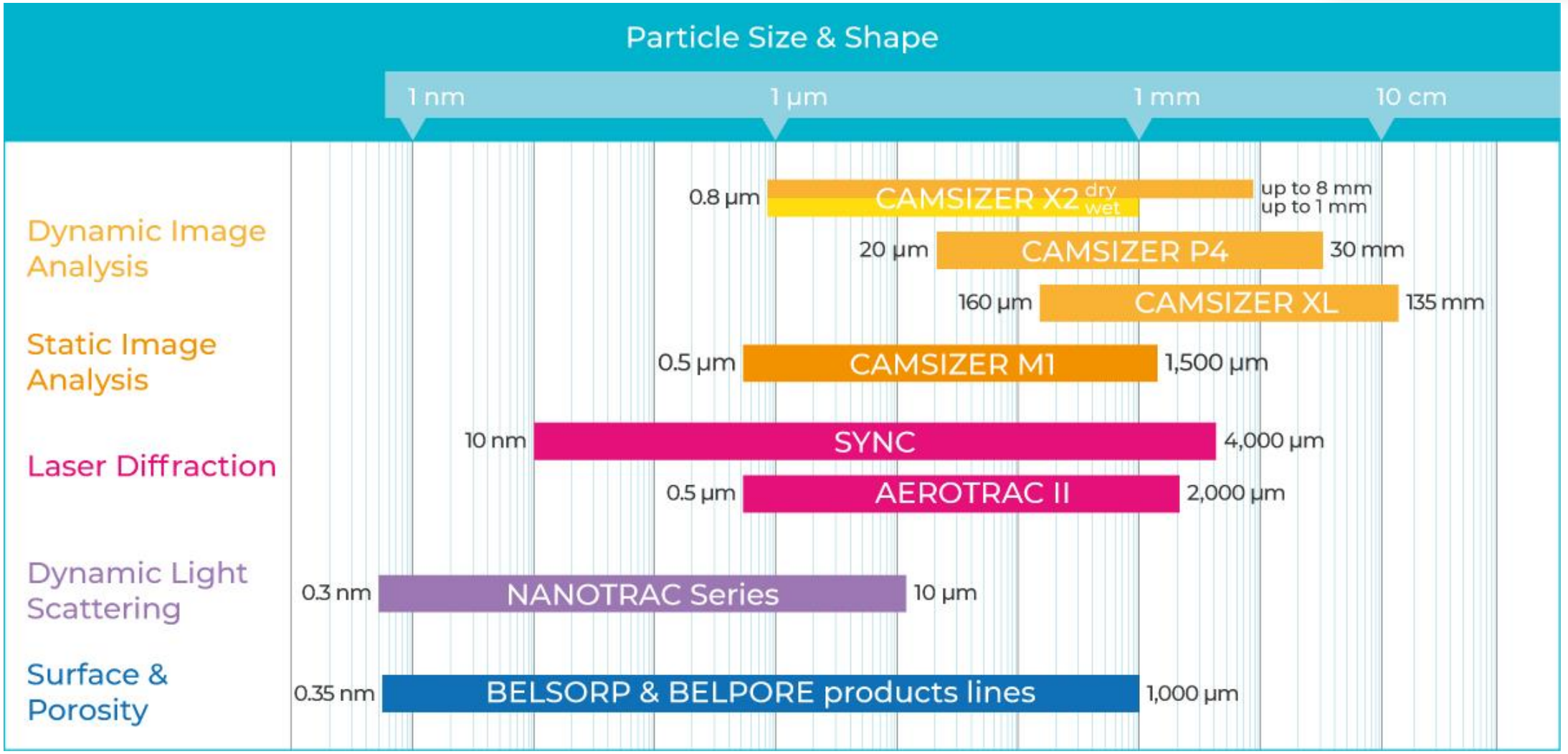
ORGANIZATION CHART SCIENTIFIC DIVISION



ORGANIZATION CHART



PARTICLE ANALYSIS TECHNIQUES



MICROTRAC MRB BUSINESS UNITS & TECHNOLOGIES

Particle Size:

- 1 nm – 4 mm
- Technology: Laser Diffraction, Dynamic Light Scattering
- Site: Montgomeryville, PA, USA

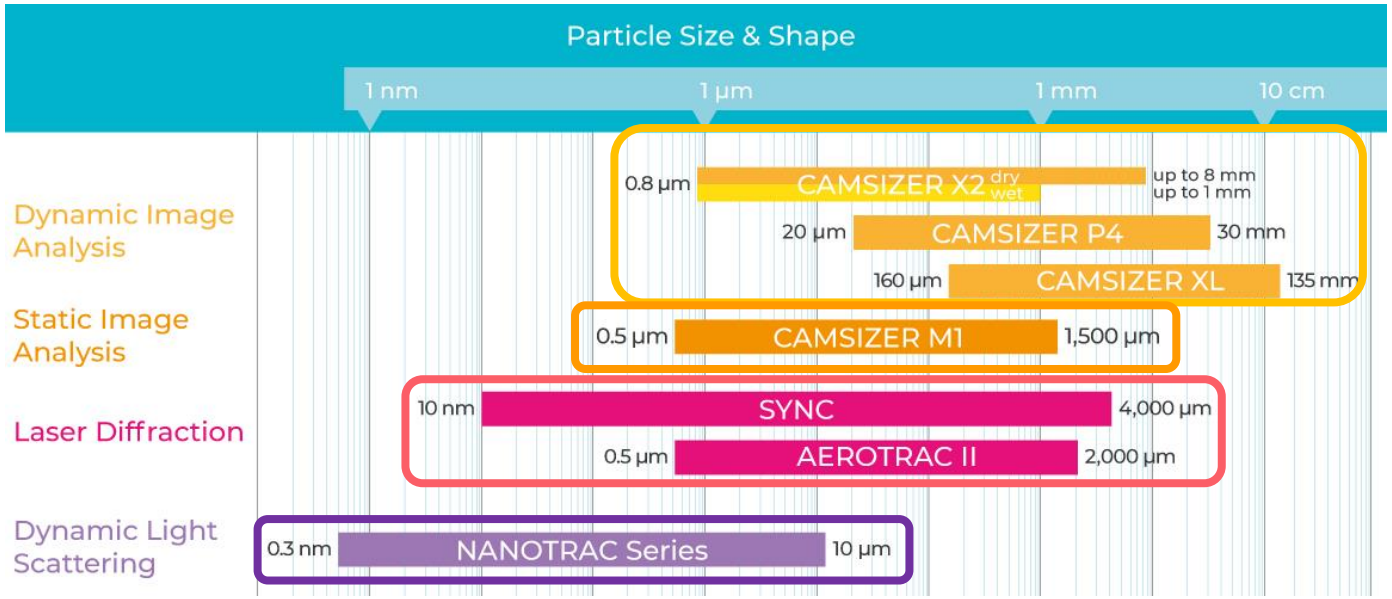
Particle Size & Shape:

- 0.5 µm – 135 mm
- Technology: Dynamic and Static Image Analysis
- Site: Haan, Germany

Surface and Porosity:

- Technology: Gas Adsorption
- Site: Osaka, Japan

PARTICLE ANALYSIS TECHNIQUES



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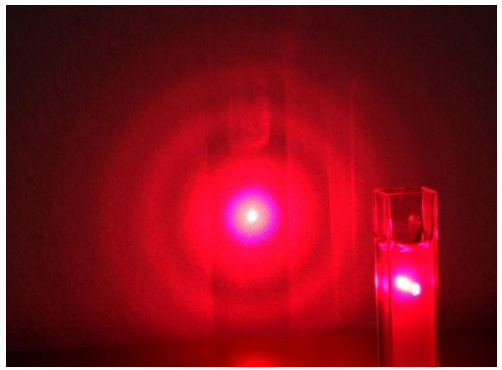
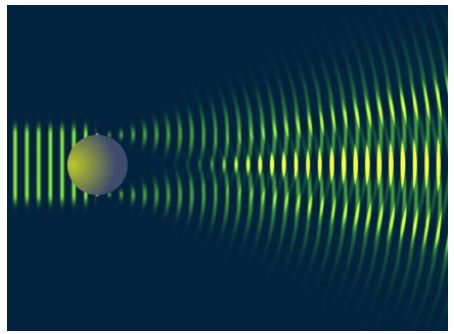
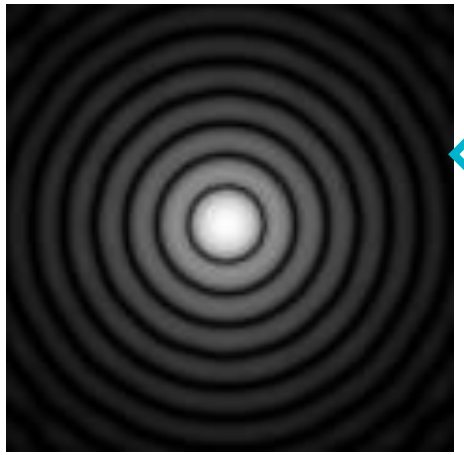
LASER DIFFRACTION





How it works:

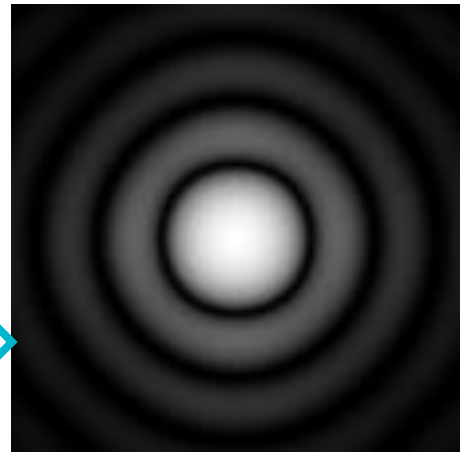
- Electromagnetic waves (light) show diffraction when interacting with matter. Superposition of the waves (interference) leads to amplification or extinction.
- The phenomenon can be observed with grids, slits, apertures and PARTICLES.



Diffraction patterns

Large particles ➔ small angles of diffraction, high intensity

Small particles ➔ large angles of diffraction, low intensity, blurry



Advantages:

- Wide measuring range
- Fast
- Versatile

Diffraction angles depend on wavelength and particle size

DIFFRACTION ANALYZER: SYNC

Advantages:

- Wet and dry analysis
- Easy change of modules
- Camera for additional image information
- 3 configurations: 2R, 3R, 1R2B

PARTICLE SIZE AND SHAPE: LASER DIFFRACTION AND DYNAMIC IMAGE ANALYSIS

Two fixed photoelectric detector arrays

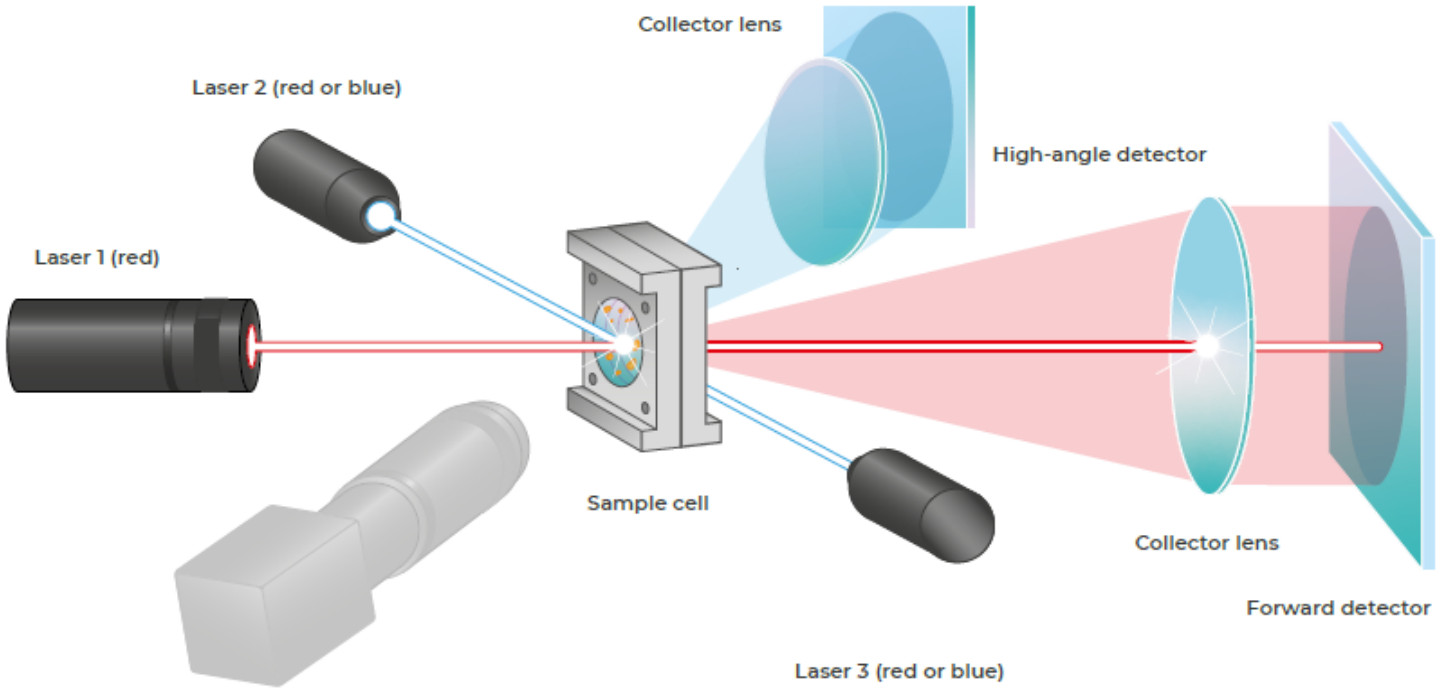
- 0,02 to 163°
- 151 Detector-Segments

Laser wavelength:
780 nm (red),
405 nm (blue)

Available Configurations:

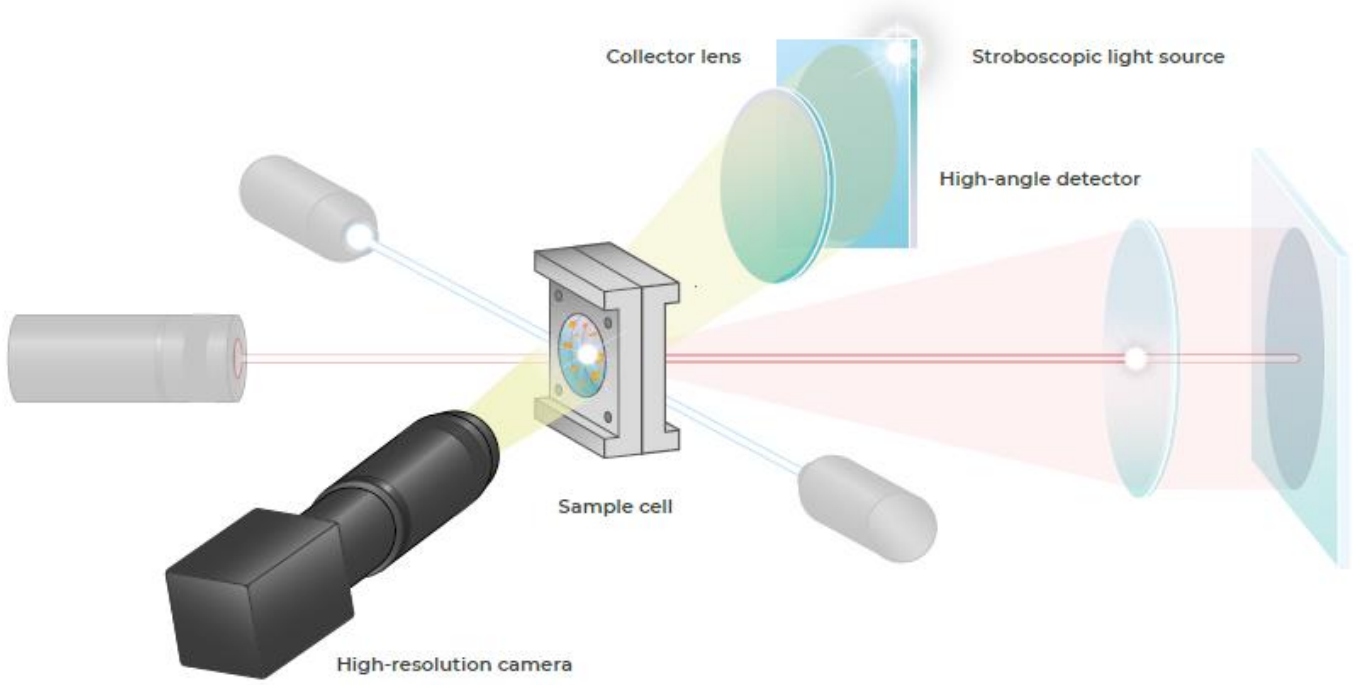
- *3 red lasers*
- *Laser 1 red / Laser 2 & 3 blue*
- *2 red lasers*

Microtrac's innovative **modified Mie scattering theory** produces accurate particle size distributions for both spherical and non-spherical particles.

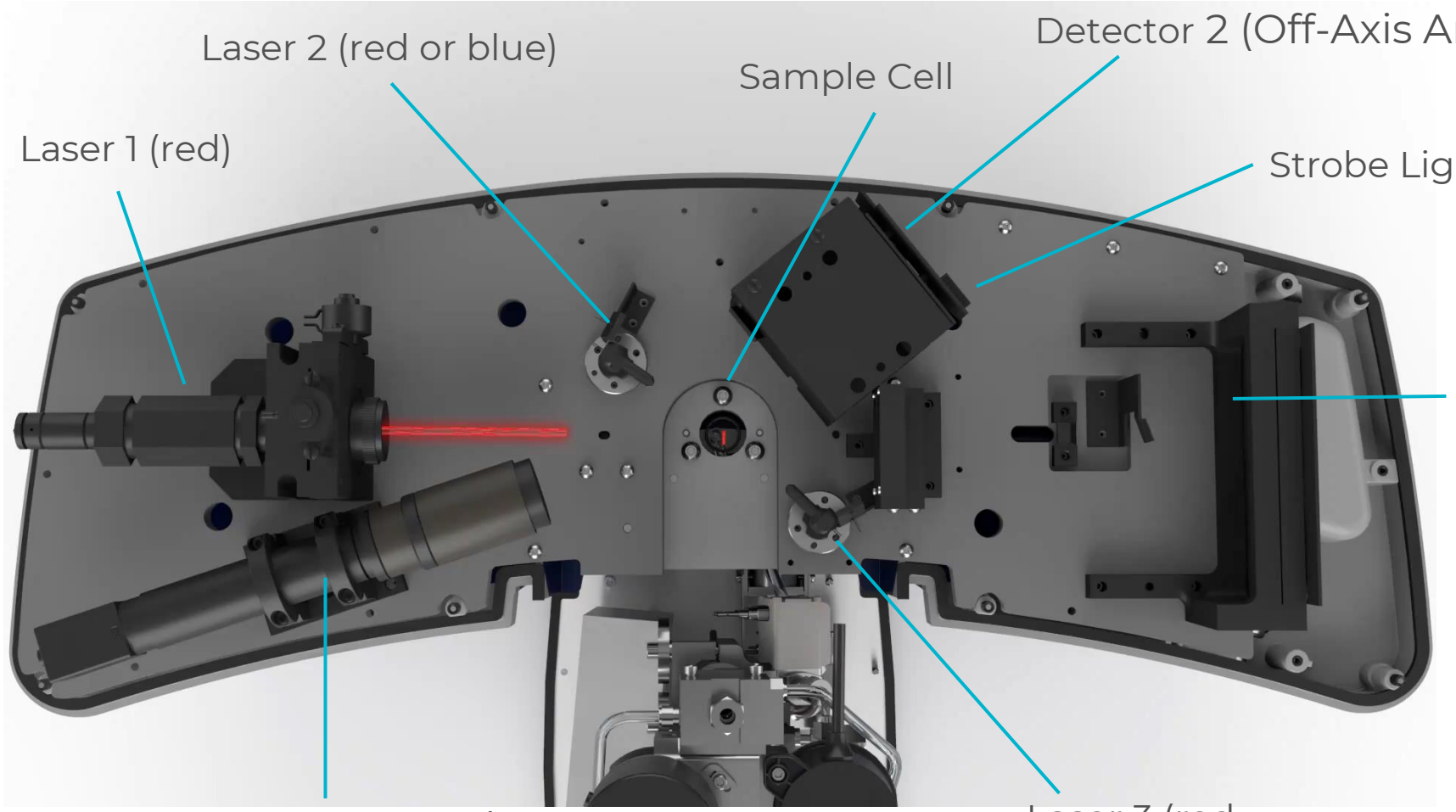


SYNC – IMAGE ANALYSIS

- 5.2 Megapixel camera with 22-60 fps
- Realtime visualization of particles during the measurement
- Reporting of graphical and tabular size and shape data
- More than 30 size and shape parameters: width, length, area equivalent diameter, circularity, aspect ratio, compactness, sphericity, roundness, convexity etc....
- Powerful search and filter options
- Two camera resolutions available (high-range and low-range)



DATA ACQUISITION



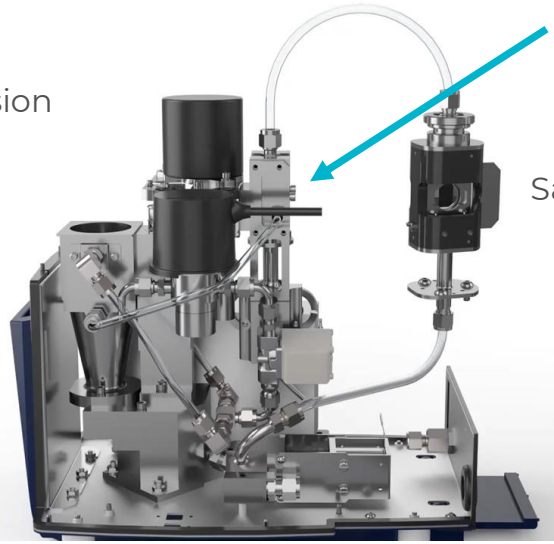
WET & DRY DISPERSION

FlowSync

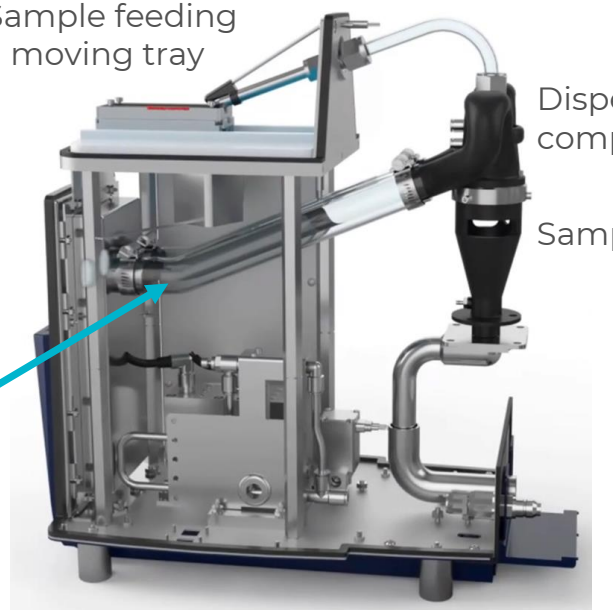
Wet dispersion

TurboSync

Dry dispersion



Centrifugal Pump



DYNAMIC LIGHT SCATTERING

Nanotrac Wave II

- Size 0,3 nm – 10.000 nm
- Zeta potential
- Flow cell for titrations
- Compliant to DIN ISO 22412:2017

Nanotrac Flex

- Size 0,3 nm – 10.000 nm
- External probe: in-situ analysis
- Online capability
- Multiple probe lengths
- Compliant to DIN ISO 22412:2017

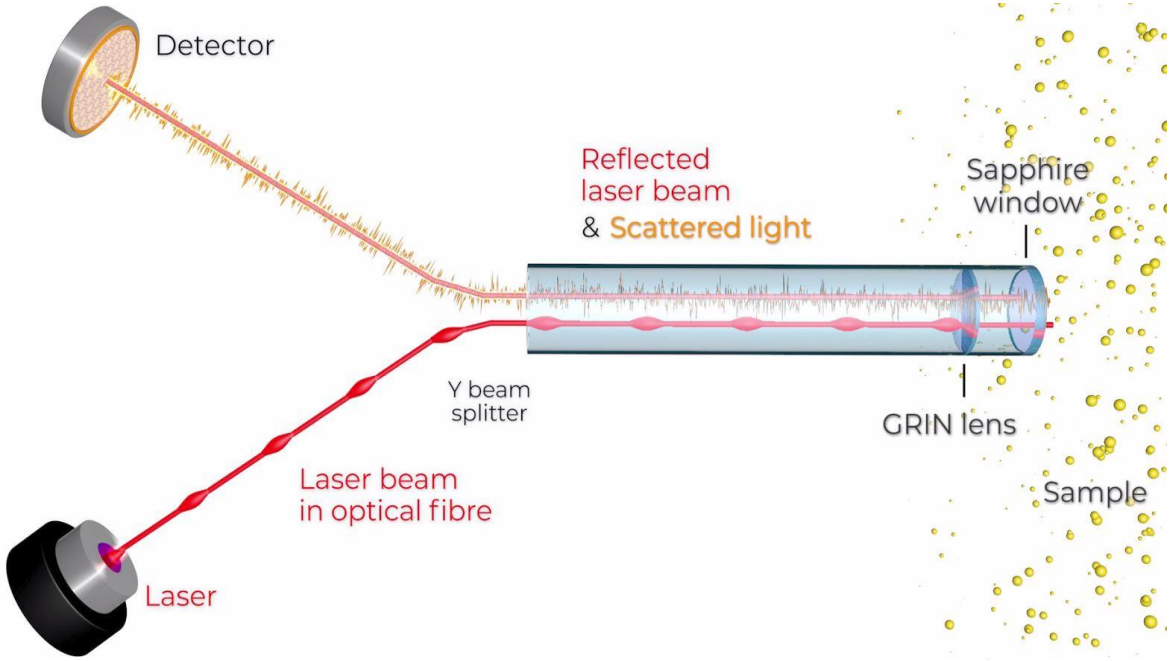
Dynamic light scattering is used to measure NANOPARTICLES!
Proteins, nano-metals, org. macromolecules, inks, pigments etc.

DYNAMIC LIGHT SCATTERING

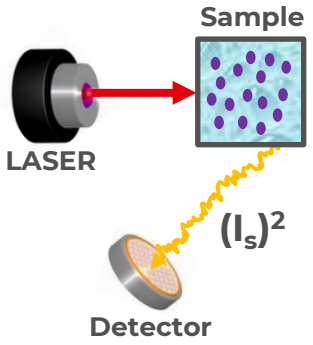
How it works:

- DLS measures Brownian Motion of small particles in a suspension
- Diffusion coefficient (D_t) is related to particle size (d_h) by the Stokes-Einstein Equation:

$$D_t = \frac{kT}{3\pi\eta d_h}$$



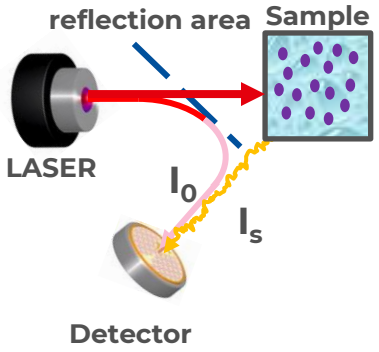
Homodyne
Self - Beating



PCS
Photon correlation spectroscopy

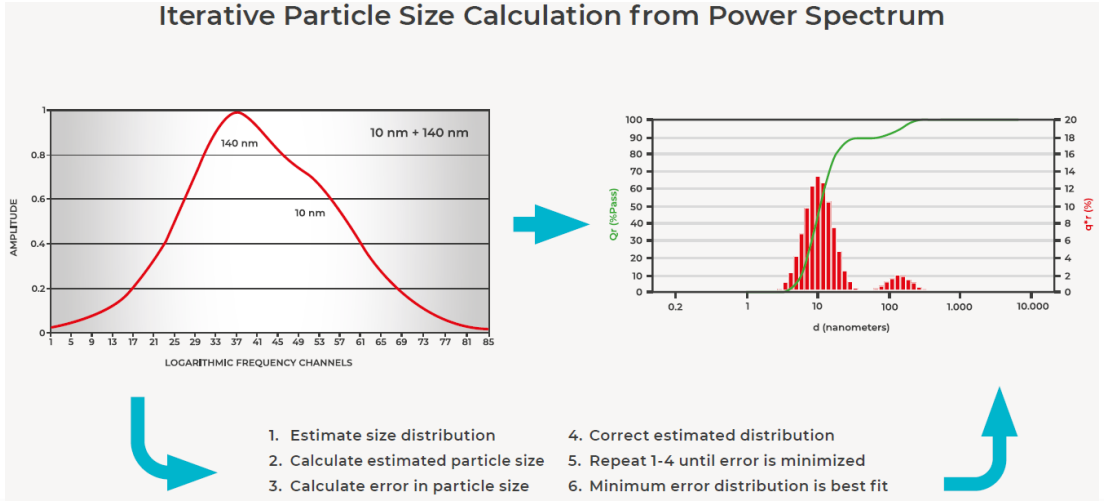
d^6

Heterodyne
Laser-amplified scattering reference method



FFT
Frequency Power spectrum

d^3



APPLICATIONS LASER ANALYZERS

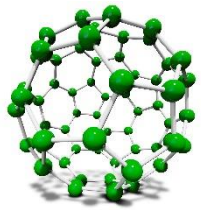
Pharmaceuticals

Pigments

Polymers

Emulsions

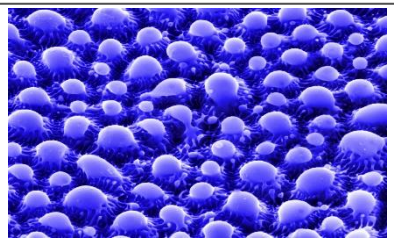
Nanomaterials



Spices

Food

Colloids



Cosmetics

Ink & Paint

Cement

Chemicals

BUSINESS UNITS & TECHNOLOGIES

Particle Size:

- 1 nm – 4 mm
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- Site: Montgomeryville, PA, USA

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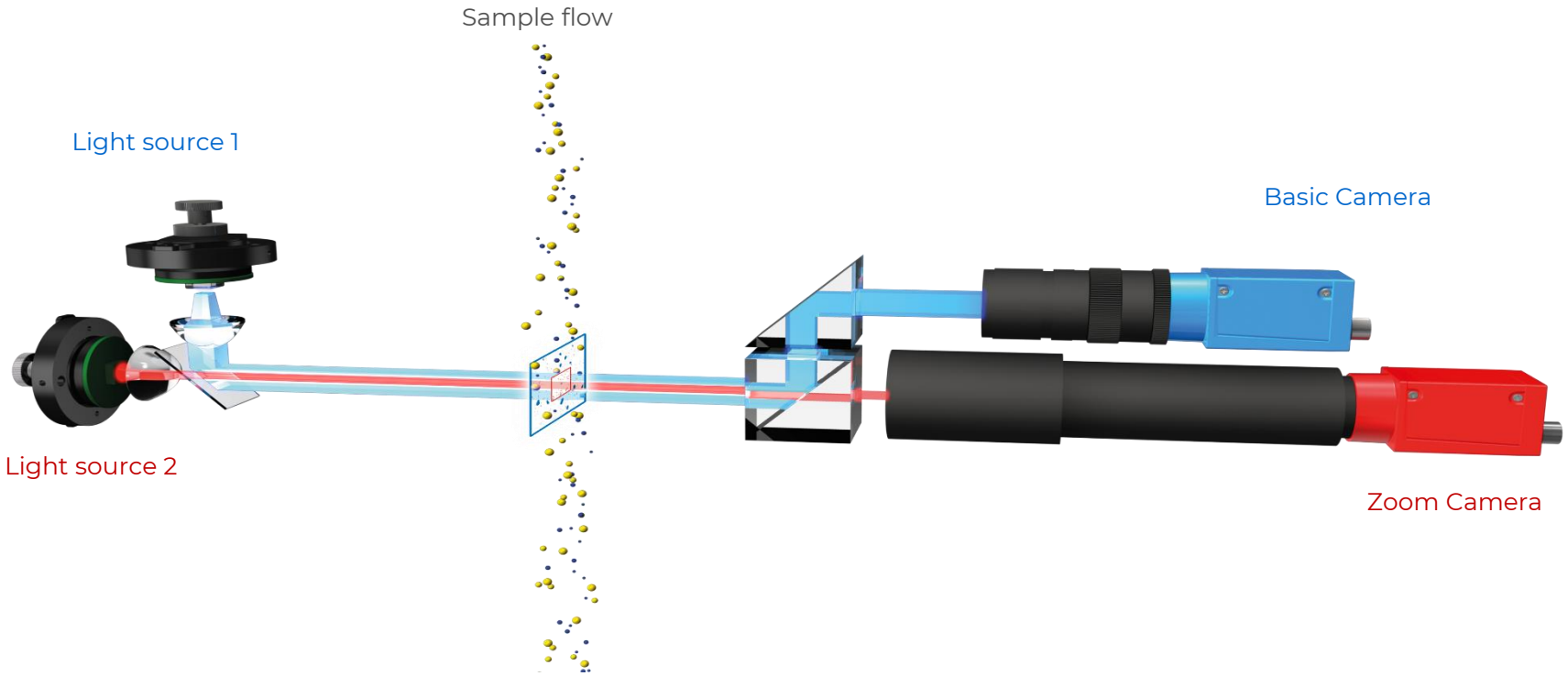
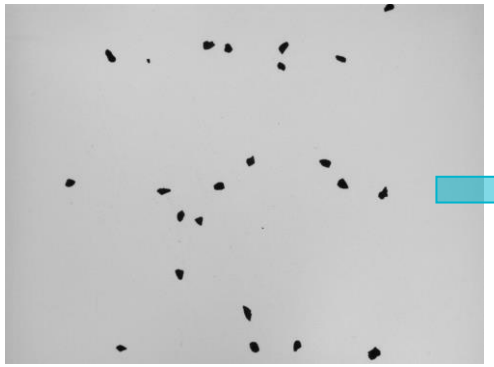
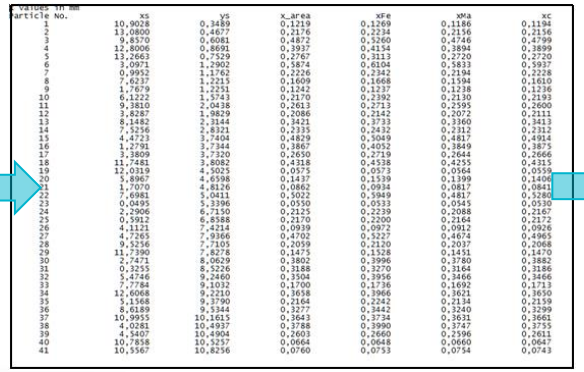
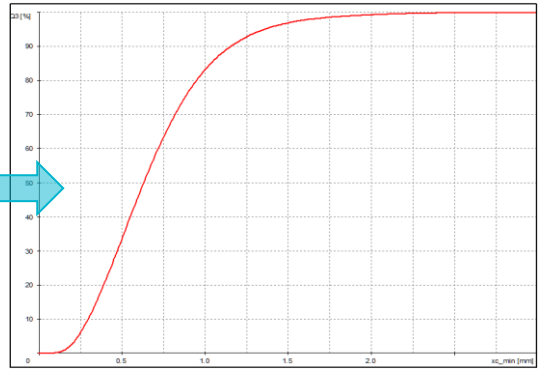
DYNAMIC IMAGE ANALYSIS (DIA)









How it works:

- Stream of particles
- In front of illuminated background
- Shadows of particles detected by the cameras

Advantages:

- Wide dynamic range thanks to Dual Camera Technology
- Fast: 2 – 3 minutes
- High sensitivity for oversize and undersize
- Results comparable to sieve analysis
- Analysis of large number of particle detections: reproducible and meaningful results
- Shape analysis

DYNAMIC IMAGE ANALYSIS: CAMSIZER SERIES

CAMSIZER P4

- 20 µm – 30 mm
- Dry measurement
- Gravity dispersion
- 60 images / second
- Pourable bulk materials: fertilizer pellets, sugar, dry sand etc.

CAMSIZER X2

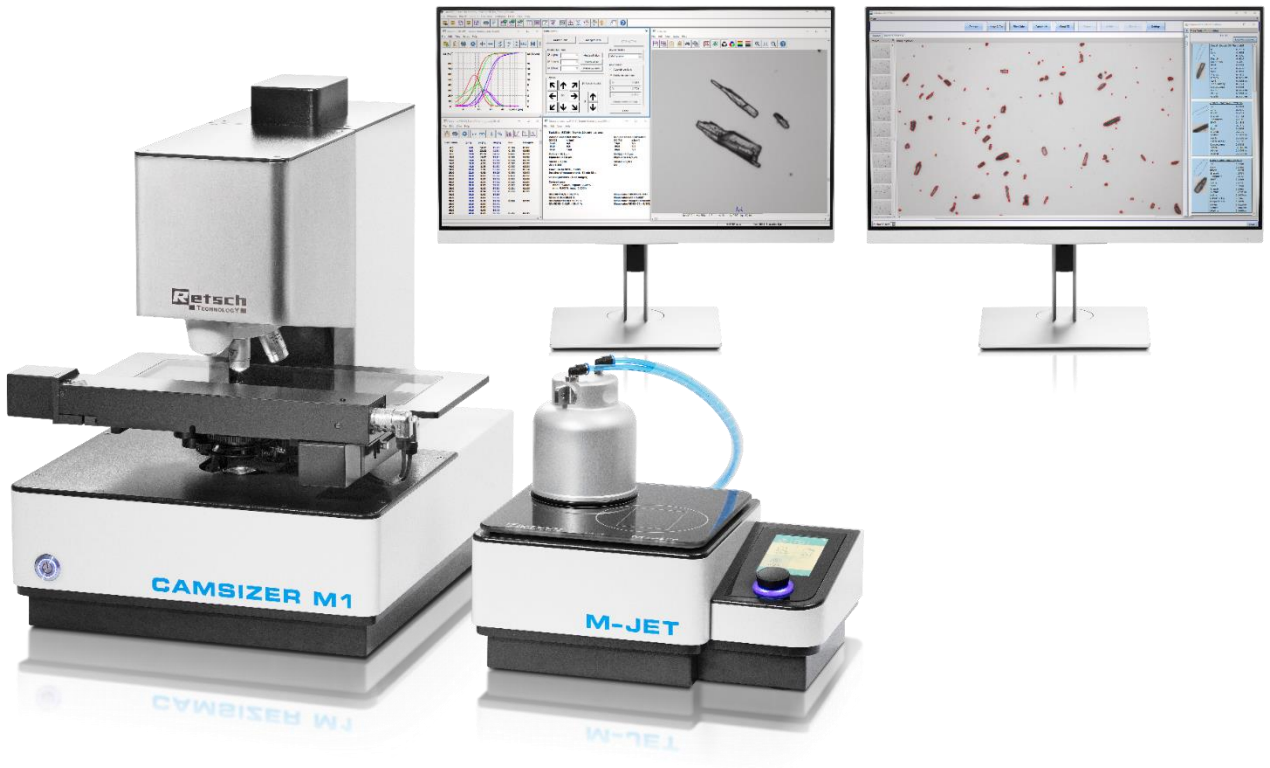
- 0.8 µm – 8 mm
- Dry or wet measurement
- Air-jet dispersion
- > 300 images / second
- Agglomerated powders: ground coffee, crushed rock, metal power etc.

CAMSIZER ONLINE

CAMSIZER offers unique advantages for on-line analysis:

- Specifically designed for on-line analysis in harsh, industrial environments
- Patented 3D size and shape
- Integration with plant Data Control System (DCS)
- 100% correlation with sieve analysis
- Self-cleaning, low maintenance
- SOP feature for unattended operation
- Explosion proof (optional)
- Custom, integrated sampling systems returning sample to the process

STATIC IMAGE ANALYSIS: CAMSIZER M1



How it works:

- Microscopic evaluation of particles
- Sample is prepared on an object slide
- A moving sample stage is moving the slide along a camera system
- Images are acquired by a high-resolution camera
- The stage is NOT moving during image acquisition

Advantages:

- High accuracy for narrow distributions (within one decade)
- Excellent image quality
- Detailed shape analysis

APPLICATIONS IMAGE ANALYSIS

MICROTRAC MRB

Fertilizer

Medicine + Pharmacy

Coal + Carbon Black

Additive Manufacturing

Chemicals + Plastics

Construction Materials

Ceramics + Glass

Sand

Food

Mineralogy /Geology

Catalysts

Abrasives

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PRODUCT OVERVIEW POROSIMETRY

PHYSISORPTION

- BELSORP mini X
- BELSORP max G
- BELSORP max II

CHEMISORPTION

- BELCAT II

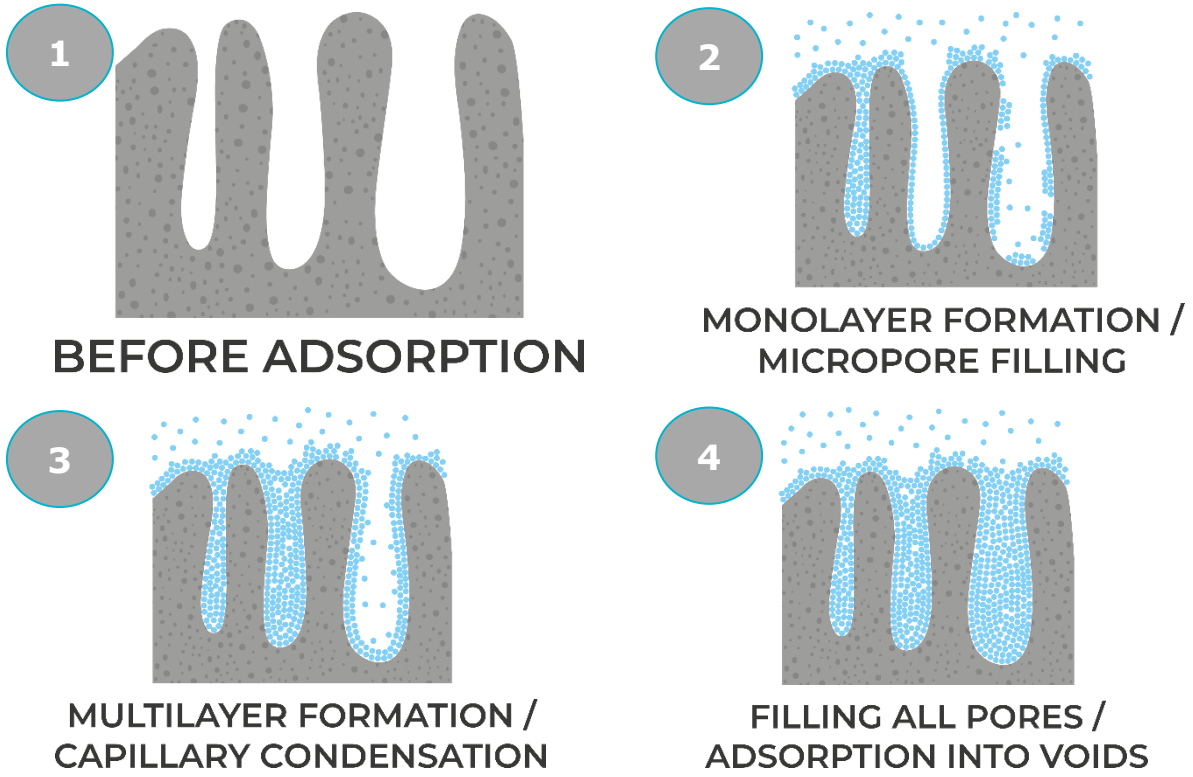
DENSITY

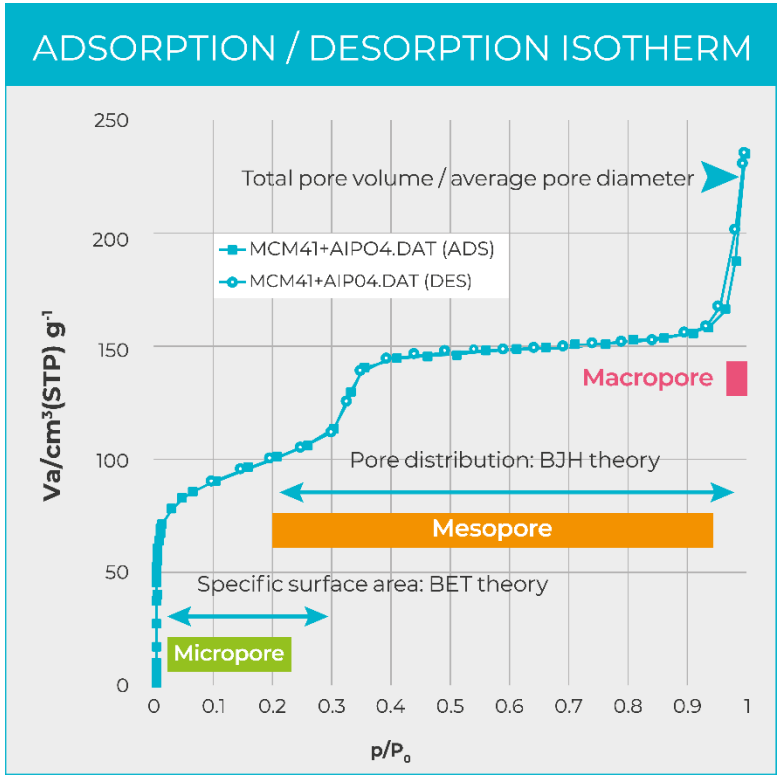
- BELpycno
- BELpycno L

MERCURY POROSIMETER

- BELPORE LP
- BELPORE MP
- BELPORE HP

PHYSI- & CHEMISORPTION





Physisorption

- Weak adsorption
- Reversible
- Surface area & pore analysis

Chemisorption

- Strong adsorption
- irreversible
- Chemical surface reactions (catalysts)

BELSORP SYSTEMS

BELSORP mini X

- 4 samples can be measured simultaneously
- AFSM™ High reproducibility
- Gas dosing optimization (GDO)
- Compact
- Low-cost

BELSORP max G

- Low pressure adsorption
- Suitable for micropore analysis
- AFSM™ High reproducibility
- AFSM II
- Gas dosing optimization (GDO)
- Compact

BELSORP max II

- 4 samples can be measured simultaneously
- max. 3 low pressure adsorption ports
- Suitable for micropore analysis
- AFSM™ High reproducibility
- Gas dosing optimization (GDO)
- Vapor adsorption
- High speed evacuation line

Specific surface area and pore size analyzer

OTHER ANALYZERS

BELCAT II

- Catalyst evaluation
- TPD·TPR/TPO, Pulse chemisorption, BET single point measurement
- Breakthrough curve
- Compact/reasonable, but high-end model Compact
- Covers BELCAT-B and -A

BELPycno

- Determination of the pure density of solids and powders using the gas displacement method.
- Highly accurate measurement of sample volumes with variable volumes in the measuring chambers.
- The device is easy to use
- one-hand operation
- Touch-Screen

BELPycno L

- Determination of the pure density of solids and powders using the gas displacement method.
- Highly accurate measurement of sample volumes with variable measuring chambers.
- The device is easy to use
- one-hand operation

BELPORE

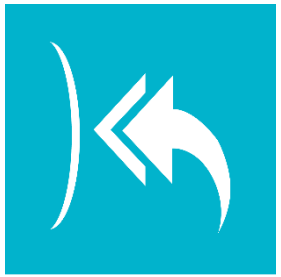
BELPORE LP / MP / HP

- Pore size distribution (differential, integral and as histogram)
- Pore volume, porosity
- Particle size distribution
- Bulk density and apparent density
- Frost resistance of concrete
- Compliant to DIN ISO 15901

WHERE IS IT USED?

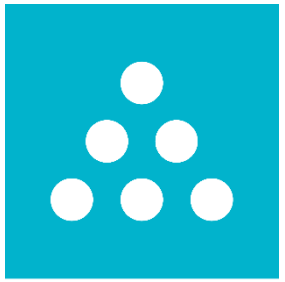

Catalysts


Carbon

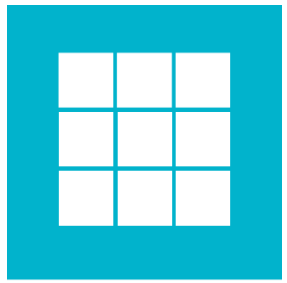

Adsorbents

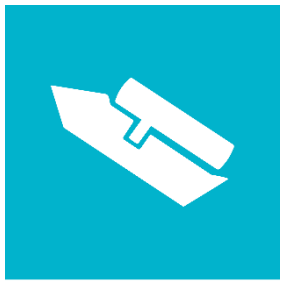

Batteries

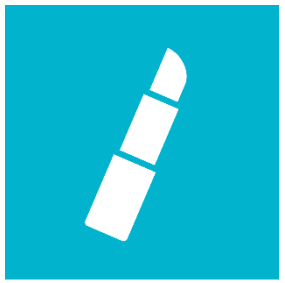

MOFs / PCPs


Toner

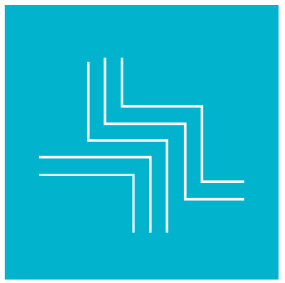

Medicine


Ceramics


Cement


Cosmetics


Pigments


Semiconductors

Most customers are related to "POWDERS".
~ 80 % R&D, universities, research organizations

TIMELINE

1974
Microtrac launches the first commercial laser diffraction analyzer, Microtrac Model 7991.

1987
Rollout of the high-precision gas adsorption instrument BELSORP-28 by MicrotracBEL.

1998
Retsch Technology develops the CAMSIZER and its patented dual camera system.

2002
Premiere of the breakthrough curve measurement system via adsorption column method, BELSORP-Dyna.

2006
Improvement of CAMSIZER with AutoHeight, LED technology, enhanced software features, improved resolution, sharpness & contrast.

2011
Introduction of CAMSIZER XT with optional modules for wet and dry measurement.

2013
MicrotracBEL introduces the multi-sample BET surface area measurement system, BELSORP-MR6.

2018
Launch of the Microtrac Sync: laser diffraction and dynamic image analysis combined in one instrument.

2019
Retsch Technology launches the CAMSIZER M1, enhancing the product portfolio with a static image analyzer.

2020
Merging of Retsch Technology, Microtrac & MicrotracBEL into Microtrac MRB under the umbrella of Verder Scientific.

Establishing a new leader in particle analysis:

- Fifty million US$ turnover
- 200 employees
- Three production sites
- One company

Thank you
for your attention!