

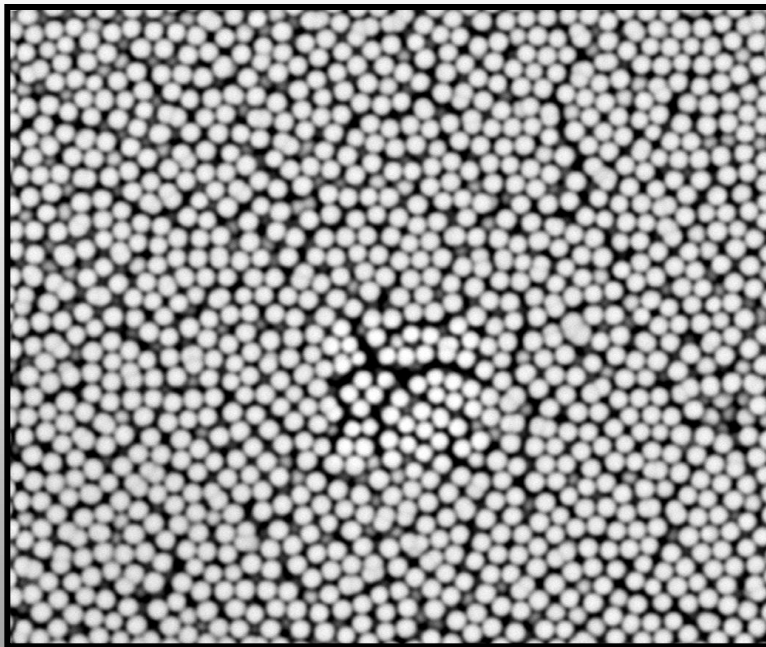
# Characterization of nanoparticles with modern light scattering technologies

*Charles Völker, LS Instruments AG*

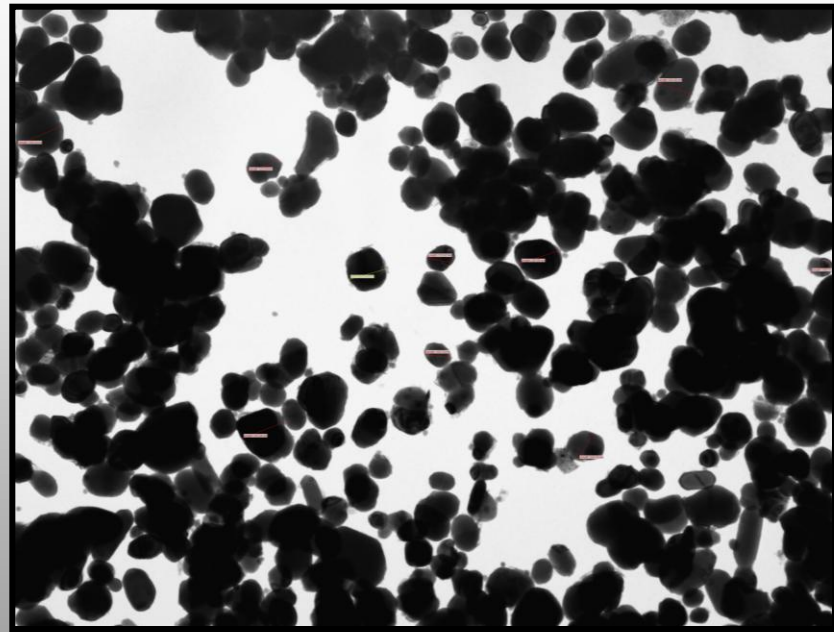
**November 2010**

## Two Typical Nanoparticles:

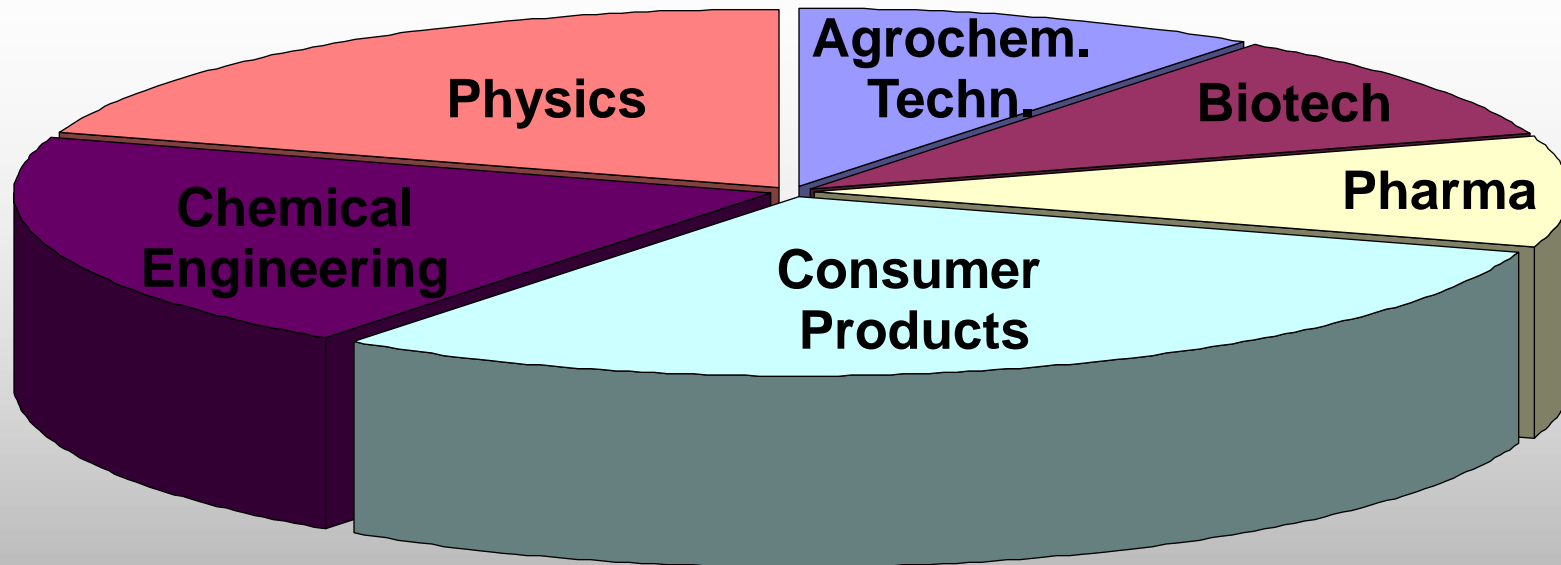
**Silica**



**TiO<sub>2</sub>**



**monodisperse spherical (left) – somewhat polydisperse (right)**

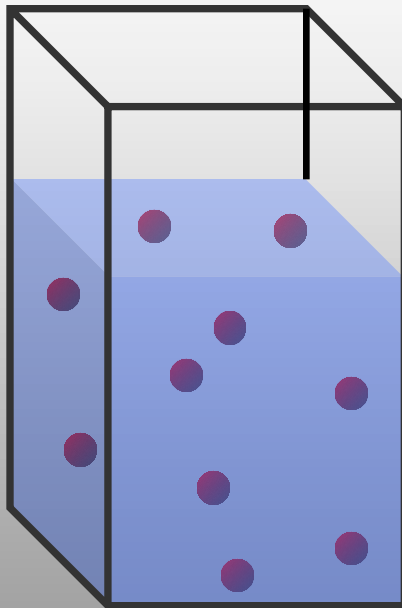


**Market for instruments measuring nanomaterials:  
From academic research to industrial production**

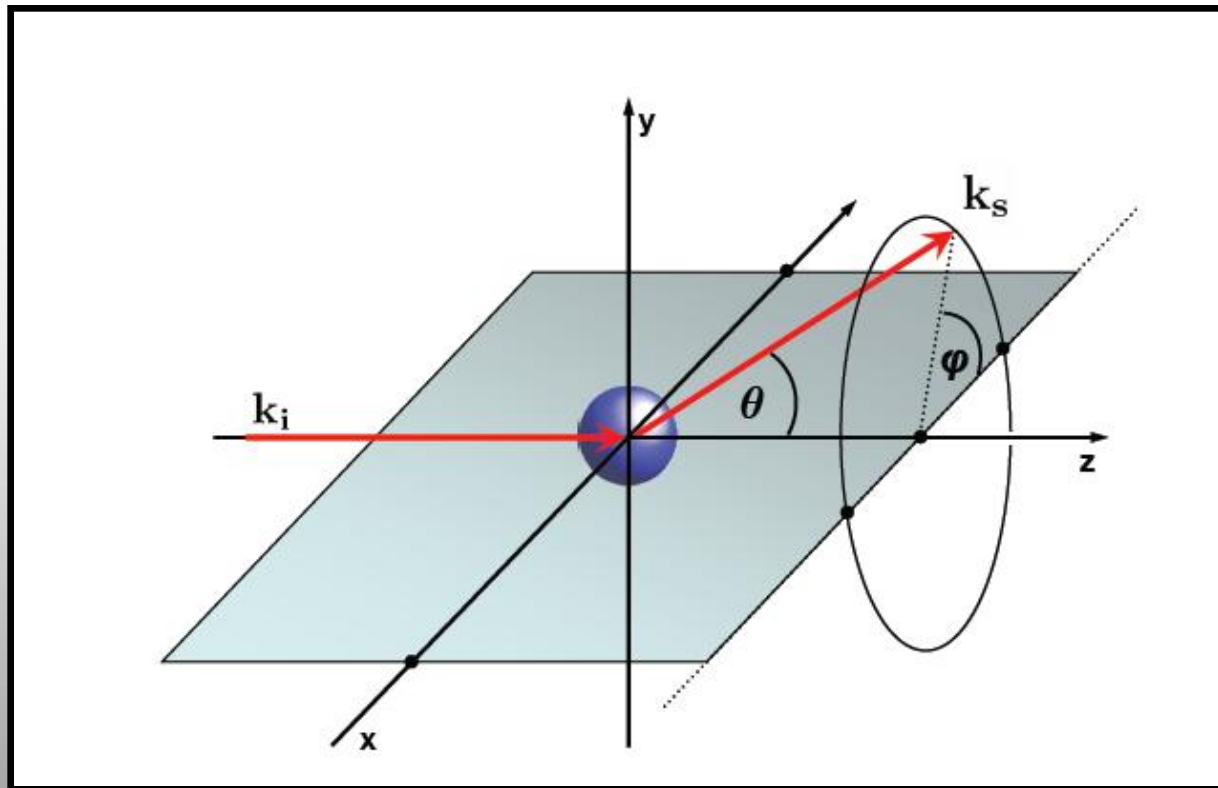
## **Growing quantities of Nanoparticles in consumer products result in need for :**

- **Production monitoring**
- **Quality control**
- **Stability studies**
- **Standardization (ISO, DIN...)**
- **Consumer health regulations**

## Solvent with Nanoparticles



## One analysis option: single light scattering



**DLS: Dynamic Light Scattering**

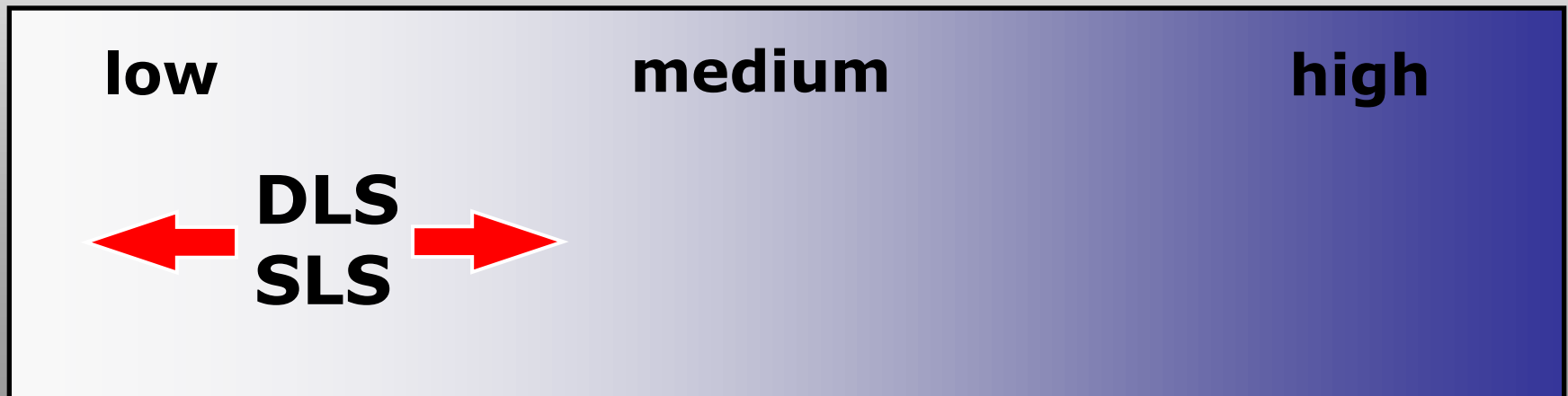
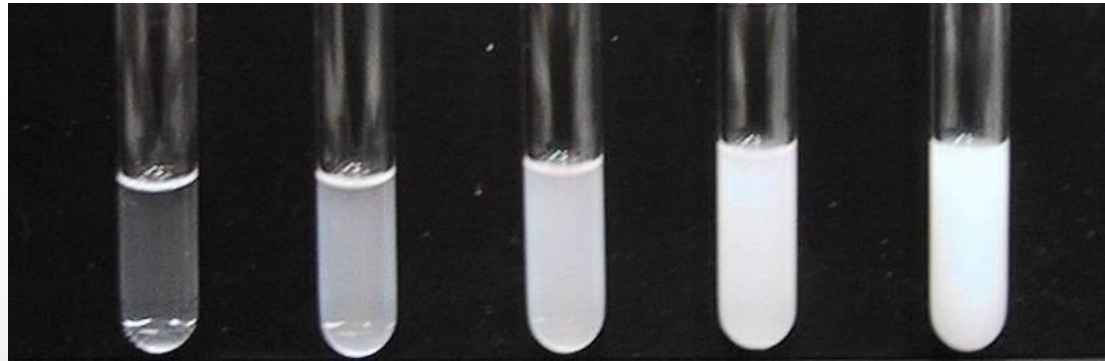
**SLS: Static Light Scattering**

## **D**ynamic **L**ight **S**cattering:

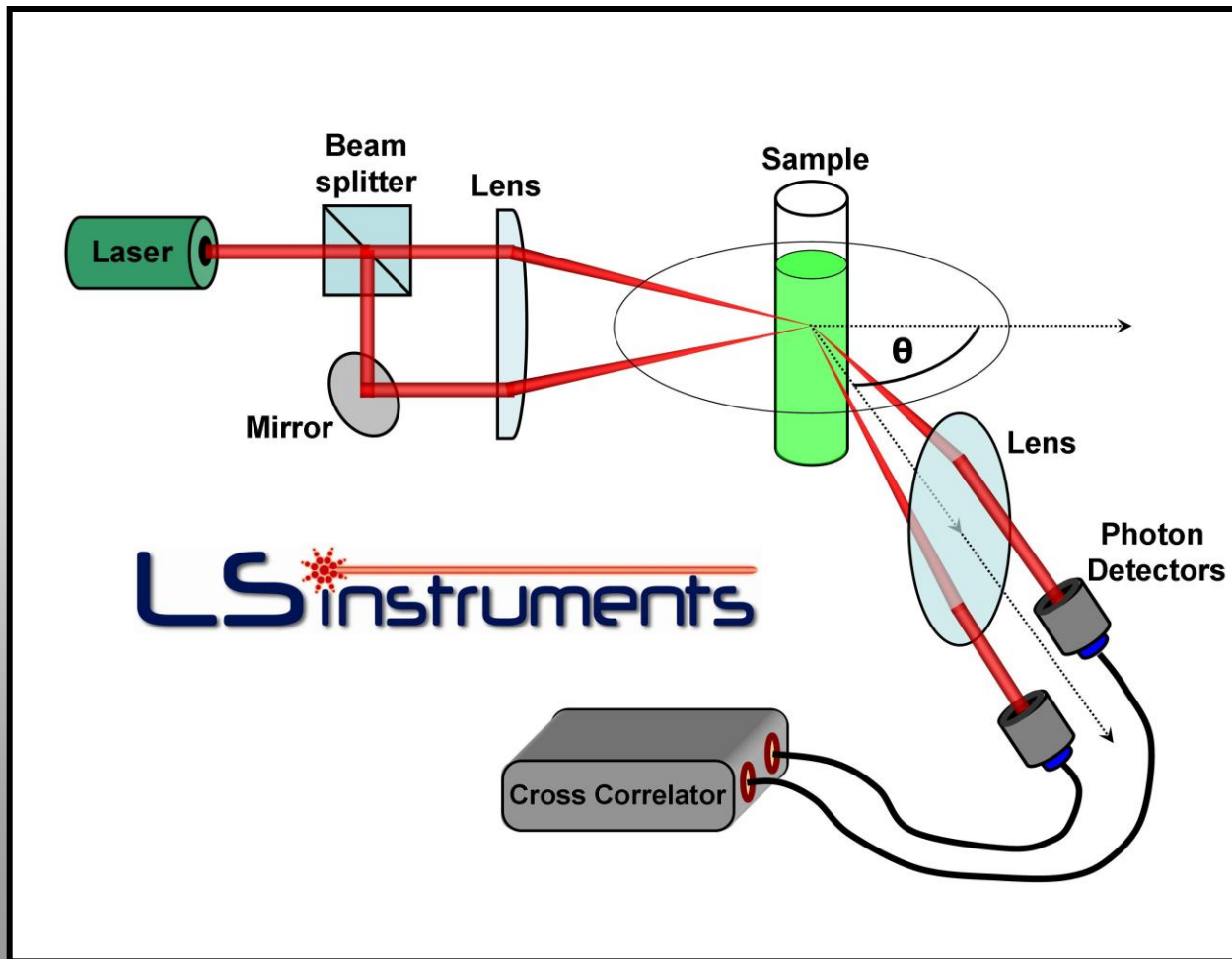
- **particle size (Hydrodynamic Radius  $R_H$ )**
- **size distribution**

## **S**tatic **L**ight **S**cattering:

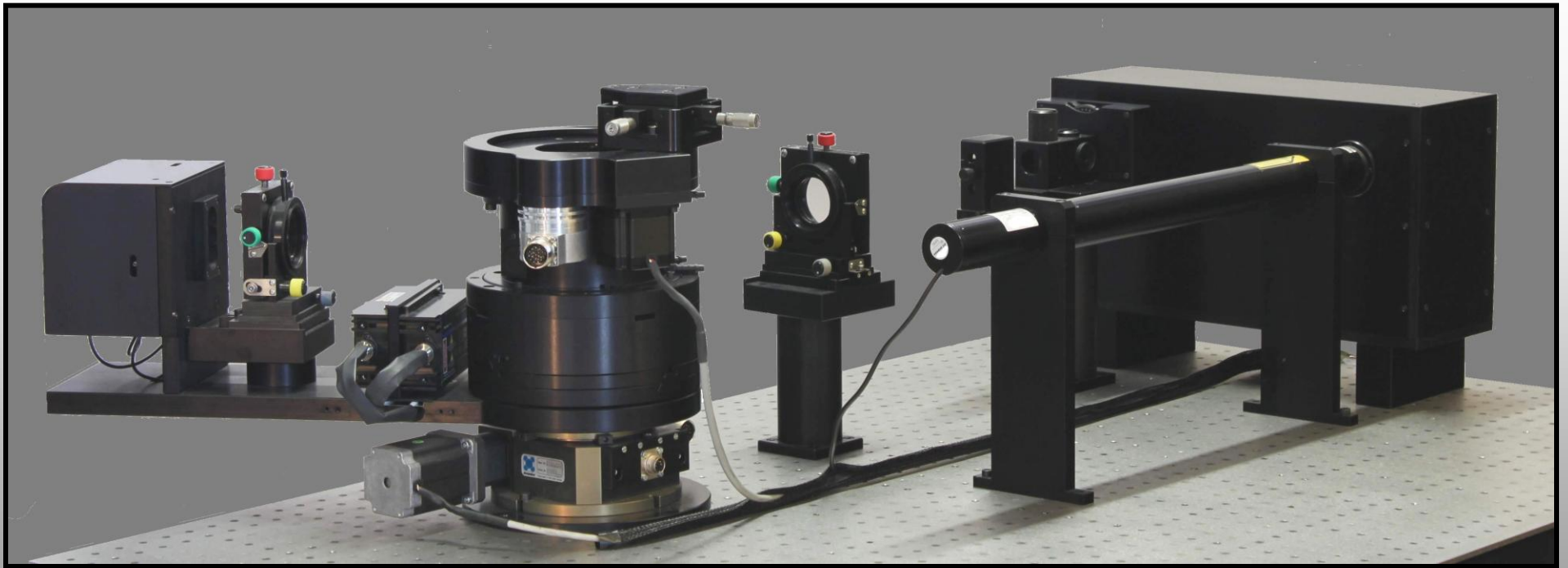
- **particle size (Radius of Gyration  $R_G$ )**
- **form and structure factor**
- **molecular weight**



# Modern Light Scattering: Cross-Correlation

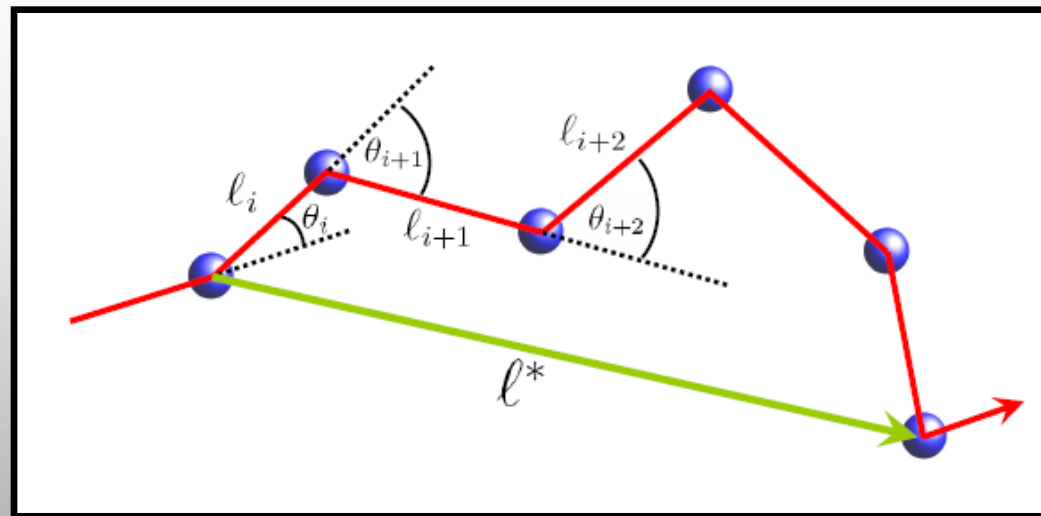


## 3D LS Spectrometer for DLS and SLS



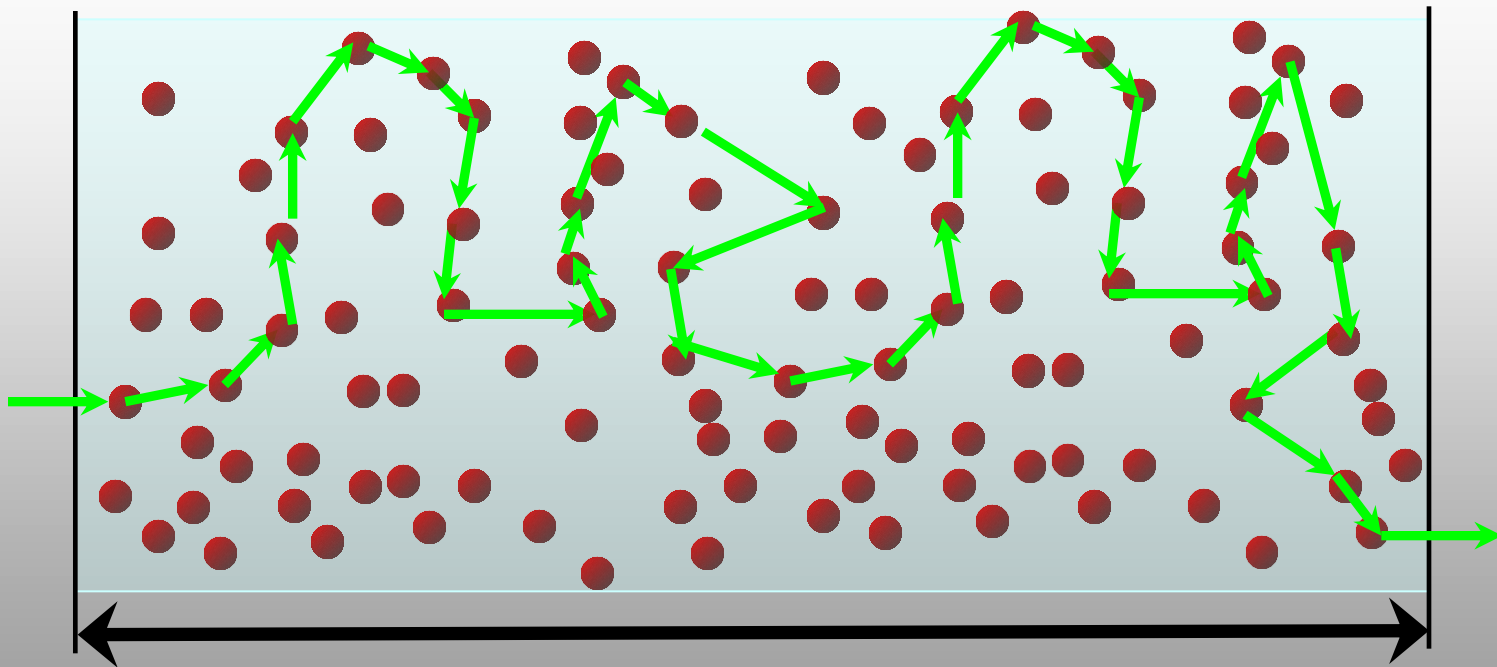


## Multiple Scattering events on several particles:



**DWS: Diffusing Wave Spectroscopy**

## Diffusing **W**ave **S**pectroscopy: Optical Rheology

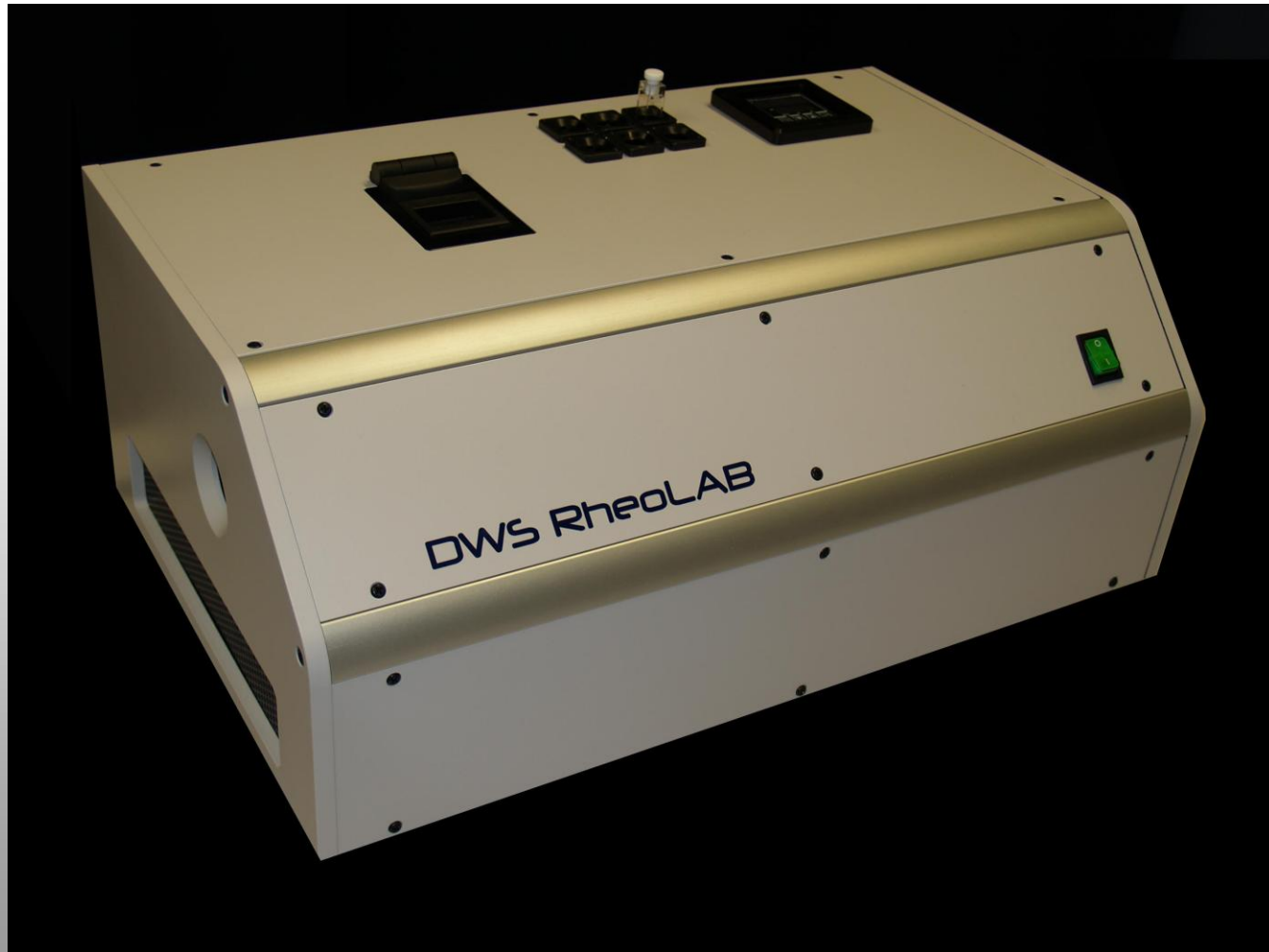


Measures Loss and Storage Modulus:  $G'$  &  $G''$

## DWS: Optical Rheology

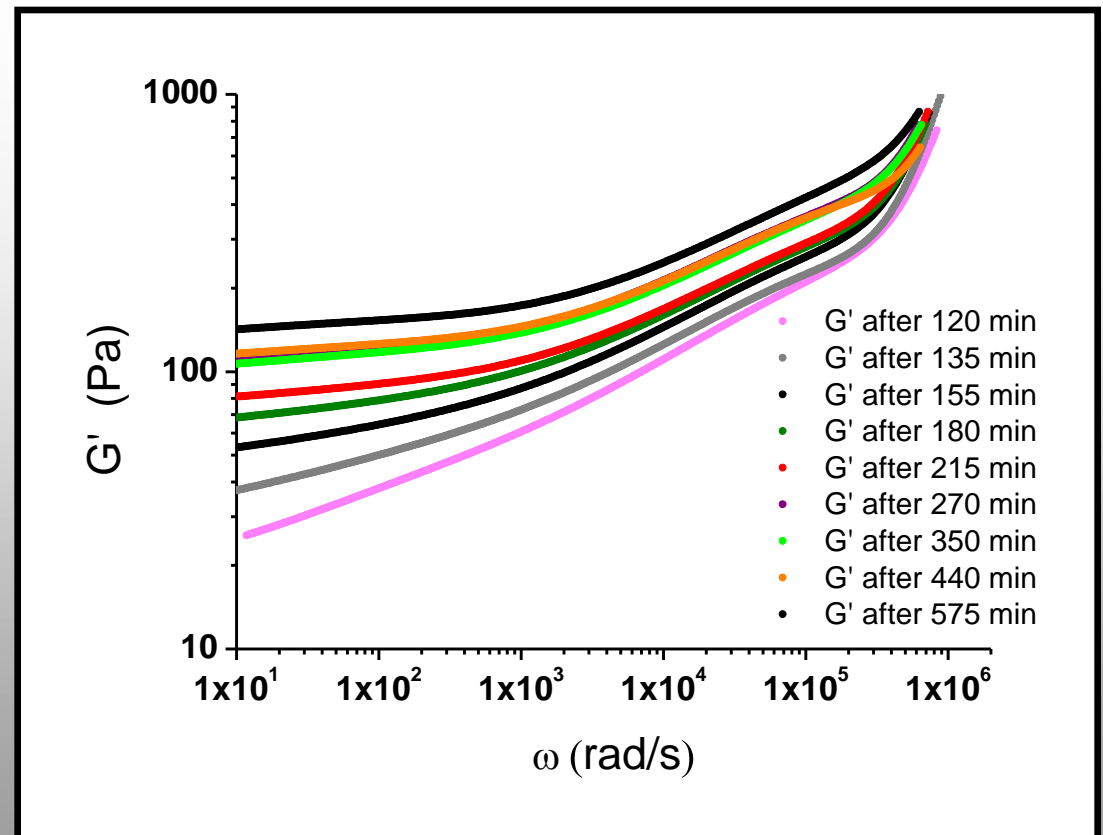
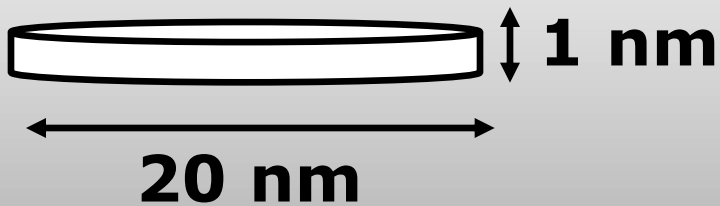


**Applications: Polymers, Biomaterials, Stomach Mucus, Cytoplasm, Magnetic fluids, Surfactant Phases (lamellar, micellar), Food (milk, starch, etc.), Emulsions, Dispersions, Ceramics, Soft Glassy Materials, Clays , Hydrogel Scaffolds for artificial tissue, Film Drying, Cell Rheology, Actin-Myosin molec. motors,....**



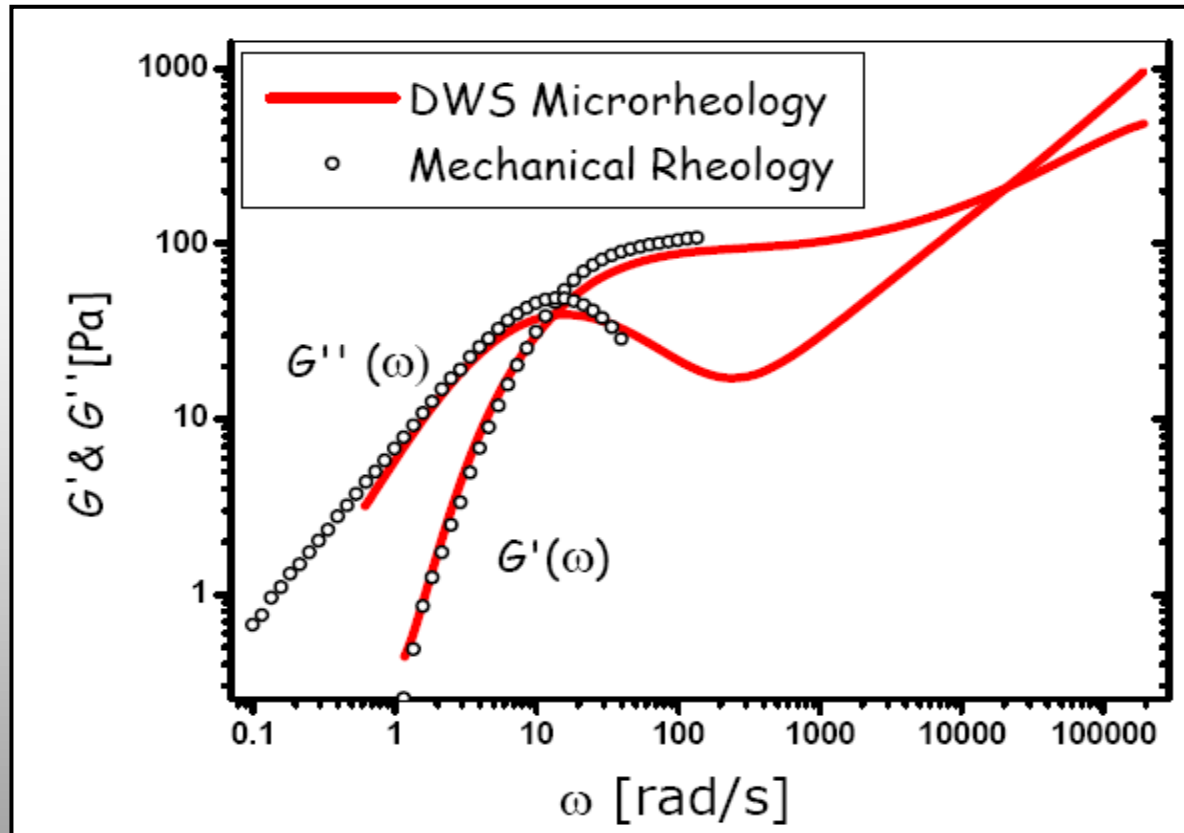
# Laponite particles

Laponite 3.2% ww  
in water



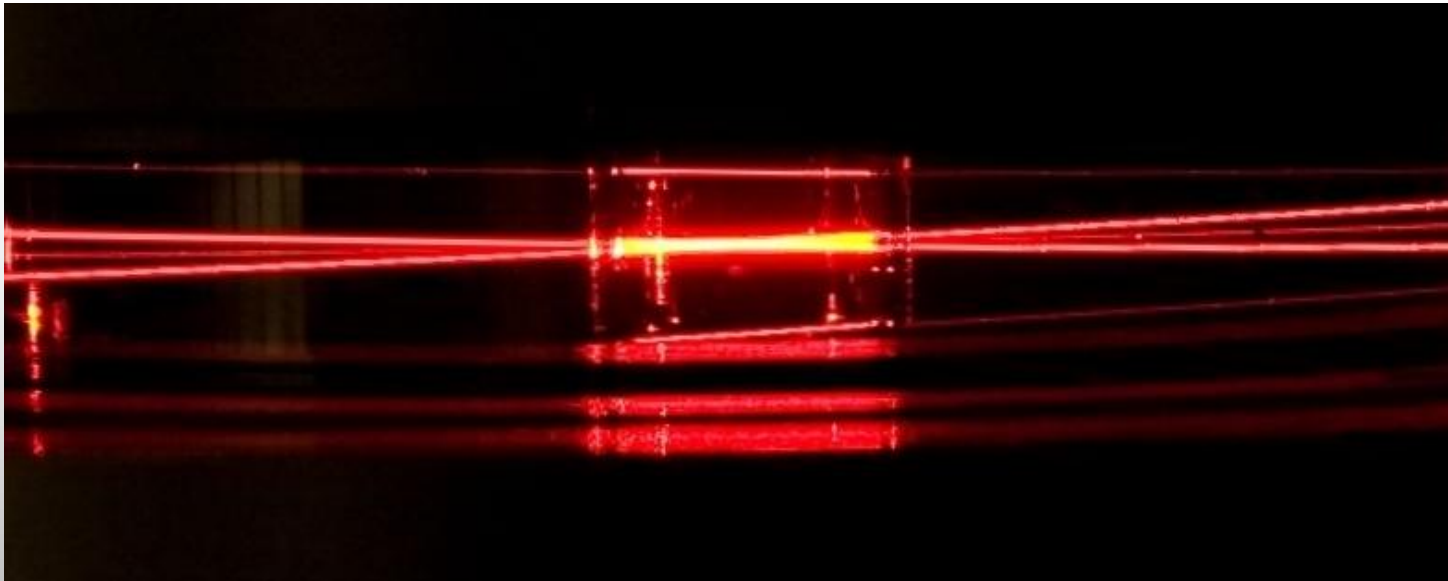
Tracer Particles: 200 nm Silica

## Wormlike Micelle Solutions



N. Willenbacher,\* C. Oelschlaeger,  
M. Schopferer, P. Fischer, F. Cardinaux  
and F. Scheffold  
PRL 99, 068302, 2007

100mM CPyCl and 60mM NaSal



**Thank you for your attention !**