Light Scattering (SLS/DLS)

In addition to the neutron scattering experiments described elsewhere a state-of.-the-art light scattering laboratory is available. The use of light scattering is necessary if additional information from another Q and t range is required. The existing experimental equipment allows to carry out static as well as dynamic measurements in the same experiment.

Instrument Details

light source:	Coherent Innova 90/4 Ar^+-ion laser, λ = 488nm, 514.5nm (max. 1.9W TEM00), etalon mode possible Uniphase HeNe laser, λ = 632.8nm (22mW)
polarizers:	Glan-Thompson prism (B. Halle, Berlin)
goniometer:	ALV/SP125 compact goniometer, Q =10^{-1}
detectors:	fiber optical detection system operating with ALV/SO-SIPD detector systems ("pseudo"-cross correlation) ALV high QE APD (autocorrelation , SLS) EMI 9130/100S B03 (autocorrelation, SLS)
correlator:	ALV-5000E fast version, 319 channel (multi-tau)
time range:	12.5 x 10^{-9} - 5.47 10^3 s
Q-range:	2.3 x 10^{-4} - 3.8 x 10^{-3} Å^{-1}
Intensity	14kHz (toluene, θ=90°)
coherence factor:	0.92
sample volume:	minimum 250 µl
sample environment:	cryostat 260 ...420K rotating sample holder for nonergodic samples (e.g. gels, glasses)

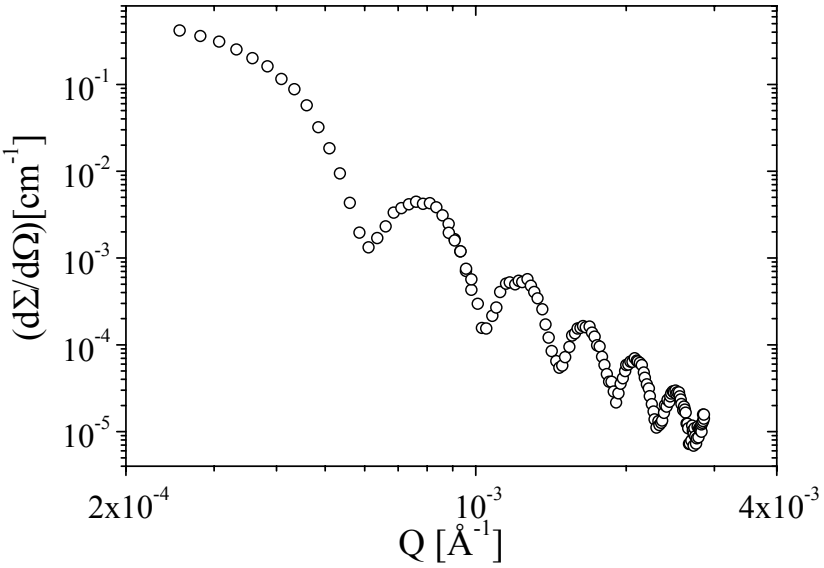
Instrument Decription

In static light scattering (SLS) the integrated intensity of the scattered light is measured as a function of the scattering vector Q, i.e. $S(Q)$. A classical field of application is the characterisation of polymers (radius of gyration R_g, weight average of molecular weight M_W, 2nd virial coefficient A_2).

Dynamic light scattering (DLS), also called quasi-elastic light scattering (QUELS) or photon correlation spectroscopy (PCS) works as a pectroscopic method in time domain; the measured quantity is the autocorrelation function of the scattered light intensity $g^2(Q,t)=<I(Q,0)I(Q,t)>/<I(Q)>^2$. The large time range (about 10 decades) covered by this method as well as its characteristic length scale (Q^{-1}~100 nm) make PCS an important method for the investigation of dynamic processes in the melt and in solution (D_{trans}, $D_{rot.}$, R_h, polydispersity). Typical applications range from biological systems (DNA fragments, microorganisms) to the internal dynamics of polymer networks.

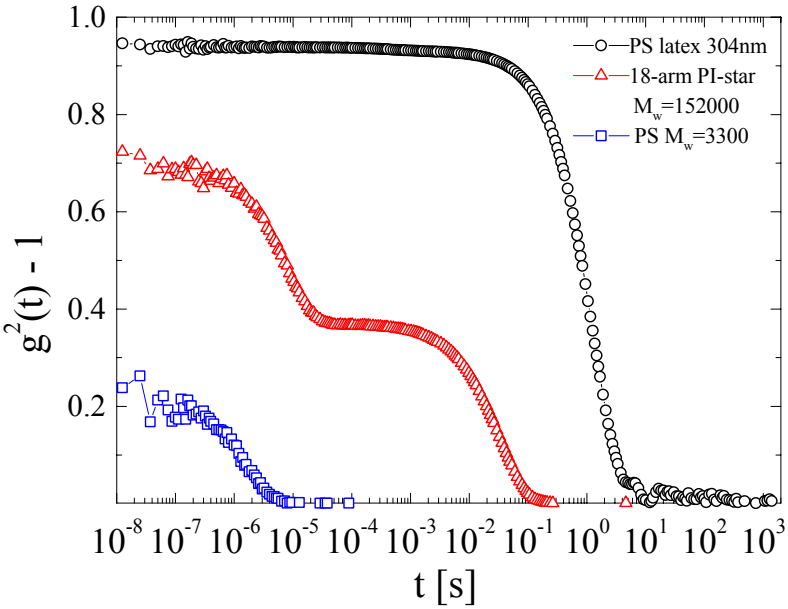
Examples of Measurements

a. SLS



Form factor $P(Q)$ of a hard-sphere colloid, Poly(Methylmethacrylat) in cis-Dekalin, with R=760nm, 10°<Θ=154°, T=293K.

b. DLS

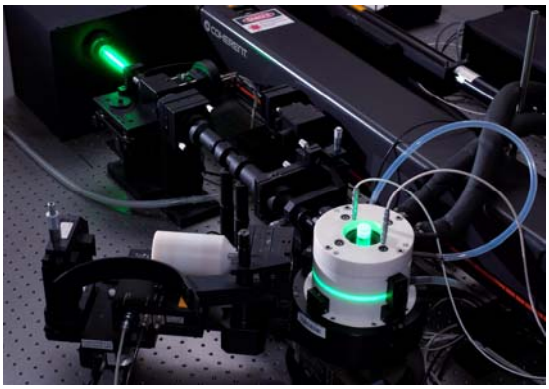


The intensity autocorrelation functions $g^2(Q,t)$ shown here from samples with extremely different relaxation times demonstrate the large time window of dynamical light scattering.

a. τ=2.5s; Polystyrene Latex Standard (d=304nm) in H_2O/Glycerin (23:87), 10^{-4} weight-%, Θ=30°, T=283K.

b. τ_1=68ms, τ_2=8.6µs; 18-arm Polyisoprene star polymer (M_W=152000 g/mol) in Methylcyclohexan, c=0.309g/ml, Θ=90°, T=293K

c. τ=3.3µs; Polystyrene (M_W=3300 g/mol) in Benzene, c=0.1g/ml, Θ=150°, T=293K.



Light scattering set-up