Dynamic Light Scattering Labb.

1) Set up a dynamic light scattering experiment for measurements of the diffusion constant of polystyrene particles in water with $\theta=90^o$ scattering geometry.
Use a oscilloscope and/or a frequency counter to optimize the number of photon counts by adjusting the detector position.

2) Control the temperature to 15^o C.

3) After the temperature has stabilized, measure the correlation function $G(\tau)$ and fit the result to an exponential function. Measure the decay time of the correlation function.

4) Perform similar experiments for different temperatures 20^o, 25^o, $30^{o,}$ and 35^o C.

5) Calculate the diffusion constant of the polystyrene beads and the viscosity of water as function of temperature from the measurements 3) and 4).

6) Set up the experiment for a pure shear velocity with $\theta=90^o$ scattering geometry.

7) Set the sample in slow rotation and measure the rotational frequency. Make sure that G(0) is sufficient big. G(0) about 1.8 should be OK. You will obtain this by using a sufficient small slit width and a sufficient big distance to the detector. It is also important to screen the detector from background light and unexpected reflections. Measure the correlation function and the rotational speed of the sample.

8) Increase the rotational velocity of the sample with a factor 2 and measure the correlation function again. Measure the rotational speed of the sample.

9) Try to scale the time axes when plotting the correlation function in such a way that you get a data collapse of the two different correlation functions measured at two different rotational speeds.

Exercises:

1) Calculate or explain the correlation function of a periodic square signal of period T, high level intervals of T/2 and low level intervals of T/2.

2) For a linear scattering volume show that the particle density distribution (see notes):
$m(r)=(N^2/l)(1-r/l)$,
where r is the distance between pair of particles and l the length of the sample.

3) For $\theta=90^o$ scattering geometry and a pure velocity shear show that:
$G(x)=1+(\sin(x)/x)^2$,
where $x=Slq_y\tau/2$. Se notes for definition of S, l, $q_{y,}$ and τ.