Thermal Diffusion Forced Rayleigh Scattering

Principle of IR-TDFRS and classical TDFRS:

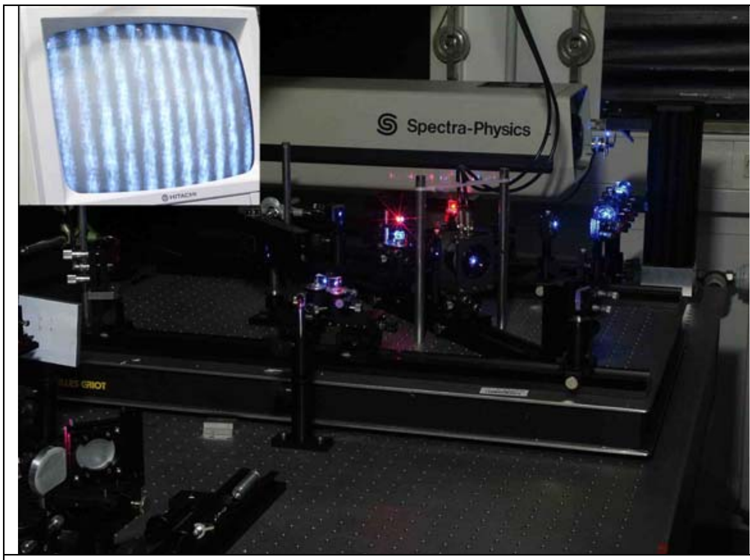

Figure 1: Main part of the TDFRS experiment. The inset shows the interference grating as it can be observed by a video camera.

A grating created by the interference of two laser beams is written in a sample. In the classical TDFRS a small amount of dye, present in the sample, converts the intensity grating into a temperature grating, which in turn causes a concentration grating by the effect of thermal diffusion. Both gratings contribute to a combined refractive index grating that is read out by diffraction of a third laser beam. Analyzing the time dependent diffraction efficiency, the three transport coefficients can be obtained: the thermal diffusivity D_{th}, the translational diffusion coefficient D, and the thermal diffusion coefficient D_T. The ratio of the thermal diffusion coefficient and the translational diffusion coefficient allows the determination of the Soret coefficient S_T.

We have two set-ups a so called classical set-up, with a solid state laser operating at 488 nm as writing laser and an IR-TDFRS set-up with a single frequency laser operating at 980 nm. The advantage of the IR-TDFRS is that aqueous solutions can be investigated without the addition of a light absorbing dye, because water itself has a weak absorption band around 980 nm.

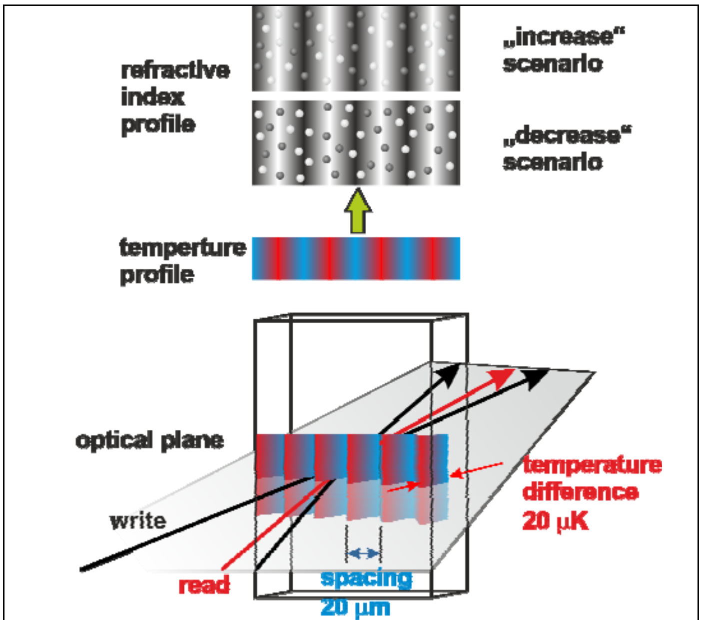

Figure 2: Principle of the TFDRS. Two writing beams create a sinusoidal interference grating, which is converted into a temperature grating due to absorption of the wavelength of the writing laser. This leads to an refractive index grating, which is influenced by temperature and concentration. The strength of the refractive index grating is probed by a Helium-Neon laser.