Friedrich-Alexander-Universität
Technische Fakultät

AOTTP

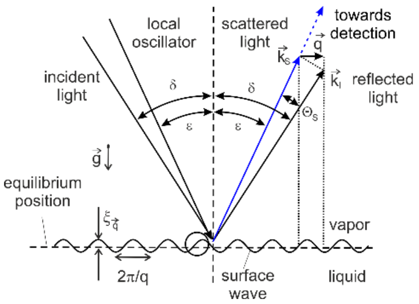
The **Institute of Advanced Optical Technologies – Thermophysical Properties (AOT-TP)** offers a

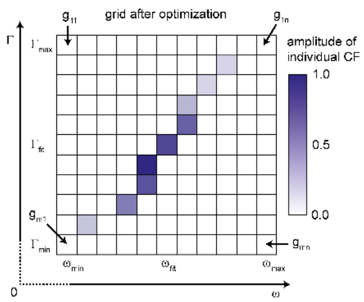
Master's Thesis

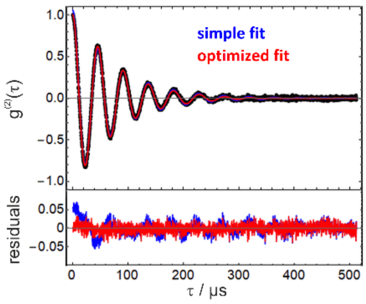
with the tentative title

Application of surface light scattering in presence of line-broadening effects

Surface Light Scattering (SLS) is a well-established technique for the determination of viscosity and surface or interfacial tension with high accuracy in a non-invasive way. This is possible by probing thermal fluctuations at phase boundaries, whose dynamics is reflected by the temporal behavior of the scattered light intensity. Continuous developments of the SLS technique open up further application possibilities in thermophysical property research with strong reference to process engineering, including its on-line or in-line operation. Here, process-relevant fluids are often translucent or opaque, which is why SLS experiments need to be performed in reflection geometry employing small wave vectors of the probed surface fluctuations. In this range, however, line-broadening effects originating from experimental uncertainties in the definition of the wave vector are present, which cause a systematic over- and underestimation of the determined viscosity and surface tension, respectively. To address this problem, physically solid evaluation approaches are required, yet lacking so far.







At AOT-TP, a Monte-Carlo-based data evaluation method has been developed and tested on selected reference systems, aiming at the determination of accurate viscosity and surface tension data from SLS experiments under small wave vectors that are subjected to line-broadening effects. In particular, without making prior assumptions about the underlying distribution of wave vectors, the method allows decomposition of the measured SLS signal in the form of a correlation function represented by the superposition of individual contributions in the form of damped oscillations. The latter are characterized by different values for the dynamics of the surface fluctuations, i.e., their damping and frequency. By using this information as input for solving the hydrodynamic theory in its exact form, the objective is to obtain accurate data for viscosity and surface tension free of line-broadening effects.

The major task of the Master's thesis is to broaden the applicability of the developed SLS evaluation strategy to additional systems for the reliable determination of viscosity and surface tension in the presence of line-broadening effects. For this, both theoretical and experimental work will be required. The theoretical part mainly includes further optimization of the existing program code with respect to computation time and numerical stability, as well as the development of its applicability to account for different systems. Complementary experimental investigations will be carried out on selected fluids to validate the evaluation procedure and to implement additional adaptations to the setup, including a laser-beam stabilization and profiling system, in order to ensure accurate measurements in the range of small wave vectors.

For the described thesis, we are looking for a committed student with interests in the fields of optical metrology and thermophysical property research. We offer a diverse, multidisciplinary, and international working environment with excellent potential for scientific and personal development.

Start of the thesis: as soon as possible

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