

# Accurate Determination of Diffusivities Applying an Optimized Multi-Fit-Procedure in Dynamic Light Scattering Experiments

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Dynamic light scattering (DLS) is used for accurate measurements of thermophysical properties of fluids. In DLS experiments, the time-dependent auto correlation function (ACF) of the scattered light intensity governed by microscopic fluctuations is recorded. In the case of pure statistical fluctuations of only one kind, e.g., temperature or concentration fluctuations, the theoretical ACF describes a single exponential. Here, the decay time is characteristic for the dynamics of the fluctuations and gives access to properties such as thermal diffusivity, mutual diffusivity, or particle diffusion coefficient. In many cases, the experimental ACFs computed by correlators are distorted by various signals stemming, e.g., from the sample itself or an inadequate design of the setup. In case of multi-component mixtures, a clear separation of the signals originating from fluctuations in species concentration and in temperature cannot always be maintained. In the data evaluation procedure, the ACFs are often fitted to single- or multiple-exponential functions via a non-linear least-square fitting procedure. The uncertainty in the decay time can drastically be affected if disturbing signals are not considered. This was the motivation of former works to introduce a multi-fit-procedure (MFP). The method applies a non-linear least-square fitting procedure to various lag times, but only considers a single-exponential fit model. In the present study, a major improvement of the MFP is accomplished by extending the selectable fit models with an expandable polynomial describing the disturbances over a wide time range and kept constant during the MFP. This approach allows a maximum accuracy in the calculation of the decay time and specification of its uncertainty in the presence of disturbing signals. The principle of the optimized MFP is demonstrated for thermal diffusivity measurements of the refrigerants R417A and R417B in their liquid phases close to saturation conditions over a wide temperature range approaching the critical point.