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The Intermediate Scattering Function in Fluorescence Correlation Spectroscopy RODRIGO GUERRA, Harvard, BALLARD ANDREWS, PABITRA SEN, Schlumberger-Doll Research — We formulate the autocorrelation function for Fluorescence Correlation Spectroscopy (FCS) $G_D(\tau)$ in reciprocal space in terms of the of the Intermediate Scattering Function ISF($\overrightarrow{k}$, t) and the fourier transform of the Optical Response Function ORF($\overrightarrow{k}$). In this way we may extend the use of FCS to processes that have been studied using NMR, DLS, and neutron scattering. This formalism is useful for the complicated propagators involved in confined systems and in the study of diffusion in cells: where diffusion is either restricted or permeation through membrane is important. Calculations in k-space produce approximate expressions for the ORF using cumulant expansions that are accurate for small wavevectors. This provides descriptions for longer timescales better suited for studying time-dependent diffusion $ISF(\overrightarrow{k}$,t) $\rightarrow exp[-tD(t)k^2]$ and provides a natural separation of contributions from system dynamics and from optical artifacts and aberrations. We will show an explicit derivation of a semi-analytical fit function for free diffusion based on standard electromagnetic analysis of a confocal optical apparatus. This fit function is then used to analyze a representative data set and has no free fit parameters other than the diffusion constant.

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