

17. Photon Correlation Spectroscopy and Applications

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17.1 Research Program

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A high-resolution spectroscopic technique based on scattered light intensity fluctuation measurement has been in use for some time. Our method is a variation of the digital time-domain pulse correlation technique using a 256-channel clipped correlator developed in the laboratory. The correlator-multichannel memory system is controlled by a PDP 11/MINC computer system which is capable of high-speed data acquisition and analysis necessary for the study of time-varying phenomena.

We have developed theoretical methods to calculate quasi-elastic light-scattering spectra from cells undergoing Brownian motions or self-propelled motions in liquid media. The methods have been successfully tested with a model bacterium *Escherichia coli*, and applicability of the model calculation to cells of dimensions of the order of a micron has been ascertained. The photon correlation technique is further developed to incorporate a flow method which permits us to study time-dependent phenomena with a temporal resolution greater than the time taken for the accumulation of the correlation function. The combined theoretical and experimental progress now enables us to perform the following three categories of experiments:

1. Motility characteristics of bacteria in response to external stimuli such as light and chemical
2. Study of traveling-band formation of bacteria as a result of chemotaxis
3. Study of conformational change and denaturation of globular protein induced by amphiphilic molecules
4. Study of Brown Dynamics in strongly interacting colloids

Recently another powerful technique has been brought into our study of macromolecular solutions.

Small angle neutron scattering has been demonstrated by us to be an exceptionally versatile tool for studies of structure and interactions of strongly interacting colloids. Active experimental program is being pursued at small angle scattering centers at Oak Ridge and Brookhaven National Laboratories.

Publications

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