16. Photon Correlation Spectroscopy and Applications

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16.1 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 analyze 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 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 instability and spatial pattern formation in a chemotactic band of Escherichia coli

4. Study of competition between aerotaxis and magnetotaxis in bacteria aquaspirillum magnetotacticum

5. 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 shown to be an exceptionally versatile tool for studies of structure and interactions of strongly interacting colloids. The following experimental program is

being pursued at small angle scattering centers at Oak Ridge and Brookhaven National Laboratories.

1. Investigation of Intra- and Inter-Micellar Structure

2. Structure of Three-component Microemulsion Near the Critical Point

3. Structure and Interaction of Globular Proteins in Solutions

Publications

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