

A STUDY OF QUASI-ELASTIC LASER LIGHT
SCATTERING BY PHOTON CORRELATION SPECTROSCOPY

By

H.B. BOHIDAR

Thesis submitted to
Indian Institute of Technology, Delhi
for the award of Degree of
DOCTOR OF PHILOSOPHY

Department of Physics
Indian Institute of Technology, Delhi

July, 1981

ACKNOWLEDGEMENTS

It is extremely gratifying to acknowledge Dr. S.Chopra who was mainly responsible for my initiation into the realm of experimental research, which in a set up like ours has its own charms and fascinations. But for his ceaseless and positive guidance this work would not have been possible.

I do also take the opportunity to express my deep sense of gratitude to Dr. S.C. Abbi, with whom, often, I had very enlightening and stimulating discussions, and since my joining the department, he has been taking keen interest in my research activities.

Instances of revolutionary experiments in the history of science are not lacking. But behind this climax lies a tale of toil and tears and a hard grind. Unlike the theoretician who can afford to be a loner - an experimentalist has to create and develop his system 'ab initio'. It can be an exhilarating or a frustrating experience depending on whether one's stars combine bonaficially with that of the set-up - comprising of the people and equipments. At any given instant, an experimentalist has to cautiously use all his wits, charms and determinations in maintaining a harmonious or at least a working relationship with the animate and the inanimate. And the result is, one acquires excellent credentials as a clever diplomat, an expert trouble-shooter, a competent purchase officer and finally a proud member of clerical cadre.

I did find to my utter dismay that inspite of my best efforts often I failed to persuade 'quite a few persons' into doing what they were supposed to do. And all my initiatives to break their resistance and reluctance to work -always proved futile.

At the same time it is a pleasure to earnestly extend my sincere gratitude to all those who did not mind wasting their precious time and going out of their ways to render valuable encouragement and help from time to time, neither by way of affecting their duties nor for any gain, but who felt that by doing so, they will be encouraging good research.

Unfortunately, such persons are far and few in our small IIT Community.

CONTENTS

<u>CHAPTER</u>		<u>PAGE</u>
I	INTRODUCTION	1
II	BASIC THEORY OF QUASI-ELASTIC LIGHT SCATTERING	
	2.1 Scattering due to polarizability fluctuations	20
	2.2 Correlation function for entropy fluctuations	27
	2.3 Correlation function for concentration fluctuations	32
	2.4 Micellar systems	36
	2.5 Correlation approach to polymerization	38
	2.6 Study of surface inhomogeneties	40
	References	45
III	INSTRUMENTATION	49
	3.1 Principle	49
	3.2 Block by block analysis	50
	3.10 Relevant parameters	62
	3.11 Shortcomings and limitations	63
	References	66

<u>CHAPTER</u>		<u>PAGE</u>
IV	EXPERIMENTAL INVESTIGATIONS AND DISCUSSIONS OF RESULTS	67
	4.1 Scattering set-up assembly	67
	4.2 Study of pure liquids	68
	4.3 Study of Aqueous solutions	71
	4.4 Study of binary liquid mixtures	72
	4.5 Study of macro-molecular diffusion	74
	4.6 Study of micellar system.	76
	4.7 Study of polymerisation	82
	4.8 Estimation of surface inhomogeneities	83
	4.9 Discussions of experimental procedures and results	86
	References	95
V.	LASER INTERACTIONS WITH TPA-FLUCTUATION STUDIES	97
	5.1 Introduction	97
	5.2 Interactions of Laser with TPA	98
	5.3 Fluctuation effects	102
	5.4 Time-dependent fluctuation behaviour	103
	5.5 Discussions and conclusion	108
	References	110

<u>CHAPTER</u>	<u>PAGE</u>
VI DISCUSSIONS AND CONCLUSIONS	111
References	126
<u>APPENDIX-I:</u>	130
IDEAL AND CLIPPED CORRELATION FUNCTIONS	
<u>APPENDIX-II</u>	134
POLYDISPERSITY	
LIST OF PUBLICATIONS	
BIO-DATA	
