

Contents

Preface	v
Acknowledgements	vi
1 Fluorescence, its Time Dependence and Applications	1
1.1 Fluorescence intensities	1
1.2 Bimolecular interactions	6
1.3 General environmental effects	15
1.4 Polarization of electronic transitions	20
1.5 Measurement of fluorescence decay times	25
References	34
2 Basic Principles of the Single Photon Counting Lifetime Measurement	36
2.1 The standard experiment	36
2.2 Details	37
2.3 Experiments to correct for wavelength-dependent PM distortion	49
2.4 Standards	51
References	52
3 Light Sources	55
3.1 Introduction	55
3.2 Storage ring radiation	56
3.3 Flash lamps	58
3.4 Pulsed lasers	84
3.5 Summary of flash lamps and pulsed lasers	94
References	99
Appendix 3.A1	100
4 Photomultipliers	103
4.1 Introduction	103
4.2 Characteristics	105
4.3 The voltage divider	114
4.4 Wavelength dependence of transit time	119
4.5 New developments	124
References	127
Appendix 4.A1	128
Appendix 4.A2	128

5 Electronics 132

5.1 Introduction 132

5.2 Individual electronic components 132

5.3 Setting discriminator levels 152

5.4 Time calibration and choice of timescale 153

References 155

Appendix 5.A1 156

6 Data Analysis 158

6.1 Introduction 158

6.2 The data 158

6.3 Distortions 160

6.4 Correction for pulse pile-up 164

6.5 Mathematical analysis techniques 165

6.6 Application of the least-squares fitting technique 177

6.7 Evaluating the success of the fit 180

6.8 Synthetic data 189

References 190

Appendix 6.A1 192

Appendix 6.A2 197

7 Nanosecond Time-resolved Emission Spectroscopy 211

7.1 Introduction 211

7.2 Applications and limitations 213

7.3 Other methods of spectral time resolution 218

7.4 Direct recording of TRES 219

7.5 Construction of TRES from deconvolved decay functions 222

7.6 Decay-associated spectra 226

7.7 Conclusion 228

References 230

Appendix 7.A1 231

8 Time Dependence of Fluorescence Anisotropy 252

8.1 Introduction 252

8.2 Effects of polarization on intensity measurements 254

8.3 Time-dependent anisotropy measurements 261

8.4 Deconvolution procedures 269

8.5 Theory of time-dependent fluorescence depolarization 274

8.6 Form of time-dependent anisotropy for restricted motion 279

References 282

Subject Index 285