

Contents

CONTRIBUTORS	xi
PREFACE	xiii

Experimental Realization of the BCS-BEC Crossover with a Fermi Gas of Atoms

C.A. Regal and D.S. Jin

1. Introduction	2
2. BCS-BEC Crossover Physics	10
3. Feshbach Resonances	18
4. Cooling a Fermi Gas and Measuring its Temperature	24
5. Elastic Scattering near Feshbach Resonances between Fermionic Atoms	36
6. Creating Molecules from a Fermi Gas of Atoms	42
7. Inelastic Collisions near a Fermionic Feshbach Resonance	51
8. Creating Condensates from a Fermi Gas of Atoms	56
9. The Momentum Distribution of a Fermi Gas in the Crossover	64
10. Conclusions and Future Directions	71
11. Acknowledgements	72
12. References	72

Deterministic Atom-Light Quantum Interface

Jacob Sherson, Brian Julsgaard and Eugene S. Polzik

1. Introduction	82
2. Atom-Light Interaction	85
3. Quantum Information Protocols	93
4. Experimental Methods	103
5. Experimental Results	108
6. Conclusions	121
7. Acknowledgements	122
8. Appendices	122
A. Effect of Atomic Motion	122
B. Technical Details	125
9. References	128

Cold Rydberg Atoms*J.-H. Choi, B. Knuffman, T. Cubel Liebisch, A. Reinhard and G. Raithel*

1. Introduction	132
2. Preparation and Analysis of Cold Rydberg-Atom Clouds	135
3. Collision-Induced Rydberg-Atom Gas Dynamics	149
4. Towards Coherent Control of Rydberg-Atom Interactions	159
5. Rydberg-Atom Trapping	176
6. Experimental Realization of Rydberg-Atom Trapping	186
7. Landau Quantization and State Mixing in Cold, Strongly Magnetized Rydberg Atoms	192
8. Conclusion	196
9. Acknowledgements	197
10. References	198

Non-Perturbative Quantal Methods for Electron-Atom Scattering Processes*D.C. Griffin and M.S. Pindzola*

1. Introduction	204
2. The Configuration-Average Distorted-Wave Method	204
3. The <i>R</i> -Matrix with Pseudo-States Method	206
4. The Time-Dependent Close-Coupling Method	211
5. Results	218
6. Summary	232
7. Acknowledgements	233
8. References	234

R-Matrix Theory of Atomic, Molecular and Optical Processes*P.G. Burke, C.J. Noble and V.M. Burke*

1. Introduction	237
2. Electron Atom Scattering at Low Energies	241
3. Electron Scattering at Intermediate Energies	256
4. Atomic Photoionization and Photorecombination	271
5. Electron Molecule Scattering	282
6. Positron Atom Scattering	289
7. Atomic and Molecular Multiphoton Processes	293
8. Electron Energy Loss from Transition Metal Oxides	307
9. Conclusions	311
10. Acknowledgements	312
11. References	312

Electron-Impact Excitation of Rare-Gas Atoms from the Ground Level and Metastable Levels*John B. Boffard, R.O. Jung, L.W. Anderson and C.C. Lin*

1. Introduction	320
2. Electronic Structure	321
3. Experimental Methods	325
4. Background: Excitation of Helium and the Multipole Field Picture	342
5. Argon	348
6. Neon	372
7. Krypton	384
8. Xenon	397
9. Comparison to Theoretical Calculations	406
10. Conclusions	410
11. Acknowledgements	418
12. References	418

Internal Rotation in Symmetric Tops*I. Ozier and N. Moazzen-Ahmadi*

1. Introduction	424
2. Theory	436
3. Spectroscopy from 50 kHz to 1000 cm ⁻¹	449
4. Discussion	498
5. Acknowledgements	505
6. References	506

Attosecond and Angstrom Science*Hiromichi Niikura and P.B. Corkum*

1. Introduction	512
2. Tunnel Ionization and Electron Re-collision	515
3. Producing and Measuring Attosecond Optical Pulses	520
4. Measuring an Attosecond Electron Pulse	523
5. Attosecond Imaging	534
6. Imaging Electrons and their Dynamics	539
7. Conclusion	545
8. References	546

Atomic Processing of Optically Carried RF Signals*Jean-Louis Le Gouët, Fabien Bretenaker and Ivan Lorgère*

1. Introduction	550
---------------------------	-----

2. Radio Frequency Spectral Analyzers	552
3. Spectrum Photography Architecture	555
4. Frequency Selective Materials as Programmable Filters	564
5. Rainbow Analyzer	570
6. Photon Echo Chirp Transform Spectrum Analyzer	581
7. Frequency Agile Laser Technology	595
8. Conclusion	607
9. Acknowledgements	608
10. References	608

Controlling Optical Chaos, Spatio-Temporal Dynamics, and Patterns

Lucas Illing, Daniel J. Gauthier and Rajarshi Roy

1. Introduction	616
2. Recent Examples	620
3. Control	628
4. Synchronization	656
5. Communication	672
6. Spatio-Temporal Chaos and Patterns	682
7. Outlook	691
8. Acknowledgement	691
9. References	692

INDEX	697
CONTENTS OF VOLUMES IN THIS SERIAL	1