

Contents

CONTRIBUTORS	ix
------------------------	----

Direct Frequency Comb Spectroscopy

Matthew C. Stowe, Michael J. Thorpe, Avi Pe'er, Jun Ye, Jason E. Stalnaker, Vladislav Gerginov and Scott A. Diddams

1. Introduction and Historical Background	2
2. Comb Control and Detection	5
3. Direct Frequency Comb Spectroscopy	12
4. Multi-Frequency Parallel Spectroscopy	30
5. Coherent Control Applications	38
6. Future Outlook	45
7. Concluding Remarks	52
8. Acknowledgements	52
9. References	53

Collisions, Correlations, and Integrability in Atom Waveguides

Vladimir A. Yurovsky, Maxim Olshanii and David S. Weiss

1. Introduction	62
2. Effective 1D World	64
3. Bethe Ansatz and beyond	85
4. Ground State Properties of Short-Range-Interacting 1D Bosons: Known Results and Their Experimental Verification	103
5. What Is Special about Physics in 1D	113
6. Summary and Outlook	125
7. Acknowledgements	126
8. Appendix: Some Useful Properties of the Hurwitz Zeta Function	126
9. References	127

MOTRIMS: Magneto-Optical Trap Recoil Ion Momentum Spectroscopy

Brett D. DePaola, Reinhard Morgenstern and Nils Andersen

1. Introduction to MOTRIMS	140
2. Relative Total Electron Transfer Cross Sections	147
3. Case Studies in Total Electron Transfer Collisions	149

4. Case Studies of Differential Electron Transfer Cross Sections	161
5. Probing Excitation Dynamics	172
6. Future Applications	180
7. Concluding Comments	184
8. Acknowledgements	185
9. References	185

All-Order Methods for Relativistic Atomic Structure Calculations

Marianna S. Safronova and Walter R. Johnson

1. Introduction and Overview	192
2. Relativistic Many-Body Perturbation Theory	194
3. Relativistic SD All-Order Method	198
4. Motivation for Further Development of the All-Order Method	206
5. Recent Developments in the Calculations of Monovalent Systems: Non-Linear Terms and Triple Excitations	209
6. Many-Particle Systems	213
7. Applications of High-Precision Calculations	219
8. Conclusion	230
9. Acknowledgements	231
10. References	231

B-Splines in Variational Atomic Structure Calculations

Charlotte Froese Fischer

1. Introduction	236
2. The Hartree–Fock Approximation	238
3. Multiconfiguration Hartree–Fock Approximation	249
4. B-Spline Theory	251
5. B-Spline Methods for the Many-Electron Hartree–Fock Problem	261
6. B-Spline MCHF Equations	275
7. Conclusion	288
8. Acknowledgements	289
9. References	289

Electron–Ion Collisions: Fundamental Processes in the Focus of Applied Research

Alfred Müller

1. Introduction	294
2. Basics of Electron–Ion Collisions	298
3. Experimental Access to Data	319

4. Overview of Experimental Results on Free-Electron–Ion Collisions	355
5. Conclusions	397
6. Acknowledgements	399
7. References	399

Robust Probabilistic Quantum Information Processing with Atoms, Photons, and Atomic Ensembles

Luming Duan and Christopher R. Monroe

1. Introduction	420
2. Quantum Communication with Atomic Ensembles	421
3. Quantum State Engineering with Realistic Linear Optics	434
4. Quantum Computation through Probabilistic Atom–Photon Operations	442
5. Summary	459
6. Acknowledgements	460
7. References	460

INDEX	465
CONTENTS OF VOLUMES IN THIS SERIAL	473