# Contents

1 **Balancing Detail and Completeness in Collisional-Radiative Models** .......................... 1
   Stephanie B. Hansen
   1.1 Introduction ................................................. 1
   1.2 State-Space Completeness ................................ 2
   1.3 Degree of State Detail ..................................... 6
   1.4 Application-Driven Approaches to Balancing Detail and Completeness ............................... 9
      1.4.1 Coronal Fine-Structure Models ......................... 10
      1.4.2 General Models for Moderate-Density Plasmas .......... 10
      1.4.3 Self-consistent Field Models for Dense Plasma ......... 13
   1.5 Conclusions ................................................... 14
   References ....................................................... 15

2 **Self-consistent Large-Scale Collisional-Radiative Modeling** ................................. 17
   Christopher J. Fontes, James Colgan and Joseph Abdallah Jr
   2.1 Introduction ................................................. 18
   2.2 Large-Scale Collisional-Radiative Modeling ............... 20
      2.2.1 The Los Alamos Suite of Atomic Physics Codes ......... 20
      2.2.2 Selecting a List of Configurations ..................... 22
      2.2.3 Selecting the Level of Refinement ..................... 26
      2.2.4 Constructing the Rate Matrix .......................... 28
      2.2.5 Steady-State Solutions Versus Time-Dependent Solutions ........................................... 29
      2.2.6 Boundary Conditions for the Steady-State CR Equations ............................................ 29
      2.2.7 Different Methods of Solving the Steady-State CR Equations ............................................ 31
   2.3 An Illustrative Example ..................................... 33
   2.4 Summary and Outlook ....................................... 40
   References ....................................................... 42
5.3 The Rates of Collisional and Radiative Processes
  5.3.1 Excitation by Electron Impact
  5.3.2 Electron-Impact Ionization and Three-Body Recombination
  5.3.3 Autoionization and Dielectronic Capture
  5.3.4 Rates of Radiative Processes
5.4 Configuration Accounting in the Extended CR-AA Model
5.5 Reducing Detailed Level Kinetics to Extended CR-AA Model
5.6 The Calculation Algorithm
5.7 Results of Calculation for Tin Plasma
References

6 Collisional-Radiative Modeling and Interaction of Monochromatic X-Rays with Matter
  O. Peyrusse
  6.1 Introduction
  6.2 Atomic Model Construction for the Modeling of X-Ray Interaction with Matter
  6.3 Interaction with Gas
  6.4 Interaction with Small Objects
  6.5 Interaction with Solids
    6.5.1 Population Kinetics and Atomic Structure at Solid Density
    6.5.2 Temperature and Population Evolution
    6.5.3 Energy Deposition
    6.5.4 Modeling of Al, V and Ag Samples Irradiated in the X-UV or X-Ray Range
  6.6 Conclusion
References

7 Spectral Modeling in Astrophysics—The Physics of Non-equilibrium Clouds
  G.J. Ferland and R.J.R. Williams
  7.1 Introduction
  7.2 Working with Real Nebulae: The Observational Questions We Are Trying to Answer
  7.3 Approaches to Astronomical Spectral Modelling
  7.4 Spectral Calculations
    7.4.1 The Ionization Balance in the ISM Limit
  7.5 The Physics of the Astronomical Problem
  7.6 Future Opportunities and Challenges
    7.6.1 New Spectroscopic Opportunities
    7.6.2 And the Grand Challenges to Exploiting Them
References
Modern Methods in Collisional-Radiative Modeling of Plasmas
Ralchenko, Y. (Ed.)
2016, X, 212 p. 76 illus., 52 illus. in color., Hardcover
ISBN: 978-3-319-27512-3