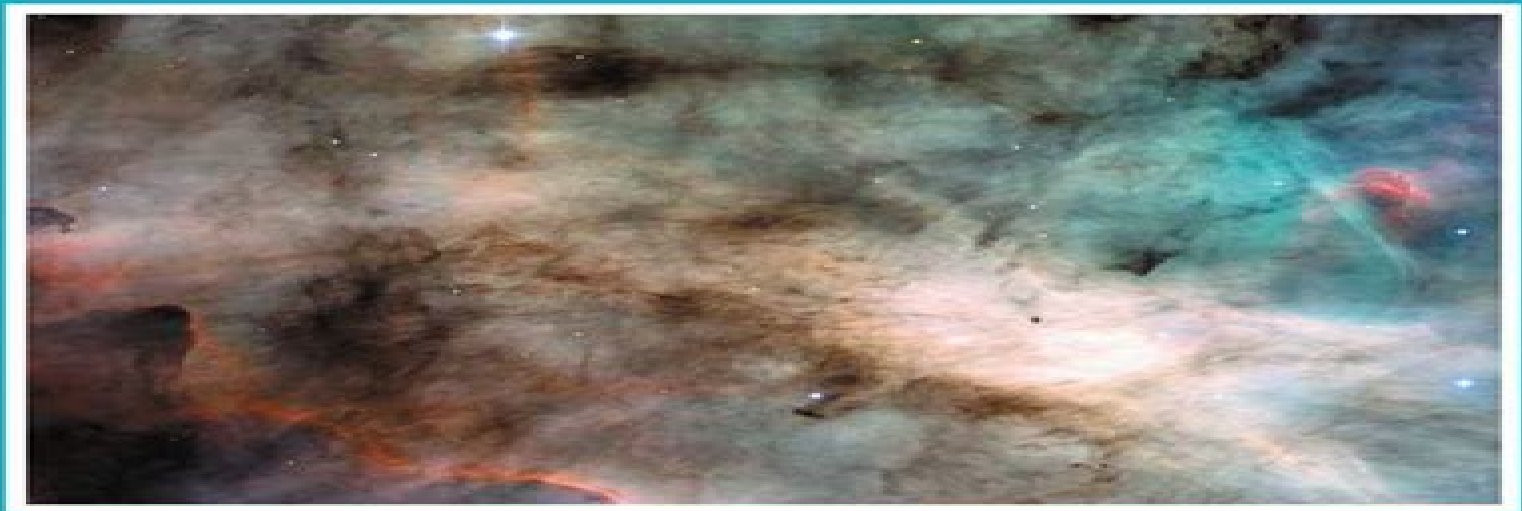


RADIO RECOMBINATION LINES

Their Physics and Astronomical Applications

M.A. GORDON
R.L. SOROCHENKO



Radio Recombination Lines Their Physics And Astronomical Applications

M. A. Gordon, R. L. Sorochenko



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Radio Recombination Lines M. A. Gordon, R. L. Sorochenko, 2010-08-20 **Radio Recombination Lines** Mark

Gordon, Roman L. Sorochenko, 2002-11-30 This book is a comprehensive guide to the physics and observations of Radio Recombination Lines from astronomical sources written for astronomers physicists and graduate students It is suitable for a graduate level textbook It includes the history of RRL detections the astrophysics underlying their intensities and line shapes including topics like departures from LTE and Stark broadening the maximum possible size of an atom as well as detailed descriptions of the astronomical topics for which RRLs have proved to be effective tools The text includes more than 250 equations and 110 illustrations It also contains hundreds of specific references to the astronomical literature to enable readers to explore additional details The appendix includes supplementary information such as the detailed physics underlying the Bohr atomic model tables of RRL frequencies including fine structure components techniques for calculating hydrogenic oscillator strengths FORTRAN code for calculating departure coefficients and a discussion with formulas for converting observational telescope intensity units to astrophysical ones Radio Recombination Lines M.A. Gordon, R.L.

Sorochenko, 2009-01-31 This guide to the physics and observations of Radio Recombination Lines from astronomical sources includes history theory applications 250 equations and 110 illustrations This soft cover edition contains corrections and updates from hardbound edition Radio Recombination Lines M.A. Gordon, Roman L. Sorochenko, 2012-12-06

Recombination lines at radio wavelengths have been and still are a powerful tool for modern astronomy For more than thirty years they have allowed astronomers to probe the gases from which stars form They have even been detected in the Sun In addition observations of these spectral lines facilitate basic research into the atom in forms and environments that can only exist in the huge dimensions and extreme conditions of cosmic laboratories We intend this book to serve as a tourist's guide to the world of Radio Recombination Lines It contains three divisions a history of their discovery the physics of how they form and how their voyage to us influences their spectral profiles and a description of their many astronomical contributions to date The appendix includes supplementary calculations that may be useful to some astronomers This material also includes tables of line frequencies from 12 MHz to 30 THz ALOJLm as well as FORTRAN computer code to calculate the fine structure components of the lines to evaluate radial matrix integrals and to calculate the departure coefficients of hydrogen in a cosmic environment It also describes how to convert observational to astrophysical units The text includes extensive references to the literature to assist readers who want more details *Tools of Radio Astronomy* Thomas Wilson, Kristen Rohlfs, Susanne Huettemeister, 2008-12-19 Four significant factors have led us to update this text The first is the breathtaking progress in technology especially in receiver and digital techniques The second is the advance of radio astronomy to shorter wavelengths and the increased availability of astronomical satellites The third is a need to reorganize some of the chapters in order to separate the basic theory that seldom changes from practical aspects that change often Finally it is our desire to enhance the

text by including problem sets for each chapter In view of this ambitious plan we have expanded the number of authors In the reorganization of this edition we have divided Chap 4 of the 4th edition into two Chaps 4 and 5 The rst remains Chap 4 with a slightly different title Signal Processing and Receivers Theory This was expanded to include digital processing and components including samplers and digitizers In Chap 5 Practical Receiver Systems we have relegated the presentations of maser and parametric amplifier front ends which are no longer commonly used as microwave receivers in radio astronomy to a short section on historical developments and We have retained and improved the presentations of current state of the art devices cooled transistor and superconducting front ends We have also included descriptions of local oscillators and phase lock loops Chapters 5 and 6 in the 4th edition has now become Chap 6 Fundamentals of Antenna Theory and Chap Tools of Radio Astronomy Kristen Rohlf, T. L. Wilson, 2013-03-14 Progress in the fields of science and technology is again the reason for updating this text most changes occur in Chaps 4 7 8 and 14 in the others we have made a number of minor improvements In Chap 4 Signal Processing and Receivers we have shortened the presentation of maser and parametric amplifier front ends which are no longer commonly used as microwave receivers in radio astronomy Instead we have expanded the presentation of cooled transistor and superconducting front ends and we have added a short section on coherent multi beam receiver systems The chapter titled Observational Methods now appears as Chap 7 and mainly addresses single dish observations Chapter 8 now concerns Interferometers and Aperture Synthesis Aperture synthesis has become the single important imaging technique in observational astronomy and its use most has spread from the radio frequency range into other wavelength bands providing the only general method available for obtaining images of extremely high resolution and quality The discussion of the foundations for aperture synthesis therefore have been extended and hopefully improved Both the hardware and the software instrumentation is now collected in this chapter *Screening Constant by Unit Nuclear Charge Method* Ibrahima Sakho, 2018-03-27 The reader will find in this collection a clear exposition of the method of the Screen Constant by Nuclear Charge Unit which can be applied in a simple and immediate way to many fields of Physics in relation to atomic spectroscopy **Recollections of "Tucson Operations"** M.A. Gordon, 2006-03-30 A personal account of the evolution of millimeter wave astronomy at the US National Radio Astronomy Observatory The author recounts the behind the scenes activities of the staff from the beginnings at Kitt Peak to the closing of the Tucson offices **Radio Recombination Lines: 25 Years of Investigation** Mark Gordon, Roman L. Sorochenko, 1990-06-30 Text no 1 Radio Recombination Lines RRLs discovered in the USSR in 1964 have become a powerful research tool for astronomers Available throughout the radio spectrum these lines carry information regarding the density temperature turbulence and velocity of thermal plasmas Their very existence shows the presence of thermal gas They also can carry information regarding magnetic fields if Zeeman splitting were to be detected Containing the proceedings of an IAU Colloquium celebrating the 25th anniversary of their detection this volume tells us what has happened since It contains the story of the detection of RRLs and

reviews of many areas of physics of the interstellargas from which stars form HII regions excited by newly formed stars planetary nebulae involving dying stars and the structure of our Milky Way and other galaxies reflecting the large scale morphology of the star formation process In addition there is an article describing modern laboratory studies of Rydberg atoms to probe the basic physics of atomic structure and articles describing the theory of collisions and radiation upon Rydberg atoms leading to observate effects to be used as diagnostic tools in astromony This book focuses on the 25 years of astronomical research with radio recombination lines RRLs since their discovery in 1965 It covers a wide range of topics papers dealing with research into Rydberg atoms both in the laboratory and in the interstellar medium of our galaxy and others papers on the interaction of radiation and atomic systems as well as with the effects of inadiabatic collisions between these atoms and both ions and electrons It deals with astronomical observations of atoms with diameters ranging from 0.08 to 50 μm a size factor of 625 It deals with RRLs in absorpction in emission and as true masers And it deals with plasmas with temperatures ranging from 10 to greater than 104 kelvins and with an even greater range of volume densities Much new work is reported including low frequency RRLs discovered in 1980 and the maser RRLs from the star MWC349 discovered in 1989 The advent of aperture synthesis telescopes and large single element telescopes have made possible RRL studies with high angular resolution The sum total of the work reported here will make the volume a platform from which to search new horizons in RRL research

Secular Evolution of Galaxies Jesús Falcón-Barroso, Johan H. Knapen, 2012 The formation and evolution of galaxies is one of the most important topics in modern astrophysics Secular evolution refers to the relatively slow dynamical evolution due to internal processes induced by a galaxy's spiral arms bars galactic winds black holes and dark matter haloes It plays an important role in the evolution of spiral galaxies with major consequences for galactic bulges the transfer of angular momentum and the distribution of a galaxy's constituent stars gas and dust This internal evolution is in turn the key to understanding and testing cosmological models of galaxy formation and evolution Based on the twenty third Winter School of the Canary Islands Institute of Astrophysics this volume presents reviews from nine world renowned experts on the observational and theoretical research into secular processes and what these processes can tell us about the structure and formation of galaxies The volume provides a firm grounding for graduate students and early career researchers working on galactic dynamics and galaxy evolution

Spectral Line Shapes Marco A. Gigoso, Marco Antonio Gigoso, Manuel Angel Gonzalez, 2008-11-04 This biennial conference is the main international forum for both fundamental and applied works dealing with processes related to the formation of the spectral line profiles and with their use for diagnostic purposes On the fundamental side the study of the line profiles reveals the underlying atomic and molecular interactions On the practical side the line profiles are employed as powerful diagnostic tools for various media such as neutral gases technological gas discharges magnetically confined plasmas for fusion laser and Z pinch produced plasmas astrophysical plasmas and planetary atmospheres

Radio Recombination Lines P.A. Shaver, 2012-12-06 Since their first detection 15 years ago radio

recombination lines from several elements have been observed in a wide variety of objects including HII regions planetary nebulae molecular clouds the diffuse interstellar medium and recently other galaxies The observations span almost the entire range from 0.1 to 100 GHz and employ both single dish and aperture synthesis techniques The theory of radio recombination lines has also advanced strongly to the point where it is perhaps one of the best understood in astrophysics In a parallel development it has become possible over the last decade to study these same highly excited atoms in the laboratory this work provides further confirmation of the theoretical framework However there has been continuing controversy over the astrophysical interpretation of radio recombination line observations especially regarding the role of stimulated emission A workshop was held in Ottawa on 24-25 August 1979 bringing together many of the active scientists to review the field and discuss these questions of interpretation A broad consensus has emerged the subtleties of the line formation process are understood and the conditions under which reliable information can easily be extracted from the line measurements are known It thus appears likely that the emphasis will shift increasingly from the study of the line phenomenon itself to further application in other areas of astrophysics ranging from physical processes in plasmas temperatures densities ionization structure to the large scale properties of our galaxy abundances kinematics structure and studies of extragalactic systems

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